3.2.1	Research funding received by the institution and its faculties through Government and non- government sources such as industry, corporate houses, international bodies for research project, Endowment Research Chairs during the last five years (INR in Lakhs)

DVV Clarification

DVV Query:

HEI to provide the copy of project proposal applied for research funding along with all sanction letter for 2022-23

DVV Response:

Copy of the project proposal applied for research funding for 2022-23 is as below;

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SSR DT S.N.	Name of of the PI/ Co-PI/Name of the person holding the Chair	Title of the research project, endowments, Research Chairs	Name of the funding agaency	Duration	Year of award or sanction	Amount in INR.
77	Ashish Kothari	Student Startup and Innovation Policy 2.0 Grant	Knowledge Consortium of Gujarat, Government of Gujarat	2022-2024	2022-2023	100.00
78	Hiren Ramani	Mission Amrit Sarovar - Jal Dharohar Sanrakshan	All India Council for Technical Education (AICTE), Government of India	2022-2023	2022-2023	2.00
79	Hemantkumar Sonkushare	Mission Amrit Sarovar - Jal Dharohar Sanrakshan	All India Council for Technical Education (AICTE), Government of India	2022-2023	2022-2023	2.00
80	Mayank Parekh	Mission Amrit Sarovar - Jal Dharohar Sanrakshan	All India Council for Technical Education (AICTE), Government of India	2022-2023	2022-2023	2.00
81	Hardik Pujara	Mission Amrit Sarovar - Jal Dharohar Sanrakshan	All India Council for Technical Education (AICTE), Government of India	2022-2023	2022-2023	2.00
82	Mousumi Das	Demystifying the drinking water microflora by Copper vessel storage and Agnihotra ash treatment	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
83	Mousumi Das	Vedic Science: A Homegrown Approach to Tackling Water Pollution - A Menace	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
84	Chitra Bhattacharya	Mosquito Repellent	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
85	Chitra Bhattacharya	Melishield Mosquito Repellent	E-YUVA, BIRAC, Government of India	2022-2024	2022-2023	1.50
86	Vivek Pattani	Biofertiliser	E-YUVA, BIRAC, Government of India	2022-2023	2022-2023	2.35
87	Shivani Tank	Soapy Chips	E-YUVA, BIRAC, Government of India	2022-2024	2022-2023	2.26
88	Abhijeet Joshi	Financial support for National Conference-Emerging Paradigm in Agriculture Microbiology	Government of Gujarat (Gujarat State Biotechnology Mission - GSBTM)	2022-2023	2022-2023	0.85
89	Abhijeet Joshi	Sponsorship for National Conference-Emerging Paradigm in Agriculture Microbiology	Techno Enterprises, Ahmedabad	2022-2023	2022-2023	0.30
90	Abhijeet Joshi	Sponsorship for National Conference-Emerginig Paradigam in Agriculture Microbiology	Shiddhivinayak Enterprises, Ahmedabad	2022-2023	2022-2023	0.25

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SSR DT S.N.	Name of of the PI/ Co-PI/Name of the person holding the Chair	Title of the research project, endowments, Research Chairs	Name of the funding agaency	Duration	Year of award or sanction	Amount in INR.
91	Rohan Pandya	Development of quality biofertilizer using cow dung: Metagenomic studies of Gir and Kankrej breed	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2024	2022-2023	13.48
92	Preetam Joshi	Faculty Development Program on CRISPR/Cas9 - mediated Genome Editing for Crop Improvement at ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi.	Government of Gujarat (Gujarat State Biotechnology Mission - GSBTM)	2022-2023	2022-2023	0.45
93	Ragini Raghav	Grey Water Recycling	E-YUVA, BIRAC, Government of India	2022-2023	2022-2023	2.60
94	Ragini Raghav	Exploration, isolation and characterization of indigenous rhizobacteria from *Trigonella foenum-graecum* L. (Fenugreek) rhizosphere as PGPR candidates in producing IAA and Gibberellic acid	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.13
95	Govind Vagadiya	Indian Knowledge System-Internship Project - Moliya Isha	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
96	Govind Vagadiya	Indian Knowledge System-Internship Project - Vanshilkumar Tada	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
97	Ashish Kothari	Ensuring sustainable enhancement in quantity and quality of crops by implementing concepts of Indian agricultural philosophy using modern technologies based on Internet Of Things and artificial intelligence.	E-YUVA, BIRAC, Government of India	2022-2024	2022-2023	2.27
98	Hiren Ramani	Mission Amrit Sarovar	All India Council for Technical Education (AICTE), Government of India	2022-2023	2022-2023	0.30
99	Mayank Parekh	Mission Amrit Sarovar	All India Council for Technical Education (AICTE), Government of India	2022-2023	2022-2023	0.30

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SSR DT S.N.	Name of of the PI/ Co-PI/Name of the person holding the Chair	Title of the research project, endowments, Research Chairs	Name of the funding agaency	Duration	Year of award or sanction	Amount in INR.
100	Hemantkumar Sonkushare	Mission Amrit Sarovar	All India Council for Technical Education (AICTE), Government of India	2022-2023	2022-2023	0.30
101	Hardik Pujara	Mission Amrit Sarovar	All India Council for Technical Education (AICTE), Government of India	2022-2023	2022-2023	0.30
102	Rajeshri Patel	Exploring 3D printing technology for the development of nanomiceller formulation and efficacy testing in 3D tumorospheres of colon cancer	Science and Engineering Research Board (SERB), Government of India	2022-2023	2022-2023	17.71
103	Rachana Joshi	Role of indigenous system of medicine (ayurveda) and allopathic system of medicine during and post COVID-19 pandemic	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
104	Rachana Joshi	Impact Of Covid -19 Pandemics on Human Lifestyle	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
105	Samixa Patel	Detailed study on Management and Awareness of the Diabetes Mellitus by using Indian System of Medicine (Ayurveda, Siddha, Unani)	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
106	Samixa Patel	A comparative study about awareness between rural and urban areas for management of diabetes mellitus as prescribed in Indian system of medicine (Ayurveda, Siddha, Unani) along with allopathic medicine.	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
107	Kevin Garala	Current Status of Management of Cardiovascular Disease And Awareness of Ayurvedic Approaches	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
108	Kevin Garala	Consciousness of Obesity and Overweight and it's ayurvedic treatment.	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25

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SSR DT S.N.	Name of of the PI/ Co-PI/Name of the person holding the Chair	Title of the research project, endowments, Research Chairs	Name of the funding agaency	Duration	Year of award or sanction	Amount in INR.
109	Mital Manvar	Study of yogavahi effect of rasa sindoor on effective combination of *Curcuma caesia* and *Tinospora cordifolia* using in- vitro anti-diabetic model	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
110	Mital Manvar	Evaluation of in-vitro anti-arthritic properties of ayurvedic formulation	Ministry of Education, Government of India (Indian Knowledge System - IKS)	2022-2023	2022-2023	0.25
111	Rachna Joshi	Development of Herbal Formulations Using Brassica Nigra and *Celastrus Paniculetus*	Government of Gujarat (SSIP)	2022-2024	2022-2023	0.30
112	Vijay Chauhan	Formulation and Evaluation of Anti-diabetic and Wound Healing Herbal Formulation	Government of Gujarat (SSIP)	2022-2024	2022-2023	0.55
113	Samixa Patel	Herbal All Purpose Cream	Government of Gujarat (SSIP)	2022-2024	2022-2023	0.15
114	Samixa Patel	Herbal formulation for foot corn	Government of Gujarat (SSIP)	2022-2024	2022-2023	0.29
115	Falgun Dhabaliya	Studies on pharmacognotic parameters and evaluation of in vitro anti diabetic effect of O*roxylum indicum* stem extract	Government of Gujarat (SSIP)	2022-2024	2022-2023	0.45
116	Rachna Joshi	Development and Evaluation of Herbal Toothpaste containing *Achyranthes aspera*	Government of Gujarat (SSIP)	2022-2024	2022-2023	0.35
117	Samixa Patel	Herbal Face Pack	Government of Gujarat (SSIP)	2022-2024	2022-2023	0.22
118	Vijay Chauhan	Evaluation of Antidiabetic activity of *Oroxylum indicum* Stem Extract	Government of Gujarat (SSIP)	2022-2024	2022-2023	0.50
119	Rohan Pandya	Generation of Green Hydrogen using biohybrid materials	E-YUVA, BIRAC, Government of India	2022-2024	2022-2023	13.85
120	Rohan Pandya	Impacting environment by turning agri. waste into commercially viable product using fungal application	E-YUVA, BIRAC, Government of India	2022-2024	2022-2023	7.20

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121	Abhishikta Basu	Study of Immune modulation by Pongemia pinnata alcohol extract	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	3.53
122	Dharmishtha Maheshbhai Vala	Personalized Workout Routine System based on Biometric Data and Fitness Level	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	1.72
123	Dhaval Yogeshbhai Raval	Comprehensive Analysis of Decoupled Second Order Generalized Integrator Phase Locked Loop under Balanced and Unbalanced Conditions	Shri Hari Educational Trust, Mumbai	2022-2027	2022-2023	10.50
124	Dipak Jayantilal Dave	Modification of Electrical , Mechanical ,Optical and Thermal properties of Crystal with metal Ions	Shri Hari Educational Trust, Mumbai	2022-2027	2022-2023	11.00
125	Govind Vrajvallabhbhai Vagadiya	SYNTHESIS, CHARACTERISATION AND ANTIMICROBIAL SCREENING OF SOME NEW IMIDAZOLINES	Shri Hari Educational Trust, Mumbai	2022-2027	2022-2023	18.00
126	Hemantkumar Gulabrao Sonkusare	Use of 3d printers sensors and drones in construction for rapid development	Shri Hari Educational Trust, Mumbai	2022-2027	2022-2023	11.00
127	Hepi Karashanbhai Ladani	The Effect of isoleucine on Lithium Dihydrogen phosphate	Shri Hari Educational Trust, Mumbai	2022-2027	2022-2023	10.10
128	Jaydeep Ramniklal Ramani	Statistical Method to Study Rainfall Distribution Dry Spell and it's Effect on Crop Production in Gujarat Using AI	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	5.50

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SSR DT S.N.	Name of of the PI/ Co-PI/Name of the person holding the Chair	Title of the research project, endowments, Research Chairs	Name of the funding agaency	Duration	Year of award or sanction	Amount in INR.
129	Jinesh Bipinbhai Shah	Evaluation of I.C. engine performance through Bio-oil diesel blend extracted from agro waste nearby saurastra region.	Shri Hari Educational Trust, Mumbai	2022-2027	2022-2023	17.15
130	Kirtikumar Rajeshbhai Solanki	Analyzing the Relationship between FDI, FII, and India's GDP: An Evaluation from 1991 to 2021	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	5.00
131	Meerabahen Manishkumar Shah	Deep Dive into india's Education System: A Quantitative Analysis of Key Metrics	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	1.65
132	Minal Veljibhai Bhojani	Block chain technology’s role in business	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	3.25
133	Parth Kishorkumar Dave	A Study on Implementation of NEP 2020 in higher Education in Gujarat	Shri Hari Educational Trust, Mumbai	2022-2027	2022-2023	14.62
134	Rupal Jagdishbhai Shilu	Development of an Intelligent IoT-Based Health Monitoring System Using Machine Learning	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	3.20
135	Sweta A Savaliya	“Mobile Banking Adoption and Usage Patterns Among Customers of Public and Private Sector Banks"	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	3.50
136	Vaishali Sureshbhai Vaghela	Data-Driven Evaluation of Educational Access and Quality Across Indian States	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	2.30
137	Vivek Bipinchandra Pattani	Optimization of bacterial pigment production using kitchen waste	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	4.00
138	Vivek Vallabhbhai Solanki	AquaSmart: Efficient Drip Irrigation for Sustainable Farming	Shri Hari Educational Trust, Mumbai	2022-2027	2022-2023	5.00

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SSR DT S.N.	Name of of the PI/ Co-PI/Name of the person holding the Chair	Title of the research project, endowments, Research Chairs	Name of the funding agaency	Duration	Year of award or sanction	Amount in INR.
139	Yesha Jayeshbhai Gandhi	Leveraging blockchain for trust in IoT in Healthcare	Shri Hari Educational Trust, Mumbai	2022-2025	2022-2023	2.30
140	Abhijeet Sudhirrao Joshi	Gomayamrut for Sasyavivardhan: Bioremediation of xenobiotics(azo dyes) by using cow dung	M/S/ Sarvamangal Construction Co., Bharuch	2022-2027	2022-2023	15.56
141	Alpa Vinodray Joshi	Evaluating the economic impact of 9R model implimentation in small and medium enterprises(SMEs): a study of gujarat and maharashtraS	M/S/ Sarvamangal Construction Co., Bharuch	2022-2027	2022-2023	12.00
142	Anilkumar Sundarjibhai Patel	Synthesis, Characterization and Anticancer Evaluation of Pyrazole Bearing Thaizole Derivatives	M/S/ Sarvamangal Construction Co., Bharuch	2022-2027	2022-2023	12.00
143	Ankit Bharatbhai Lehru	Energy Management for Midsize Industries	M/S/ Sarvamangal Construction Co., Bharuch	2022-2025	2022-2023	3.70
144	Ankitkumar Keshavlal Kalariya	SNEAKSphere – An E-commerce website	M/S/ Sarvamangal Construction Co., Bharuch	2022-2025	2022-2023	3.00
145	Archana Yogesh Cholera	"Streamlined Synthesis of Substituted Pyridone Derivatives: A One-Pot Approach with Enhanced Antimicrobial and Antifungal Properties"	M/S/ Sarvamangal Construction Co., Bharuch	2022-2025	2022-2023	3.30
146	Ashraf Mahmad Mathakiya	Improvement of mechanical properties of dry lean concrete by using different materials.	M/S/ Sarvamangal Construction Co., Bharuch	2022-2025	2022-2023	5.00
147	Bhumika Shitalkumar Zalavadia	Yoga for Sustainable Living	M/S/ Sarvamangal Construction Co., Bharuch	2022-2027	2022-2023	13.00

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SSR DT S.N.	Name of of the PI/ Co-PI/Name of the person holding the Chair	Title of the research project, endowments, Research Chairs	Name of the funding agaency	Duration	Year of award or sanction	Amount in INR.
148	Divyesh Prafulbhai Gohel	Exploring Best Practices and Innovations in Recommendation Systems Development and Deployment	M/S/ Sarvamangal Construction Co., Bharuch	2022-2027	2022-2023	5.00
149	Chirag Vipulbhai Erda	A Comparative Study on Buying Behavior of Rural and Urban Consumer on Mobile Phone in Gujarat	Krutarth I. Patel, Bharuch	2022-2027	2022-2023	10.00
150	Chitra Bishnu Bhattacharya	Formulation of Liquid Biofertilizer Consortium and its Study of the Effect on Soil-borne Fungal Pathogens	Krutarth I. Patel, Bharuch	2022-2027	2022-2023	11.33
151	Devendra Jayantibhai Kaneriya	Water-Mediated Synthesis of Highly Functionalized S – Triazine Derivatives Using Sodium bicarbonate.	Krutarth I. Patel, Bharuch	2022-2025	2022-2023	3.25
152	Dhaval Arvindbhai Tank	Comparison of Different Biomass Sources for ABE Yield in Fermentation Processes	Krutarth I. Patel, Bharuch	2022-2027	2022-2023	10.80
153	Indrajitsinh Jitendrasinh Jadeja	Enduring Legacy of Ancient Indian Sports and Martial arts from Historical Roots to Modern Practice	Krutarth I. Patel, Bharuch	2022-2027	2022-2023	14.00
154	Kevin Chandulal Garala	Crystal Engineering: A cutting-edge approach for ameliorating biopharmaceutical performance of selected antibiotics	Krutarth I. Patel, Bharuch	2022-2027	2022-2023	37.50
155	Amisha Chintan Ghelani	Consumer awareness and adoption of ESG investment: a study in urban gujarat	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	4.00

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SSR DT S.N.	Name of of the PI/ Co-PI/Name of the person holding the Chair	Title of the research project, endowments, Research Chairs	Name of the funding agaency	Duration	Year of award or sanction	Amount in INR.
156	Birju Umeshbhai Tank	AI-Powered Traffic Management System for Smart Cities	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	3.50
157	Darshan Pareshkumar Joshi	Urban Traffic Safety Improvement through Black Spot Identification	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2027	2022-2023	3.40
158	Devanshi Bhargav Dave	Voluntary Liquidation Process: Challenges and Ways forward	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	4.98
159	Divya Solanki	Varicose vein disease prediction using Machine Learning Techniques	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	2.20
160	Drashti Purohit	Portrayal of women in the novels of Simone de Beauvoir and Kundanika Kapadia	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	3.00
161	Gemini Ashokkumar Parmar	"DDoS Mitigation in IoT Using Machine Learning and Blockchain Integration "	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	2.25
162	Hani Mukeshbhai Jani	1. Formulation and Evaluation of Withaferin A Phytosome: A Novel Approach to Enhance Bioavailability and Therapeutic Potential	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	4.50
163	Kairvi Jitendrabhai Rathod	AI-Driven Portfolio Optimization	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	4.00
164	Kairvi Jitendrabhai Rathod	AI Ethics and Fairness in Finance	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	4.00
165	Kajalben Vishalbhai Paradava	Aspect based sentiment analysis of product review	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	2.21
166	Kelsi Ashokbhai Chhatrala	Holistic Health and Wellness Innovations: Developing A2 Milk-Based Skincare Solutions with Herbal Infusions for Enhanced Skin and Overall Well-being	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	3.20

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167	Kishan Karmur	Diseases Detection in Plant Using Machine Learning Algorithms	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	2.00
168	Mansi Harjivan Chauhan	Sentiment Analysis of E - Commerce Cloth Review using Machine Leraning	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	2.30
169	Nehaben Dilipbhai Borad	The Role of Limit and Continuity in Mathematics	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2027	2022-2023	10.20
170	Nehaben Dilipbhai Borad	A Comparative Study of Wavelet Transforms and Fourier Transforms in Signal Analysis	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2027	2022-2023	10.15
171	Nirali Rameshbhai Shah	The Influence of Financial Literacy on Working Capital Management and Profitability: A Study of SMEs in Urban and Semi-Urban India	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	4.50
172	Nishita Tulsidas Thakrar	A study on the sectors affecting retail investors trading stretegies in gujarat	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	3.50
173	Prakash Prafulbhai Gujarati	Interactive Real-Time Polling and Feedback Platform for Lectures	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2027	2022-2023	5.00
174	Pratik Pravin	Factors Influencing employee satisfaction in Higher Education : A Study in Gujarat , Indai	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2025	2022-2023	3.50
175	Praveen Suresh Gupta	Cytotoxicity study and Phytochemical characterization of molecules present in methanolic extract of M. pruriens seeds	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2027	2022-2023	11.00
176	Yuvrajsinh Bhupatsinh Kanchava	Studying the intersection of positive psychology, sustainable happiness, and the impact of yoga on mental well-being.	Premier Engineering & Equipment Mfg. Co., Ahmedabad	2022-2027	2022-2023	1.00

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Student Startup and Innovation Policy (SSIP)2.0
University/Institute Proposal Format

1	Basic Information				
1.1	Institutional Identity				
(A)	Name of the University/Institute	Atmiya University, Rajkot			
(B)	Is the university UGC/NAAC/NBA accredited	No			
(C)	Furnish UGC/NAAC/NBA approval No.	NA			
(D)	Type of University/Institute (State / Private / PPP / National)	Private			
(E)	Year of Starting of University/Institute	2018			
(F)	Total Number of Institutes Constituent with the University	0			
(G)	Total Number of Enrolled Students	6325			
(H)	AISHE Code	U-0967			

1.2	Correspondence address of the University/Institute				
(A)	Address	Yogidham Gurukul, Kalawad Road, Rajkot			
	City:	Rajkot	Dist:	Rajkot	
(B)	Phone Number	7572970004	Phone-2	9879858594	
(C)	Fax Number				
(D)	E-mail Id	dy.registrar@atmiyauni.ac.in			

1.3	Details of Vice Chancellor/Principal		
Sr.No.	Name	Mobile	E-mail Id
1	Dr. Shiv K. Tripathi	7572970002	vc@atmiyauni.ac.in

1.4	Details of SSIP Coordinator(Senior Faculty / Officer of the University / Institute)			
Sr.No.	Name	Designation	Mobile	E-mail Id
1	Dr. Ashish M. Kothari	Deputy Registrar	7572970004	dy.registrar@atmiyauni.ac.in
2	Mr. Pratik Kikani	Assistant Professor	9879858594	pratik.kikani@atmiyauni.ac.in

1.5	Details of person authorised to sign MoU			
Sr.No.	Name	Designation	Mobile	E-mail Id
1	Dr. D. D. Vyas	Registrar	7572970006	dean.tracademics@atmiyauni.ac.in

2	Present Scenario of Innovation and Startup activities/Preparedness										
2.1	Students Affiliated to University						Faculty Members				
Sr.No.	Diploma	UG	PG	Ph.D	Certificate Course	Total	Lecturer	Asst. Prof.	Asso. Prof.	Prof.	Principal/ Director
1	346	5090	1226	95	118	6875	40	222	7	8	1

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2.2	Facilities Available for Innovation Pre-incubation Support (claims will be verified during evaluation)	
Sr.No.	Details	Yes/No
1	Research/Innovation/Incubation/Pre-incubation Centre Available	Yes
2	Meeting Room for Innovators and Startups, Seminar/ Computer Centre with Independent High-Speed Dedicated Internet Facility	Yes
3	Library/Reading Room/Soft Digital Infrastructure	Yes
4	Area of minimum 5000 Square Feet dedicated for Innovation and Entrepreneurship Activities	Yes
5	Dedicated Supporting Staff for Startup/Incubation/Pre-incubation Activity/Centre	Yes
6	Collaboration with Expert Individual and Organization to promote Innovation and Entrepreneurship	Yes
7	Access to University Labs/workshop and Research Infrastructure to Student Innovators and Startups	Yes

2.3	Active Student Participation in Innovation and Entrepreneurial Activities during past academic year (claims will be verified during evaluation)	
Sr.No.	Interventions	Numbers
1	Converting projects/research work into an innovation/solution	1
2	Students participating in Conferences/Symposiums/Workshops in Innovation and Entrepreneurship	2128
3	Students participating in Boot-camps/Hackathons/Hands on Activities/Problem Solving Efforts	45
4	Students trying to convert their project into a product or solution	16
5	Students participating in exposure programs like Innovation/Startup Exhibitions/Award Functions	610
6	Students participating in Product Design, Design Thinking, Immersion Programs in Innovation	1300
7	Startup Internship, Research in Innovation and Entrepreneurship, Students participating with Innovators and Startups through various Engagement programs	5
8	Students Participating in Skill Development Programs related to Innovation and Entrepreneurship	75
9	Students Startups/Alumni Startups coming out of the University	5
	Total	4185

2.4	Major Noteworthy Efforts during past three years to promote Innovation and Student Startups. (Please Mention at least 5 initiatives within 1000 words)
Sr.No.	Initiative
1	University has an active Institution's Innovation Council (IIC), functioning under the Ministry of Education's Innovation Cell (MIC) MoE, Government of India since the year 2018.The IIC, through regular conduct of numerous activities involvng active stakeholder's participation, has been significantly contributing to boost the innovativeness . Some of the examples of the IIC organized activities, include: A. Expert-Talks by leading entrepreneurs, incubator coach, start-up founder and Angel-Funding Agencies B. Leadership talk series by eminent experts C. Ideathon competitions; Design thinking workshops; IPR awareness seminar/webinar; workshops on patent filing; SSIP boot camps; Gandhian Global Solar Yatra; Panel discussion on Atmanirbhar Bharat-Vocal for Local; Workshop on Idea to Execution; Workshop on Innovation Development; International webinar on biotechnological advancement in 21st centuary; etc. Based on the active involvement and efforts of the University, Innovation Cell of MoE, Government of India has given **4 / 5 stars consicutively for 2 years**; and also the university is **selected as Mentor Institute for mentoring 3 schools** of the region

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2	Organization of SMART CITY HACKATHON-2020 in association with Rajkot Municipal Corporation (RMC) and Govt. of Gujarat. 300+ participants from across the state of Gujarat have participated to develop solutions to the problems of various departments of RMC. Organization of SMART GUJARAT FOR NEW INDIA HACKATHON-2020 in association with Govt. of Gujarat. 1100+ participants from different institutions and programmes such as BCA, Engineering, MCA, MSc IT, Pharmacy and allied branches, from across the Gujarat, developed the innovative solutions to the problems of diferent departments of the Government of Gujarat. Organization of Annual event namely Abhigyan - A National level science & innovation fair to celebate the National Science Day in the year 2019, 2020,2021 and 2022. 5000+ students from different universities and institutions across India have participated in various activities/competitions of Abhigyan namely Vyakhyan-national seminar/webinar on the theme of Science Day; Navonmesh-working model competition; Abhivyakti-poster presentation; Manthan- Ideathon; Kaaruyantram-Roborace; Akruti - Scitoons as well as other activities.
3	The university has introduced a number of academic interventions to promote the culture of reserach, innovation, startup and entrepreneurship among the students. The Curriculum is designed to promote innovation and entrepreneurship through systemic approach in terms of courses and additional learning components, from 1st to final year of the respective programme of the study. The examples of the different courses are as under: A. Compulsory Credit Courses – Concept to Practice, Design Thinking, Mini Project, Internships, Interdisciplinary and Transdisciplinary Courses B. Compulsory Skill Enhancement Courses – Value Added Courses (40 Hrs) C. Co Curricular Courses (80-100 Hrs) D. Elective Courses - Advanced Design Thinking, Startup & Entrepreneurship Program In addition, the University offers a full-time undergraduate degree course BBA (Entrepreneurship & Family Business)
4	During implementation of SSIP 1.0, the University has dedicated special space for innovation and incubation center; and spent Rs. 10 Lakh+ in different activities including sensitizing stakeholders, organizing capacity building programs, developing tinkering lab and co-working space (Rs. 2.5 Lakhs+), PoC and prototyping support (40 PoC) and patent filing support(34 patents filed).
5	The University has partnered with reputed organizations and institutions to foster the innovation. This includes: A. Collaboration with AIC-NIFTTEA for Promoting Innovation & Entrepreneurship ecosystem in Textiles & Apparels B. Collaborative Acceration program for Early Stage Entrepreneurs - 100+ participants across india C. Collaboration with Kaushalya Skill University, Government of Gujarat for promoting startup, innovation and entrepreneurship skill among the students. Also other collaborations/MoU with International and National Universities, International and National Industries, Sector Skill University, NGOs to support the research and innovation activities

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2.5	Major Achievements and Impacts during past three years in Innovation and Entrepreneurship. (Please Mention at least 5 initiatives within 500 words)
Sr.No.	Achievements and Impacts
1	**Startups and Technology Transfer related accomplishments:** A. Registered Startup - Xenhester Innovations Pvt. Ltd. B. Secured funding of Rs. 12.5 Lakhs from IIT Mandi, GTU and iHUB C. Technology Transferred to CDSpace Robotics Pvt Ltd-Bengaluru and Enercomp-Gujarat
2	PoC and prototyping support (40 PoC), patent filing support(34 patents filed - **1 Patent Granted -Indian Patent No.: 385920**)
3	4 / 5 stars consicutively for 3 years by Innovation Cell of MoE, Government of India (Only Two Universities in Gujarat) & 2020-21 (1st in Gujarat & 2nd in central zone in University Category*)
4	ARIIA - Listed in Band Promising (A.Y. 2020-21) Innovation Ambassador – IIC, MoE Innovation Grants – 32 Lakhs (Last 3 Years) Recognized as Mentors & IP Experts at GIC – 7 Faculties Winner–I&E Competitions – GIC, iCreate, iHUB, SSIP
5	Team from AU Secured 1st Position in Hackathon Three (03) solutions accepted by RMC: i. BRTS Service; ii. Sewage Plants; and iii. Smart Dustbin Also collaborated post event collaboration for adoption of the innovative solutions developed during the Hackathon.

2.6	Efforts to create Innovation Pipeline for Pre-incubation Activities (Please Mention at least 3 initiatives within 500 words)
Sr.No.	Initiatives
1	Identification of new pre-incubate entrepreneurs from Educational Institutions, Industrial Associations, MSME Units, Grassroot Innovators through organizing different events and focused outreach activities
2	We have developed an attractive operational models for early-stage innovators, encouraging them to move forward with their innovation attempts. For this purpose, we have and partnered with pre incubators
3	Our curriculum, as highlighted in 2.4(3), promotes innovation and encourages the students to try/experiment ith their ideas while learning the different programmes. Our approach is to encourage innovation by mainstreaming it to regular curriculum activities.

2.7	Internal Support System at Different Stage of Innovation	
Sr.No.	Need	Intervention being taken
1	Outreach/Sensitization/Culture Development	Sensitization of school, college and university students by organising National Level Science fair, Expert Talk, Webinar and Workshops in the areas of research, innovation, startup, entrepreneurship

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2	Support at Idea generation stage	Annual oraganization of ideathon competition and provide expert as well as funding taking their potential idea towards startup
3	Support for IPR awareness and Patent Filing	IPR Awareness session in collaboration with NIPAM Patent filing support through funding
4	Support for Proof of Concept (PoC)	Funding Support, internal and external mentoring support, Progress measurement,
5	Support for access to existing R & D infrastructure	Free Access to R & D infrastructure facilities as per the requirement of the innovation.
6	Exposure to Innovators and Student Startups	Organization of expert talks and handholding support on startup and innovation by successful entrepreneurs, incubators, startup founder, angle funding agencies, alumni
7	Collaboration and tie-up with external expert/organizations	Collaborations with external Experts and expert firms such as AIC-NIFTTEA, EDII, Ahmedabad
8	Capacity building of stake holders	Organization of capacity building programs such as Ideathon competitions, Design thinking workshops, IPR awareness seminar/webinar, workshops on patent filing, SSIP boot camps, Science and Innovation fair and leadership talk series

2.8	Outstanding efforts in the field of Research by the University in past three years				
Sr.No.	Type of Student's Projects Work	2019-20	2020-21	2021-22	Total
1	Ongoing/Completed Funded Research Projects	2	5	20	27
2	Research Publications in Peer Reviewed Journals (past 3 years)	352	413	363	1128
3	Students' Research Publications	54	41	69	164
4	Faculty Research Publications	125	158	191	474
5	Patents filed in past 3 years	3	3	5	11

6	Conferences/Workshops/Seminars/ Conducted	18	34	42	94
7	Amount Spent on Innovation and Entrepreneurship Agenda	15000	160000	336000	511000
8	Consultancy Projects Received	13	14	14	41
9	Internal Revenue Generation (IRG), in rupees	3600000	5300000	5500000	14400000

2.9	Project Work				
Sr.No.	Type of Student's Projects Work	2019-20	2020-21	2021-22	Total
1	Minor Research/Academic Projects (UG/Diploma Level)	684	883	1164	2731
2	Major Research/ Academic Projects (PG Level)	512	494	503	1509
3	Research Scholars (PhD Level)	52	41	31	124
4	Registered Student/Alumni Entrepreneurs	0	1	0	1
5	Commercialized Student's Project /Innovation	0	1	0	1

3	Core Capabilities to Host SSIP Activities at University/Institute	
Sr.No.	Area	Capabilities
1	Competent Human Resource to Operationalize SSIP action agenda	Pool of mentors in the domains of Technical | Business | IPR | Regulatory Affairs with mentorships in the form of One-to-one | Peer | Group | Distance or E-Mentoring
2	Available Infrastructure for Innovation and Incubation Centre	Centre of Excellence for Embedded Systems and Robotics (IIT Bombay) Centre for Renewable Energy Resources Central Instrumentation Facility iMac Laboratory Tinkering Laboratory Manufacturing facility with CNC and VMC S6 Computer Lab | 2000+ Systems | 7 IBM Servers | High Speed Internet
3	Core Research/Thrust Areas	Robotics | Industrial Automation | AR & VR | Data Science | Renewable Energy | E-Commerce | Chemical Science | Life Science | Agritech | AI & ML
4	Source to tap new Innovation	From Educational Institutions, Industrial Associations, MSME Units, Grassroot Innovators
5	Locational Advantage	University is located in the heart of the Rajkot City with distance of less than 4 Km from Airport, Busstand and Railway Station.
6	Proven track record to promote innovation and entrepreneurship	University got 4 / 5 Star Consicutively for Two Years - 2019-20 (Only Two Universities in Gujarat) & 2020-21 (1st in Gujarat & 2nd in central zone in University Category*) by Innovation Cell, MoE, GoI for Innovation and Entrepreneurship related activities

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7	institute's own budget to promote innovation and entrepreneurship	A separate head will be allocated in the annual budget of the institute for funding and supporting innovation and startups related activities Created a corpus fund for the seed money scheme of the university to promote the minor research carried out by the faculty members of the university.

4	Roadmap of the University/Institute to Promote SSIP2.0 Agenda

4.1	Five Year Action Plan to Support Student Innovation And Startups						
Sr.No.	Milestone	2022-23	2023-24	2024-25	2025-26	2026-27	Total
1	Total Number of Students to be Outreached and Sensitized	2000	2000	2000	2000	2000	10000
2	Total Number Innovations to be Supported at PoC Stage	60	66	73	81	90	370
3	Total Number of IPR to be Filed	5	8	12	18	25	68
4	Total Number of Student Start-ups	0	1	2	2	4	9
5	Total Number of Workshops/Conferences/Seminars/Capacity Building Programs in SSIP 2.0 Agenda (attach detail)	10	10	10	10	10	50

4.2	Key initiative to achieve the above. (Please Mention at least 10 initiatives within 500 words)	
Sr.No.	Initiatives	
1	Pedagogical Changes	MOOC and similar virtual & blended interventions for large scale outreach and providing necessary exposure to students.
		Disemination of the existing government policies related to startup, innovation and entrepreneurship

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2	Academic Interventions	Curriculum designed to promote innovation & entrepreneurship through systemic approach in terms of courses and components from 1st to final year. Compulsory Credit Courses – Concept to Practice, Design Thinking, Mini Project, Internships, Interdisciplinary and Transdisciplinary Courses Compulsory Skill Enhancement Courses – Value Added Courses (40 Hrs), Co Curricular Courses (80-100 Hrs) Elective Courses - Advanced Design Thinking, Startup & Entrepreneurship Program BBA (Entrepreneurship & Family Business)
3	Infrastructural Facilities	Establishment of centre of Excellence in startup ecosystem
		Enhancement of Tinkering Lab and preincubation facility center
4	Promotional & Sensitization Activities	Networking | Affiliate Marketing | Referals | Advertising | Participation in Special Everts | Joining Professional in Business Organizations | Collaborating with neighboring incubators
		Tapping new incubate entrepreneurs – Educational Institutions, Industrial Associations, MSME Units, Grassroot Innovators
5	Capacity Building	Events & Activities – Bootcamps, Ideathon, Capacity Building Workshops, Pitching Sessions, Business Plan Competitions Partnering with pre incubators | Hub & Spoke Model
		Courses like advance design thinking, Startup as option credit course in final year, Community engagement, minor project and Seed money initiative for capacity building of faculty would help to mentor students better.

4.3	Budget (in Rupees):						
Sr.No.	Component	2022-23	2023-24	2024-25	2025-26	2026-27	Total
1	Student Innovation Fund (SIF)	2000000	2000000	2000000	2000000	2000000	10000000

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2	Grantee Matching Fund (GMF)	2000000	2000000	2000000	2000000	2000000	10000000
3	Other Sources	0	0	0	0	0	0
	Total	4000000	4000000	4000000	4000000	4000000	20000000

4.4	Proposed budget including University/Institute contribution, SSIP2.0 Grant and other sources: (in Rupees)						
Sr.No.	Intervention	2022-23	2023-24	2024-25	2025-26	2026-27	Total
1	PoCs / Prototype / Innovation	2470000	2600000	2720000	2880000	2920000	13590000
2	IP Filing	330000	400000	480000	520000	600000	2330000
3	Tinkering lab development, infrastructure, administration, and others. Max. 30% of (SIF+GMF).	1200000	1000000	800000	600000	480000	4080000
	Total	4000000	4000000	4000000	4000000	4000000	20000000

4.5	Please provide following
(A)	Details of current state of the identified space proposed for SSIP Activity Centre with photographs
	Ready - Tinkering Laboratory and Pre-incubation center | Enhancement in the same will be carried out
(B)	Timeline as to how long will the University take to make the required infrastructure up and running from date of award letter if selected
	within a year
(C)	What is the proposed place being currently used for?
	Incubation Space ,Conference Room, Meeting Room
(D)	Host University must also give an undertaking that space earmarked for SSIP Activity Centre facility will be used for Start-up /Innovation / Entrepreneurship related activities only.
	University undertakes that the space earmarked for SSIP Activity Centre facility will be used for Start-up /Innovation / Entrepreneurship related activities only.

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All India Council for Technical Education (AICTE)

Mission Amrit Sarovar - Jal Dharohar Sanrakshan Internship

PROPOSAL under Mission Amrit Sarovar Scheme

Performa

Here are the required Details of the institute

Name and Address of the Beneficiary Institution: Atmiya University, Rajkot

Name and Address of the Beneficiary Institution:	Atmiya University, Rajkot "Yogidham Gurukul", Kalawad Road, Rajkot-360005, Gujarat, India
Scheme Under which grant is to be Released:	Mission Amrit Sarovar – Jal Dharohar Sanrakshan (MAS-JDS)
Name of Head of Institute (HOI):	Dr.Shiv Tripathi
Name of Institute Nodal officer (INO):	Mr. Hemantkumar Sonkusare
Duration of the Project:	6 months
Preference of Water Body's	1). Atal Sarovar, Rajkot 2). Mayasar Lake, Dwarka 3). Talaja Caves, Talaja
Budget (Rs.)	Total: 2,00,000/- INO: 30,000/- Student: 10,000*15=1,50,000/- Travel: 20,000/-

INO

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Performa

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Name and Address of the Beneficiary Institution: Atmiya University, Rajkot

Name and Address of the Beneficiary Institution:	Atmiya University, Rajkot "Yogidham Gurukul", Kalawad Road, Rajkot-360005, Gujarat, India
Scheme Under which grant is to be Released:	Mission Amrit Sarovar – Jal Dharohar Sanrakshan (MAS-JDS)
Name of Head of Institute (HOI):	Dr.D.D.Vyas
Name of Institute Nodal officer (INO):	Mr.Hardik Pujara
Duration of the Project:	6 months
Preference of Water Body's	1). Talaja Caves, Talaja 2). Mayasar Lake, Dwarka 3). Nawabi Pond, Junagadh
Budget (Rs.)	Total: 2,00,000/- INO: 30,000/- Student: 10,000*15=1,50,000/- Travel: 20,000/-

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All India Council for Technical Education (AICTE)

Mission Amrit Sarovar - Jal Dharohar Sanrakshan Internship

PROPOSAL under Mission Amrit Sarovar Scheme

Performa

Here are the required Details of the institute

Name and Address of the Beneficiary Institution: Atmiya University, Rajkot

Name and Address of the Beneficiary Institution:	Atmiya University, Rajkot "Yogidham Gurukul", Kalawad Road, Rajkot-360005, Gujarat, India
Scheme Under which grant is to be Released:	Mission Amrit Sarovar – Jal Dharohar Sanrakshan (MAS-JDS)
Name of Head of Institute (HOI):	Dr.Shiv Tripathi
Name of Institute Nodal officer (INO):	Mr. Mayank Parekh
Duration of the Project:	6 months
Preference of Water Body's	1). Nawabi Pond, Junagadh 2). Atal Sarovar, Rajkot 3). Talaja Caves, Talaja
Budget (Rs.)	Total: 2,00,000/- INO: 30,000/- Student: 10,000*15=1,50,000/- Travel: 20,000/-

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All India Council for Technical Education (AICTE)

Mission Amrit Sarovar - Jal Dharohar Sanrakshan Internship

PROPOSAL under Mission Amrit Sarovar Scheme

Performa

Here are the required Details of the institute

Name and Address of the Beneficiary Institution: Atmiya University, Rajkot

Name and Address of the Beneficiary Institution:	Atmiya University, Rajkot "Yogidham Gurukul", Kalawad Road, Rajkot-360005, Gujarat, India
Scheme Under which grant is to be Released:	Mission Amrit Sarovar – Jal Dharohar Sanrakshan (MAS-JDS)
Name of Head of Institute (HOI):	Dr.Ashish Kothari
Name of Institute Nodal officer (INO):	Mr. Hiren Ramani
Duration of the Project:	6 months
Preference of Water Body's	1). Mayasar Lake, Dwarka 2). Atal Sarovar, Rajkot 3). Talaja Caves, Talaja
Budget (Rs.)	Total: 2,00,000/- INO: 30,000/- Student: 10,000*15=1,50,000/- Travel: 20,000/-

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Title

Demystifying the drinking water microflora by copper vessel storage and Agnihotra ash treatment

Title: Demystifying the drinking water microflora by Copper vessel storage and "Agnihotra Ash" treatment.

1. **Absstract:**

An important role of ancient science addressing various problems of environment and public as well as domestic life not new, yet, the modern scientific technology can't mitigate completely scarcity of provision of safe and sufficient amount of drinking water. Myriad human activities along with post effect of climate change is making less availability of Safe consumable water. In India, Africa, Asia, Middle East &Europe this type application is not new. Various natural agents like herbs, amla, or boiling combined with storage in copper, iron or hot sand, usage of common plants like water lily roots, seeds of nirmali (Strychnos potatorum) were used to be worth mentioning. In Greece

usage of fabric bag "Hippocrates sleeve" used for staining the water before boiling and also the usage of sand, gravel based water filtration in in Sanskrit manuscript "Susruta Samhita"reported (Reinbold J,2018). "Agnihotra Ash"mediated energy creation and electromagnetic vibes resulted a strong impact on water storage (Berk and Sharma, 2015). Agnihotra ash and its impact in an individual can endure frame vata(V), pitta(P), kapha(K) and also can endure from impeded Agni which can influence metabolic activities of human bodies and influences the cleanliness of individual. Few reports propose that the old method of Agnihotra may offer a cheap and reasonable arrangement (Berk and Matlander,2015). Reduction of MDR strains of E. coli have been reported by Tuladhar et al., (2019). These all data indicates that ancient water storage and treatment process although sometimes not time and human labour friendly but more effective in treatment.

2. Objectives:1. Collection water sample (different municipal water samples)

- Myriad water samples available from Rajkot in and around Municipalities by standard scientific process will be collected and processed as per standard procedures

2. Effect of microbial load on adding "Agnihotra Ash" on and copper storage vessel water sample

- Storage of water in two ancient methods employing Cu vessel and "Agnihotra Ash" treatment for standard time duration would be undergone MPN count and comparative analysis;

- The optimization of the "Agnihotra Ash" treatment employing time of "Agnihotra Yagna" would also like to be carried out as comparison to evaluate the control water samples and "Agnihotra Ash" treated water microbial flora count

3. Identification of microbial flora in treated water sample

- The impact of ancient science on treatment of water samples to make it consumable will be also evaluated based on preliminary characterization as per standard methods.

3.Description of work:

The following work flow is a detailed summary of the proposed project.

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3.1 Flowchart:

- Review Literature and survey of collection sites
- Collection of water from different places
- Physical & chemical quality analysis
- Myriad vessels storage techniques of water sample
- 1st Report preparation and submission
- "Agnihotra Ash" treatment of water sample
- Quantitative evaluation of microbial load of water sample
- Comparative study of ancient technique based treated water sample
- Drafting report and submission.

3.2 methodology

3.2.1 water sample collection & processing

The different municipality water sample from Rajkot in and around will be collected & will be checked for further processing. (RL Olsen, RW Chappell, JC Loftis -Water quality sample collection, data treatment and results presentation for principal components analysis – literature review and Illinois River watershed case study, 2012 - Elsevier.)

3.2.2 physicochemical analysis of water sample

The processed, collected water sample will be under gone different physical and chemical analysis like dissolved oxygen (DO) properties, biochemical oxygen demand (BOD), temperature, color, turbidity, total solid, dissolved solid, suspended solid, odor etc. and also pH, chemical oxygen demand (COD) likewise. (Berk,U and Sharma,S. 2015. •Effect of Agnihotra energy field on water purification.Indian Journal of Traditional Knowledge 14(1):63-68.)

3.2.3 Ancient treatment technique of water sample

The same water sample with a standard amount will be under gone storage in different metallic vessels for a standard time duration and anther treatment will be carried out with "Agnihotra Ash" for a stipulated time period and with standard amount of ash content. The treated water sample will be further under gone different experiment,

3.3.4 Quantitative evaluation of water micro flora

A standard quantitative evaluation called as Most Probable Number (MPN) test will be carried out to determine the colony count by three consecutive tests namely 1) Presumptive test,2) Confirmatory test,3) Completed test respectively (Mangale Sapana M., Chonde Sonal G. and Raut P. D., March (2012), Use of Moringa Oleifera (Drumstick) seed as Natural Absorbent and an

Antimicrobial agent for Ground water Treatment, Research Journal of Recent Sciences Vol. 1(3), 31-40) employing the treated water sample.

3.2.5 preliminary characterization available microflora of water sample

Followed by the MPN test the positive colonies will be under gone standard identification to rewill the type of bacteria presents in the sample. (Reshma Tuladhar, Bijaya Laxmi Maharjan, Supriya Sharma, Anjana Singh & Ulrich Berk,November 2019,Effect of Agnihotra Ash on Drug-Resistant Escherichia coli in Water,Plant Biotic Interactions pp 243–251)

3.2.6 Comparative study of ancient technique based on treated water sample

Both the water samples followed by different ancient treatments & microbial load count along with physicochemical property analysis will be compared to document the potency of the technique and finally choice the best.

3.2.7 Effect of conducting time of Agnihotra Ash on water treatment

The timing "Agnihotra yagna" is very important and the ash recovered from such "yagna" at different time period also impart significant impact on set of action to be done. In this case the water treatment will be carried out with different ash samples (conducted t different time

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interval). Followed by this the microbial load will be documented separately and compared with all storage water.

4.Timelines:

- Week 1: Review literature and submission of workplan
- Week 2: Survey of site, collection of water sample & processing
- Week 3: Qualitative analysis
- Week 4: preparation of Report 1 and submission.
- Week 5: Treatment & microbial load count, optimization
- Week 6: Identification of microbial flora
- Week 7: Conduction of microbial load count & optimization
- Week 8: Final data interpretation & final report formation, ppt

5.outputs:

1)Retrieval of forgotten knowledge of ancient Vedic science with perspective to microbiology can be exploited for awareness of water sanitation and its significant role with cost effective tools and technique.

2)The positive vibes & healthy ambience created by "Agnihota yagna" not only beneficial for ecosystem and human health but indirectly the product i.e., "Agnihotra Ash" application is more useful in water treatment which need to be mass promoted in form of such "IKS" or allied platform so that, more avenue of reserch in this line can attractive 'youth' for reviving the knowledge of ancient science.

References:

Reinbold J. 2018.Ancient Purification Methods. Retrieved from https://sciencing.com/ancient-water-purification-methods-4794725.html.

Berk,U and Sharma,S. 2015. Effect of Agnihotra energy field on water purification.Indian Journal of Traditional Knowledge 14(1):63-68.

Berk,U and Matlander,J.2015. Scientific Aspects of Agnihotra: Purification of Water by Agnihotra.2015. Retrieved from https://agnihotra.pl/en/scientific-aspects-of-agnihotra-purification-of-water-by-agnihotra/

Tuladhar, R.Laxmi, B,Sharma , S.,Singh, A., Berk, U. et al.,2019. •Effect of Agnihotra Ash on Drug-Resistant Escherichia coli in Water.Plant Biotic Interactions.243-251.

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TITLE:- Vedic Science a Domestic Approach Solving Water pollution - A Menace

ABSTRACT:-

Nowadays undeveloped countries face scarcity of water due to less resources and novel technology for water treatment and also lack of knowledge and poor water supply system. And the most important thing we should have put in our mind is expansion of industries of any sector, that creates pollution of air, water and land. So the appropriate task of water purification is more important nowadays than previous decades.

If we use bioactive compounds for water treatment, that will help to increase water value after the purification. We are focusing on using plant or herbs base components for the purification, because we have limited resources and the population size is increasing and the need for that compound is high.

INTRODUCTION:-

In our first step of work, we are focusing on processing of stored form rainy water (such as river form or dams) or we use running water of spring for testing, because it's generally used for human activities and drinking.

If we look Towards ancient Indian culture then we clearly see great potency of knowledge and its application also. In ancient times there were no sach instrumental Technologies for any human need but methods or different ways are present there. Particularly we look for water, they have a water storage system, they have good water purification methods, they have a water measurement system; Apart From this Knowledge they have different ways for water conservation, Water hydrology etc.

In ancient times large water storage systems structured in that manner sunlight directly reached the bottom part, this way stores water in pure form. This is the way of working with natural ease. If we talked about today's technology, such as the use of filters, they process water faster, this is the advantage of today's technology but on the other hand it's not able to provide required quality of water to the human body and for long time consumption of RO water it lead to certain abnormalities and diseases. So Whenever we use any method for the treatment that is not limited to use or our comfortability, besides these things we also think about their application to Human body health, environmental effect, use of established methods by each and every person and at last their sustainability. For example in monsoon season people only use hansodak jal for drinking. What happens in this jal, firstly water collected in clay (MITTI) utensils during rain in Agastya nakshatra and covered by a thing. Required drinking water during monsoon season is facilitated by this bhansodak jal, they do not use groundwater for drinking or any store water connected with

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land (such e kundas) because when rain water mixed with surface water, water becomes acidic. This acidic water is not able to be consumed.

BACKGROUND WORK :-

In our vedic science there are 5 elements (panchamahabhuta), that is space, quark, energy, force and matter, these ingredients create earth; And these 5 ingredients (panchamahabhuta) present within the body. Water is the important part of this panchamahabhuta, and water is directly or indirectly associated with remaining panchamahabhuta; because panchamahabhuta provides stability to the human body. In the human body this panchamahabhuta maintains all the necessary activity of the human body. And balance of panchamahabhuta gives good health, power and happiness to the human body. Only yogys have knowledge of panchamahabhuta and their impact on the body. So yogys develop exercise for the maintenance of panchamahabhuta and provide it to our ancestors for the utilization power present within the panchamahabhuta, And through the designed exercise humans can maintain panchamahabhuta and this results into a healthy human body. [Article by Dr. Raghuram Y.S. MD]

We can focus on water because water actively participates in all types of activity that occurs within the human body. So, for the maintenance of healthy water rishi muni's developed some storage mechanisms. This storage mechanism is naturally important for the betterment of water. In ancient times, copper vessels were mostly used as a storage container for healthy water drinking at least for 24 hours. Copper vessel or container is used because copper has antibacterial properties that are helpful to water. Second component used for water treatment is Agnihotri ash. [London Swaminathan, 2015]

OBJECTIVES :-

- **DETECTION AND TREATMENT OF IMPURITIES PRESENT IN THE WATER**

  Collected water sample goes for pre-testing of water and that is helpful to check the level of contamination present within the sample. This impurity is present due to small solids, organic and inorganic molecules etc. This will give basic knowledge of water quality.

- **WATER PURIFICATION BY AGNIHOTRI ASH, ALUM, DRUMSTICK SEED**

  Then, purify water by the help of Agnihotri ash. Agnihotri ash applied for our water sample (that is municipal water or bore water). Agnihotri ash is used for the treatment of contaminated water and it removes bacteria from the water. so, with the help of Agnihotri ash we can do water purification treatment. Use of Agnihotri ash also helps to achieve

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Atmiya University Rajkot

sustainable goals for water treatment, because Agnihotri ash does not pollute water, soil, environment and does not affect humans.

- **QUALITY ANALYSIS ASSESSMENT**

  After collection and treatment, our next work starts with quality analysis of treated water. It gives answers about water changes found after the treatment of water by Agnihotri ash. This study will lead to answering about the effectiveness of Agnihotra Ash for water treatment. So, by way of comparison we can get ultimate applicational goal of water treatment.

DESCRIPTION OF WORK :-

- **WORK PLAN**
- **METHODOLOGY**

Our beginning of practical work started from sample collection of water and Agnihotri ash, and starting of Methodology from Preliminary examination of collected water. These examinations help to know the condition of Collected water sample. by using this collected water we can measure pH of water, Total Suspended solid particles, total solid particles, dissolve solid particles. Measurement of these particles is essential, because it may carry physical contaminants or act as carriers for Pathogenic microorganisms.

A. We are using following Measurement for pre testing of water:-

1. pH measurement.

   We can get the PH value Of desired water simply by using the pH meter. For the small amount of water (for example one Hundred microlitre to five hundred microlitre), We can take randomly only one sample and Measure the pH of a particular water sample. But in the case of a large amount of collected water (for example one thousand microlitre to five hundred microlitre), we have to Measure the pH of more than one sample; Because we can get accurate results.

   We took two different types of samples with 2 different volumes.

   First sample = 500 microliter & Second sample = 1000 microliter.

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Atmiya University Rajkot

TITLE: Formulation of Melishield Herbal Mosquito Repellent

Mentor Detail: Dr. Chitra Bhattacharya, Assistant Professor

Department of Microbiology, Atmiya University, Rajkot, Gujarat-360005

Mentor Id of IKS: BJS1_M83

Student Detail: Raheen Salim Sheth, B.Sc. Sem. V (Biotechnology), Atmiya University, Rajkot, Gujarat

Abstract:

In the present investigation, the study directed toward the formulation of safe and efficient herbal mosquito repellent that contains essential oils of neem (*Azadirachta indica*), camphor (*Cinnamomum camphora*), coconut (Cocos nucifera) and orange (Citrus sinensis) peel powder by mixing with glue for the binding ability. After the formulation of Melishield mosquito repellent, the arm-in cage method would be tested for larvicidal and mosquito-repellent activity. Each packet will be prepared of 5.0 gm each. The formulated herbal mosquito repellent packet will be exposed to 20-30 larvae and blood-sucking mosquitoes and recorded each minute for five minutes. The analysis would be carried out in a triplicate manner. Indoor and outdoor field trials on mosquito repellent herbal tiny powder sachet with active ingredients would be conducted separately on individual village houses, public toilets schools, etc., and observe mosquito repellency for up to six hours for field trials.

Keywords: Herbal mosquito repellent, cage method, indoor & outdoor field trials.

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PROPOSAL REFERENCE NO. : BT/EF0017/01/22

FACE SHEET

Applicant Type
Individual
Name of Applicant
Sodha ishwarsinh pravinsinh
How do you want to apply?
E-Yuva Fellow
Title of Proposal
Melishield mosquito repellent
Category
Agriculture and allied areas
No of Team Member
3
Preferred EYCs, in the order of preferences
1'st Preference
Atmiya University Rajkot
2'nd Preference
University of Agricultural Sciences, Dharwad
3'rd Preference
Panjab University, Sector 14, Chandigarh

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Rajkot

Atmiya University Rajkot

TEAM MEMBER DETAILS

Team Member Detail 1
First Name
RAHEEN
Last Name
SHETH
Name of Institute/College
ATMIYA UNIVERSITY
Institute Address
YOGIDHAM GURUKUL,KALAWAD ROAD RAJKOT 360005
Semester
4TH
Year
2ND
Subject/Specialization/ Course/Programme Being Pursued
BSC BIOTECHNOLOGY
Gender
Female
Roll Number
049
ICard Upload
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Indian Citizen
Yes
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Email Address
raheensheth@gmail.com
Personal Address
gulabvihar society, kalawad road, rajkot 360005
District
RAJKOT
Aspirational district?
Yes
Mobile Number
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View File

2/6

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Rajkot

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Team Member Detail 2
First Name
ISHWARSINH
Last Name
SODHA
Name of Institute/College
ATMIYA UNIVERSITY
Institute Address
YOGIDHAM GURUKUL KALAWAD ROAD RAJKOT 360005
Semester
2ND
Year
1ST
Subject/Specialization/ Course/Programme Being Pursued
BSC MICROBIOLOGY
Gender
Male
Roll Number
094
ICard Upload
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Indian Citizen
Yes
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Email Address
ishwarsinhsodha21@gmail.com
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BLOCK NO B-7 SRP CAMP JAMNAGAR ROAD GHANTESHWAR RAJKOT-360006
District
RAJKOT
Aspirational district?
Yes
Mobile Number
9727178063
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Team Member Detail 3

3/6

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

First Name
SUZAN
Last Name
BAWANI
Name of Institute/College
M.J. KUNDALIYA
Institute Address
Located inside Rashtriya Shala campus, near Lodhawad chowk, Rajkot 360002
Semester
2ND
Year
1ST
Subject/Specialization/ Course/Programme Being Pursued
BCA
Gender
Female
Roll Number
027
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
bawanisuzan@gmail.com
Personal Address
street no 2 Laxmivadi main road rajkot 360002
District
RAJKOT
Aspirational district?
Yes
Mobile Number
9898602017
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

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Atmiya University
Rajkot

Atmiya University Rajkot

Team Representative

Name of representative
RAHEEN SHETH

MENTOR DETAILS

Title	Dr.
First Name	CHITRA
Last Name	BHATTACHARYA
Gender	Female
Institue Name	ATMIYA UNIVERSITY
Designation	ASSISTANT PROFESSOR
Email	chitra.bhattacharya@atmiyauni.ac.in
Institute Address	YIGIDHAM GURUKUL KALAWAD ROAD ATMIYA UNIVERSITY RAJKOT 360005
District	RAJKOT
Aspirational district	Yes
Landline	
Personal Address	B/44,STREET1, MADHAV PARK UNIVERSITY ROAD,RAJKOT.
Mobile	7999784692
Undertaking by the mentor (as per prescribed format)	View File

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Rajkot

Atmiya University Rajkot

PROPOSAL DETAILS

Aim/Objective of the proposal
1. formulation of herbal mosquito repellent to attain the sustainable d3evelopmental goals SDG3 2. study to check the larvicidal activity 3. to reduce the chemical repellent
Unmet Need/Problem statement
mosquitoes are the major causative agent for diseases such as malaria etc. to reduce this disease and reduce chemical repellent.
Proposed solution
formulation of herbal mosquito repellent via powder form
Hypothesis (Why do you think the solution will work)
mosquito larvae will be reduced the at-least 70-90 by attainment of this herbal repellent
Commercialization Potential and business plan
to reach the local vendors and reduce the mosquito repellent
Work plan (Please upload flow chart or infographics in PDF format)
View File
Identify 4 tangible quarterly milestones
1. formulation of herbal mosquito repellent 2. cost effective 3. powdery form not available in market 4. prototype of the product
Final deliverable at the end of one year
Melishield mosquito repellent - Herbal Product
Any specialized infrastructure/ equipment required to run the project
soxlet, heating mental
Has any of the team member/mentor received funding for same/similar activities as proposed here from any other source?
Yes
If Yes, Provide Details
SSIP state level Student start-up Innovation Policy -Gujarat Govt. File No- Sr. No.-86 total grant received-25963rs
Any additional information that would facilitate better review of the proposal
already preopared the mosquito repellent and tested in the pre4pared chamber 30*30dcm mosquitos were 90 killed by this product

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Rajkot

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PROPOSAL REFERENCE NO. : BT/EF0016/01/22

FACE SHEET

Applicant Type
Individual
Name of Applicant
VARMORA NIDHI BALDEVBHAI
How do you want to apply?
E-Yuva Fellow
Title of Proposal
Use of salt tolerant bacteria as a biofertilizer
Category
Agriculture and allied areas
No of Team Member
4
Preferred EYCs, in the order of preferences
1'st Preference
Atmiya University Rajkot
2'nd Preference
Adamas University, Adamas Knowledge City Barasat-Barrackpore Road, Kolkata
3'rd Preference
Career College, Govindpura, BHEL, Bhopal

1/7

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Atmiya University
Rajkot

Atmiya University Rajkot

TEAM MEMBER DETAILS

Team Member Detail 1
First Name
Urvi
Last Name
Varmora
Name of Institute/College
Shree M & N Virani science college
Institute Address
Kalawad Road, Rajkot
Semester
4
Year
2021-22
Subject/Specialization/ Course/Programme Being Pursued
B.Sc. Microbiology
Gender
Female
Roll Number
20BMB057
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
varmoraurvi@gmail.com
Personal Address
Ranmalpur,Halvad ,Morbi
District
Morbi
Aspirational district?
Yes
Mobile Number
9173163513
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

2/7

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Team Member Detail 2
First Name
Nidhi
Last Name
Varmora
Name of Institute/College
Shree M & N Virani science college
Institute Address
Kalawad Road , Rajkot
Semester
4
Year
2021-22
Subject/Specialization/ Course/Programme Being Pursued
B.Sc. Microbiology
Gender
Female
Roll Number
20BMB056
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
nidhivarmora24@gmail.com
Personal Address
Ranmalpur, Halvad ,Morbi
District
Morbi
Aspirational district?
Yes
Mobile Number
9512096365
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View File

Team Member Detail 3
First Name
Urvi
Last Name
Thadoda
Name of Institute/College
Shree M & N Virani science college

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Rajkot

Atmiya University Rajkot

Institute Address
Kalawad road,Rajkot
Semester
4
Year
2021-22
Subject/Specialization/ Course/Programme Being Pursued
B.Sc. Microbiology
Gender
Female
Roll Number
20BMB052
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
urvithadoda@gmail.com
Personal Address
Ranmalpur,Halvad,Morbi
District
Morbi
Aspirational district?
Yes
Mobile Number
8780135645
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

Team Member Detail 4
First Name
Dhvani
Last Name
Sherashiya
Name of Institute/College
Shree M & N Virani science college
Institute Address
Kalawad road , Rajkot
Semester
4
Year
2021-22
Subject/Specialization/ Course/Programme Being Pursued

Registrar
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Rajkot

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B.Sc. Microbiology
Gender
Female
Roll Number
20BMB049
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
dhvanishershiya@gmail.com
Personal Address
502,keshav palace,ramshetu society,ravapad road,morbi
District
Morbi
Aspirational district?
Yes
Mobile Number
7567412232
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

5/7

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Atmiya University
Rajkot

Atmiya University Rajkot

Team Representative

Name of representative
Urvi Varmora

MENTOR DETAILS

Title	Mr.
First Name	Vivek
Last Name	Pattani
Gender	Male
Institue Name	Atmiya University
Designation	Assistant Professor
Email	vivek.pattani@gmail.com
Institute Address	Atmiya university, Yogidham Gurukul, kalawad road, rajkot.
District	rajkot
Aspirational district	Yes
Landline	
Personal Address	317, Nakshtra 5, sadhuvasvani road. rajkot
Mobile	9408774627
Undertaking by the mentor (as per prescribed format)	View File

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PROPOSAL DETAILS

Aim/Objective of the proposal
To screen for potential plant growth promoting salt tolerant bacteria and use it as potential biofertilizer.
Unmet Need/Problem statement
Salinity is one of the most brutal environmental factors limiting the productivity of crop plants because most of the crop plants are sensitive to salinity caused by high concentrations of salts in the soil, and the area of land affected by it is increasing day by day.
Proposed solution
We uses salt tolerant bacteria PGPB as a halophilic bacteria
Hypothesis (Why do you think the solution will work)
Salt tolerant plant growth promoting bacteria can be used as potential biofertilizer.
Commercialization Potential and business plan
To use bacteria isolates and commercialize it as biofertilizer after analysis
Work plan (Please upload flow chart or infographics in PDF format)
View File
Identify 4 tangible quarterly milestones
1.Screening of potential Plant growth promoting bacteria. 2. Characterization of bacterial isolates for their plant growth promoting activities. 3. Seed trials using selected bacterial isolates 4. Pot trials using bacterial isolates and their identification
Final deliverable at the end of one year
A possible bacterial isolates which can tolerate high salt concentration and can be use as a potential biofertilizer
Any specialized infrastructure/ equipment required to run the project
Facilities for 16srRNA identification and automated analyzer biochemical characterization of bacterial isolates. Soil testing facility.
Has any of the team member/mentor received funding for same/similar activities as proposed here from any other source?
No
Any additional information that would facilitate better review of the proposal
NA

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Rajkot

Atmiya University Rajkot

PROPOSAL REFERENCE NO. : BT/EF0014/01/22

FACE SHEET

Applicant Type
Individual
Name of Applicant
MEHTA HARSH
How do you want to apply?
E-Yuva Fellow
Title of Proposal
Soapy chips
Category
Industrial Biotechnology (Industrial Products and Process)
No of Team Member
5
Preferred EYCs, in the order of preferences
1'st Preference
Atmiya University Rajkot
2'nd Preference
University of Rajasthan,Jawahar Lal Nehru Marg, Rajasthan University Campus, Talvandi
3'rd Preference
Career College, Govindpura, BHEL, Bhopal

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Atmiya University
Rajkot

Atmiya University Rajkot

TEAM MEMBER DETAILS

Team Member Detail 1
First Name
Anjali
Last Name
Tolani
Name of Institute/College
Atmiya college
Institute Address
Atmiya University, Kalawad Road, Rajkot
Semester
4
Year
2022
Subject/Specialization/ Course/Programme Being Pursued
Bsc.biotechnology
Gender
Female
Roll Number
200601054
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
anjalitolani181102@gmail.com
Personal Address
Ghanshyam nagar,railway station road,dwarka
District
Devbhoomi dwarka
Aspirational district?
No
Mobile Number
7698719075
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

Registrar
Atmiya University
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Atmiya University Rajkot

Team Member Detail 2
First Name
KINJAL
Last Name
MODI
Name of Institute/College
ATMIYA UNIVERSITY
Institute Address
Atmiya University, Kalawad Road, Rajkot
Semester
4
Year
2022
Subject/Specialization/ Course/Programme Being Pursued
BSC biotechnology
Gender
Female
Roll Number
200601028
ICard Upload
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Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
kinjalmodi2002@gmail.com
Personal Address
sadhuvasani road behind vegitable oppsite to oarijat society silphan kunj block-1
District
Rajkot
Aspirational district?
No
Mobile Number
9638201455
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

Team Member Detail 3
First Name
Shristi
Last Name
Prasad
Name of Institute/College
Atmiya University

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Institute Address
Atmiya University, Kalawad Road, Rajkot
Semester
2nd
Year
2022
Subject/Specialization/ Course/Programme Being Pursued
Biotechnology
Gender
Female
Roll Number
33
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
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Email Address
srishtirprasad2501@gmail.com
Personal Address
Aadarsh Dream-1,Ambika township, Jivraj park . Rajkot
District
Rajkot
Aspirational district?
Yes
Mobile Number
9054158848
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View File

Team Member Detail 4
First Name
Darshit
Last Name
Bhati
Name of Institute/College
Atmiya University
Institute Address
Atmiya University, Kalawad Road, Rajkot
Semester
4
Year
2022
Subject/Specialization/ Course/Programme Being Pursued

Registrar
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Rajkot

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IMBA
Gender
Male
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200341002
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Yes
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14-365, Ranchhodnagar-2, Navlakhi Road, Morbi
District
Morbi
Aspirational district?
Yes
Mobile Number
6304877001
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Team Member Detail 5
First Name
HARSH
Last Name
MEHTA
Name of Institute/College
ATMIYA UNIVERSITY
Institute Address
Atmiya University, Kalawad Road, Rajkot
Semester
4
Year
2022
Subject/Specialization/ Course/Programme Being Pursued
mechanical department
Gender
Male
Roll Number
211005007
ICard Upload
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5/8

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Indian Citizen
Yes
Upload Proof (Adhaar/any other)
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Email Address
hrmehta@gmail.com
Personal Address
block301 kamal kunj apart near railway station junagadh 362001
District
junagadh
Aspirational district?
No
Mobile Number
6353200812
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View File

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Team Representative

Name of representative
Anjali Tolani

MENTOR DETAILS

Title	Dr.
First Name	Shivani
Last Name	Patel
Gender	Female
Institue Name	Atmiya university
Designation	Professor
Email	shivani.patel@atmiyauni.ac.in
Institute Address	Atmiya University, Kalawad Road, Rajkot
District	Rajkot
Aspirational district	No
Landline	-
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Mobile	9825394037
Undertaking by the mentor (as per prescribed format)	View File

Registrar
Atmiya University
Rajkot

Atmiya University

Rajkot

PROPOSAL DETAILS

Aim/Objective of the proposal
â€¢ To provide society with a sanitation practices. â€¢ To replace chemical containing product with natural herbal product. â€¢ To take care of nature , especially trees ,water and land. â€¢ To make biodegradable product to reduce pollution.
Unmet Need/Problem statement
â€¢ Many a times soaps having big size are not till the end. At last small pieces left are thrown away by al l of us. â€¢ And these soaps contain large amount of chemicals that pollute our environment. â€¢ Many of the soaps are non-biodegradable. â€¢ Many of the fragrances and chemicals like sulphate , paraffin wax present in soaps cause disease and harm our skin. â€¢ Paper soaps are easy to carry but we know we cut many trees to make paper.
Proposed solution
â€¢ We want to come with a product called as soapy chips. â€¢ It would be attractive product for the society. â€¢ It would have different cartoon shapes that would be attracting kids to wash hands. â€¢ INGREDIENTS USED IN PRODUCTS: glycerin soap base , aloevera gel , honey , rose water , vitamin E oil. â€¢ INGREDINTS ACCORDING TO FLOVOURS: rose petals , neem powder , tulsi powder , miltani mitti fullerâ€™s earth , coffee , oats , etc
Hypothesis (Why do you think the solution will work)
â€¢ We would like to make soap of very small size approx. Size of a bead that can be used after washing hands or face one time. â€¢ The product made can be easily carried anywhere. Example- Schools , offices , colleges , picnic spots , hotels , restaurants , etc. â€¢ During Covid pandemic it was very necessary to sanitize or wash hands frequently , but due to it many of us face skin problems due to frequent use of sanitizers. â€¢ Our product would be herbal based product. â€¢ It would be great alternative to chemical containing soaps , as we can be protected from many diseases just by washing our hands properly.
Commercialization Potential and business plan
Travelers, schools, hotels and restaurants are our primary customers. We plan on reaching our customers through local distribution and small intermediaries. The cost for one box containing 15 Soapy Chips is INR 15 and the price is INR 20 approx. business canvas model is included with the work plan
Work plan (Please upload flow chart or infographics in PDF format)
View File
Identify 4 tangible quarterly milestones
1. Formation of prototype. 2. Standardization and authorization through laboratory testing. 3. Packaging of product to be delivered. 4. Marketing and sale of final product.
Final deliverable at the end of one year
All prototypes will be tested and finalized. Standardisation would be approved and the startup would be launched. There will be regular sales at the end of one year.
Any specialized infrastructure/ equipment required to run the project
Stainless Steel Rollers, Mechanical equipment, Conveyer belt, Mould
Has any of the team member/mentor received funding for same/similar activities as proposed here from any other source?
No
Any additional information that would facilitate better review of the proposal

8/8

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

ATMIYA UNIVERSITY
(Established under the Gujarat Private University Act 11, 2018)
Yogidham Gurukul, Kalawad Road, Rajkot - 360005, Gujarat (INDIA)

Ref. No.:
Date: 14/12/2022

To,
The Director,
Gujarat State Biotechnology Mission,
9/11, Udhyog Bhavan,
Sector-11, Gandhinagar-382010

Subject: Financial Assistance to organize National Conference

Sir,

Season's greetings!

Atmiya University is established on April 13, 2018, under the Gujarat Private University Act 11, 2018, Atmiya University emphasizes to train young minds in consonance with the doctrines of higher education and human values.

Department of Microbiology, Faculty of Science, Atmiya University is planning to organize a one day National conference on Emerging Paradigm in Agricultural Microbiology on 11th February, 2023. We would like to obtain financial support for same under the GSBTM Financial Assistant Program.

Pl. find the attached application in prescribed performa along with tentative program schedule. Look forward for your quick and positive response.

With regards,

Organizing Secretary,
National conference on
Emerging Paradigm in
Agricultural Microbiology

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Annexure-1

Application Form for the Financial Assistance for organizing Seminar /Symposia /Workshop/ Training Programme in different areas of Biotechnology

1. DETAILOF ORGANIZATION			
Name of Coordinator(s)	Dr. Abhijeet Joshi		
Designation	Assistant Professor		
Department	Microbiology		
Name of Institute	Atmiya University		
2. CONTACT DETAILS			
Phone Number	+91 281 256 3445		
Mobile Number	+ 91 9423138178		
Email-Id	Abhijeet.joshi@atmiyauni.ac.in		
3.LEGALSTATUSOF INSTITUTE[WITH DETAILSOF REGISTRATION]			
Status of the organizing Body	☐	College/Department [Government]	
	☐	College/Department [Self-Finance]	
	√	Private Institute	
	☐	Government Institute	
	☐	Non-Governmental Organization (NGO)	
	☐	Central Government Institute	
	☐	Other	Specify_____
Affiliation of Institute/University	Atmiya University		
Year of Establishment	2018		

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

4. DETAIL OF THE EVENT			
Title of the Programme proposed		"Emerging Paradigm in Agricultural Microbiology"	
Scope of Programme	√	National	
	☐	International	
	☐	State	
Venue of the Programme			
Type of the Activity Proposed	☐	Seminar	
	√	Conference	
	☐	Symposia	
	☐	Workshop	
	☐	Training Programme	
	☐	Other	Specify_____
Major Area	☐	Plant Biotechnology	
	☐	Animal Biotechnology	
	☐	Industrial Biotechnology	
	☐	Environmental Biotechnology	
	☐	Pharmaceuticals & Healthcare Biotechnology	
	☐	Bioinformatics	
	☐	Rules and Regulations related to Biotechnology	
	√	Other	Specify_Agriculture
Brief of the programme (Pl. limit to 200 words andattach other details inclusive of Prog. Schedule as Appendix):		Refer attached sheet	
Collaborating institutions/Organizations, if any			

5. PROGRAMM SCHEDULE [attach Programme Structure, detail of Speakers and their Topics]	
Event/Activity Duration from	Date of Start of Event: 11/02/2023 Date of Completion: 11/02/2023

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6. TOTAL ESTIMATED EXPENDITURE FOR THE PROGRAMME

HEAD	AMOUNT [InINR]
TA/DA	Rs. 68000/-
Printing, Stationary, Publication of the proceedings, Folders/Kits	Rs. 440000/-
Honorarium	Rs. 12000/-
Chemicals and Consumables	Not Applicable
Food/Refreshments	Rs. 85000/-
Accommodation	Rs. 70000/-
Contingency	Rs. 115000/-
Others[Secretarial Assistance]	Rs. 11000/-
TOTAL	**Rs.801000.00 (Rs. Eight Lacks one thousand Only)**

7. TOTAL ESTIMATED INCOME FOR THE PROGRAMME

TYPEOFTHEAGENCY	NAMEOFTHE AGENCY	TOTALAMOUNT[InINR]
State Government	Gujarat State Biotechnology Mission	Rs. 153000/-
Central Government	SERB	Rs, 3,01,000/-
Private Sector	---	---
Industries	---	Rs. 5000/-
Self/By the Hosting Institute	Sarvoday Kelavani Samaj	Rs. 110000/-
Fees/Registration	Not Applicable	Rs. 100000/-
Other Sources[Specify]	Other funding agencies	Rs. 132000/-
TOTAL		**Rs. 801000.00 (Rs. Eight Lacks one thousand Only)**

8. FINANCIAL ASSISTANCE REQUESTED FROM GSBTM

HEAD	AMOUNT[InINR]
TA/DA	Rs. 30000/-
Printing, Stationary, Publication of the Proceedings, Folders/Kits	Rs. 50000/-
Honorarium	Not Applicable
Chemicals and Consumables	Not Applicable
Food/Refreshments	Rs. 48000/-
Accommodation	Rs. 15000/-
Contingency	Rs. 10000/-
Others[Specify]	Not Applicable
TOTAL	**Rs. Rs. 153000/- (One Lac Fifty three thousands only) (See attached file for description)**

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9. DETAILS OF THE DELEGATES	
Foreign Delegates	Not Applicable
Indian delegates	• **Prof. D.K. Maheshwari**, Department of Botany & Microbiology, Gurukul Kangri University, Haridwar • **Dr. Snehal Bagatharia**, Joint Director, (Research & Development), Gujarat State Biotechnology Mission (GSBTM), Department of Science and Technology, Udyog Bhavan, Block 11, Floor 9, Sector 11, Gandhinagar. • **Dr. Suchi Shrivastava,** Principal Scientist, National Botanical Research Institute, Lucknow, Division of Microbial Technologies, T. N. Khoshoo Block, CSIR-National Botanical Research Institute, Ranapratap Marg, Lucknow, India - 226001 • **Dr. Poonam C. Singh**, Principal Scientist, National Botanical Research Institute, Lucknow, Division of Microbial Technologies, T.N.Khoshoo Block, CSIR-National Botanical Research Institute, Ranapratap Marg, Lucknow, India - 226001
Students	Aprox. 250 (Including faculties, research scholars and PG students)
Others	10 (Industry delegates)
TOTAL	Aprox. 260

10.BANK DETAIL	
Bank Name	HDFC BANK LTD
Account Holder Name	Atmiya University
Account Number	50100376645135
IFSC Code	HDFC0000379
Name & Designation of the official empowered to receive the grant	ATMIYA UNIVERSITY

DECLARATION

Certified that the details furnished above are correct to the best of my knowledge & belief and that the amount of financial assistance if granted, will be utilized for the purpose for which it is granted and within the time prescribed by GSBTM. I also undertake to submit the Utilization Certificate duly executed and shall abide by the rules & other conditions prescribed & revised from time to time.

PLACE: Rajkot **Signature of Coordinator**

DATE: 14/12/2022 **Signature of the Head of the Institute (with seal)**

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Financial Supported description:

8. FINANCIAL ASSISTANCE REQUESTED FROM GSBTM		
HEAD	**AMOUNT[In INR]**	**Description**
TA/DA	Rs. 30000/-	1. TA and DA of 2 speakers
Printing, Stationary, Publication of the Proceedings, Folders/Kits	Rs. 50000/-	1. Abstract book printing
Honorarium	Not Applicable	
Chemicals and Consumables	Not Applicable	
Food/Refreshments	Rs. 48000/-	1. High tea and snacks from GSBTM
Accommodation	Rs. 15000/-	1. Of 2 speakers
Contingency	Rs. 10000/-	1. Account audit
Others[Specify]	Not Applicable	
TOTAL	**Rs. 153000/- (One Lac Fifty three thousands only)**	

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NATIONAL CONFERENCE on

"Emerging Paradigm in Agricultural Microbiology"

Date: 11th February 2023

Time: 9.30 am – 5.30 pm

Program Schedule

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Master of Ceremony-Dr. Hitarth Bhatt & Dr. Abhishikta Basu			
Inaugural Session: Venue Auditorium)			
	IST (Indian Standard Time)		
1	9:30 to 9:35 am	Inauguration	
2	9:35 to 9:40 am	Prayer	
3	9:40 to 9:45 am	The lighting of the Lamp	All the dignitaries and guests
4	9:45 to 09:50 am	Welcome-Address by Convener	**Dr. Rohan Pandya** Head, Department of Microbiology Atmiya University, Rajkot
5	09:50 to 10:00 am	Presidential Address	**P. P. Tyagvallabh Swamiji** President, Atmiya University, Rajkot
6	10:00 to 10:10 am	Special Address by Patron	**Prof. Sheela Ramachandran** Pro-Chancellor, Atmiya University, Rajkot
Technical Sessions–I (10.30 am to 1.30 pm, Auditorium)			
7	10:30 to 11:15 am	Keynote Address	**Prof. D. K. Maheshwari** Former Vice Chancellor, Gurukul Kangri University, Haridwar
8	11:20 to 11:55 am	Special Address	**Dr. Snehal Bagatharia** Joint Director, Gujarat State Biotechnology Mission, Gandhinagar
9	12:00 to 12:40 pm	Special Address	**Dr. Suchi Shrivastava** Principal Scientist, National Botanical Research Institute, Lucknow
10	12:45 to 1:20 pm	Special Address	**Dr. Poonam C. Singh** Principal Scientist, National Botanical Research Institute, Lucknow
Lunch Break (1.20 pm - 2.15 pm, Aashwaad Canteen)			
Technical Sessions – II (2.30 -5.00 pm, Parallel Tracks)			
11	2:15 to 4:30 pm	Poster / Oral Presentation (Auditorium-I)	Poster Presentation(Library Reading Hall)
High Tea (4.30 - 4.50 pm, Outside Central Auditorium)			
Valedictory Ceremony (5.05 - 6.00 pm, Auditorium)			
12	5:00 to 5:15 pm	Prize Distribution Ceremony	Conference Committee Members
13	5:15 to 5:25 pm	Session Ending Remarks	Organizing Secretary
14	5:25 to 5:30 pm	Vote of Thanks	Organizing Secretary
15	5:35 to 6:00 pm	Post Conference Trip Briefing	-

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National Conference on **Emerging Paradigm in Agricultural Microbiology** Organized by department of Microbiology, Atmiya University, Rajkot

Sponsorship details

Date: 10/02/2023

Dear Sir/Madam...

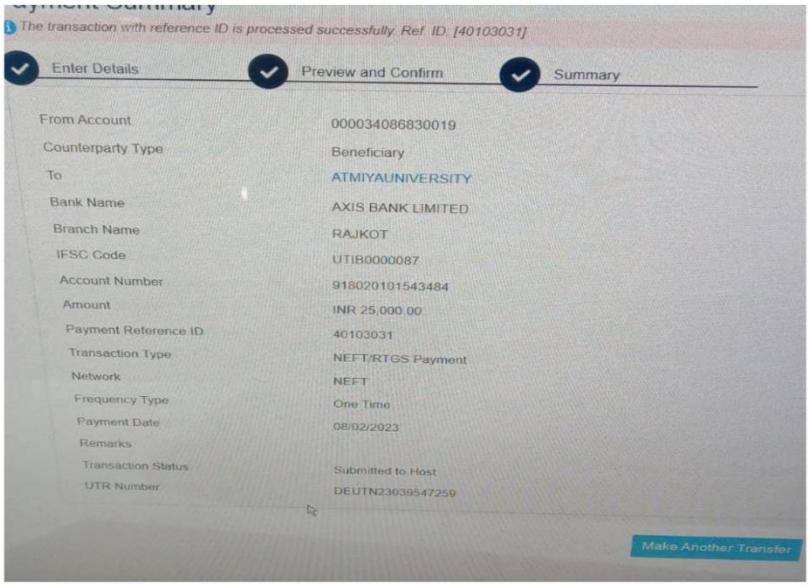
Jay Swaminarayan….

Here I am sending you the sponsorship details of National Conference on Emerging Paradigm in Agricultural Microbiology Organized by department of Microbiology, Atmiya University, Rajkot on 11th Feb 2023.

Sr No	Sponsor details	Amount transferred	Transaction id	Date of transaction
1	Siddhivinayak enterprises	25000/-	DEUTN23039547259	08/02/2023
2	Techno Enterprises Pvt Ltd	30000/-	AIA4FZK12153	08/02/2023

You are requested to kindly acknowledge the receipt.

1. Siddhivinayak enterprises



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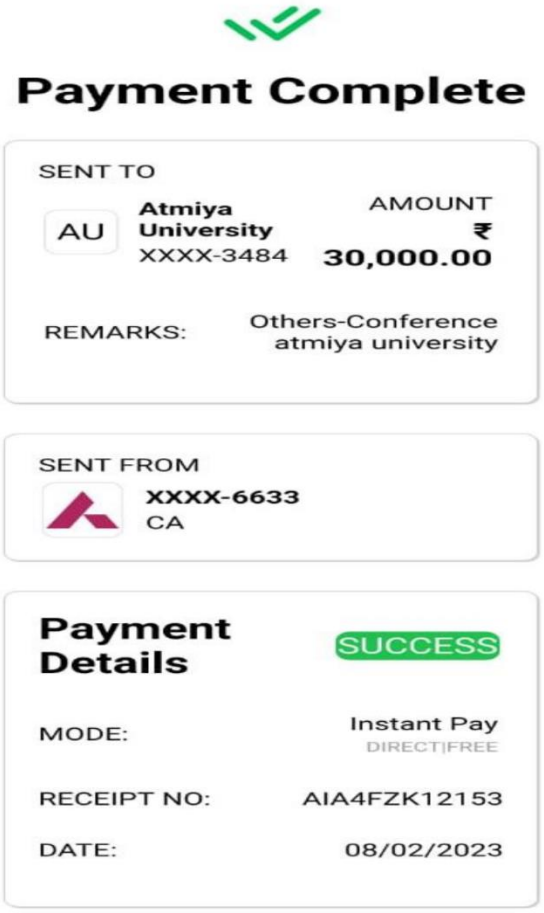
2. **TechnoEnterprises Pvt Ltd**



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Gmail

Abhijeet Joshi <abhijeet.joshi@atmiyauni.ac.in>

Fwd: Logos of Company and principal companies

1 message

Chitra Bhattacharya <chitra.bhattacharya@atmiyauni.ac.in> Fri, Feb 3, 2023 at 5:02 PM
To: AU-Microbiology HOD <micro.hod@atmiyauni.ac.in>, Abhijeet Joshi <abhijeet.joshi@atmiyauni.ac.in>

---------- Forwarded message ---------
From: <darshanmehta@ssvent.com>
Date: Fri, 3 Feb 2023, 16:18
Subject: Logos of Company and principal companies
To: <chitra.bhattacharya@atmiyauni.ac.in>
Cc: Vijay Trivedi <vijay@ssvent.com>, <mukesh.p@ssvent.com>

Dear Chitra,

Please find attached Logos of Shree Siddhivinayak enterprise and our principal companies for your reference.

Thanks & Regards,

Darshan Mehta

SHREE SIDDHIVINAYAK ENTERPRISE

One stop solution for all your lab needs

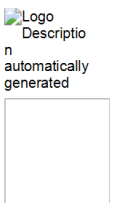
Office : 1006 & 1007, 10th Floor - Shilp Epitome Behind Rajpath Club, Rajpath Rangoli Road, Sindhubhavan Road, Bodakdev - Ahmedabad Pin : 380054 INDIA.

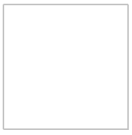
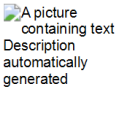
Ank Office : Plot No. 2209/3, Opp.Vansh residancy, Nr.Vision school, GIDC, Ankleshwar – 393002.

Contact : M: 90330 06673

Email: darshanmehta@ssvent.com; infoahd@ssvent.com;

Authorized Distributor for:


32 attachments

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THE INDIAN KNOWLEDGE SYSTEMS DIVISION OF MoE @ AICTE

भारतीयज्ञानसवंर्नधयोजना

COMPETITIVE RESEARCH PROPOSAL PROGRAM – 2022-2023
2022-23 IKS SAMVARDHINI PROPOSAL COVER PAGE

Proposal title: Development of quality biofertilizer using cow dung: Metagenomic **studies of Gir and Kankrej breed**

Lead Researcher (Principal Investigator):
Name: Dr. Rohan Pandya
Email address: rohan.pandya@atmiyauni.ac.in
Phone number: +91 9825473703
Academic rank: Associate Professor & Head of the Department (I/c)
Appointment type: Permanent
Physical work location: Atmiya University, Yogidham Gurukul, Kalawad Road, Rajkot 360005 (Gujarat) India
Academic home department: Microbiology

Co-PI(s):
Name: Dr. Abhijeet Joshi
Email address: abhijeet.joshi@atmiyauni.ac.in
Phone number: +91 9423138178
Academic rank: Assistant Professor
Appointment type: Permanent
Physical work location: Atmiya University, Yogidham Gurukul, Kalawad Road, Rajkot 360005 (Gujarat) India
Academic home department: Microbiology

Cooperator(s)/Collaborator(s): Nil

Project Budget Amount: 1566600.00 (Fifteen Lacks Sixty Six thousand and Six Hundred Only)

I certify that I will lead the project and complete all the tasks outlined in the proposal. I certify that a complete project report will be submitted at the end of the project and the funding support from IKS Division of MoE@AICTE will be acknowledged in any publication resulting from this work.

Rohan Pandya, Ph.D.
Principal Investigator

Date: February 24, 2023

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Overview of the Project:

The project aims to develop biofertilizer formulation(s) by studying the properties of microbes of indigenous cow breeds (Gir and Kankrej) of different ages. It has preliminary objective to isolate and identify the potent isolates for development of consortia which can be further use for the development of novel biofertilzer formulation(s) suitable for the crops such as cotton, groundnut and pulses. The project aimed to link ancient Indian knowledge of cows and sustainable farming by utilizing the cow dung in agricultural application where the data will be validated by modern DNA sequencing based techniques to identify the responsible microbes and their role in plant growth and yield increase. It would also support the local ecosystem, social livelihood as well as helps to protect the indigenous breed of cows and their populations.

Contribution to IKS Mission:

Sasya vidya or Krishi vidya is an ancient literature regarding agricultural practices in India. Sasya means crop which is a basic backbone of human civilization, which is nicely explained by Rsuhi Parashara in his sanhita. कृषि कृषिम ज नजंवेनंकृषि - कृषि पराशर Along with that it is also quoted in Kshetrapati Suktam as ेपति सु मे े पतिना वयंहितेनेजयमासि, in which we pray to field executive for better prosperity and yield. This Sasya vidya is also explains about role of Srushti, animals, crops and soil conditions while in Sukta Ratnavali confirms the presences of microorganisms and its impact over the human health. Here we are trying to communicate both the things together with new dimension as the role of microorganisms with Sasya vidya. With this expect to elaborate the role of microbes within it by suing the modern techniques to reprove our ancient knowledge in front of the world.

Justification:

Cow dung is an excellent source of biofertilizer. Cow dung is a natural fertilizer rich in essential nutrients and minerals. It is a renewable source of nutrients that can be used to enrich soils and improve crop yields. The use of cow dung as a biofertilizer has been practiced for centuries in India and other parts of the world. Cow dung is rich in nitrogen, phosphorus, and potassium, which are essential for plant growth and development. These nutrients are released slowly over time, providing a steady supply of nutrients to the soil and plants. Cow dung also contains microorganisms that help to break down organic matter into nutrients that plants can use. These microorganisms also help to prevent soil compaction and improve soil structure, allowing water and air to reach plant roots.

In addition to providing nutrients to the soil, cow dung also provides a habitat for beneficial insects and microbes. These beneficial organisms help to keep pests and diseases in check, as well as improving the health of the soil. Cow dung also acts as natural mulch, helping to retain moisture in the soil, reducing the need for irrigation. The microbial flora of indigenous cow breed is very least explored for their potential in various applications. The present study aimed to develop biofertilizer formulation(s) based on consortium developed using indigenous cow breeds (Gir and Kankrej) suitable for the higher growth and yield of local crops such as cotton, pulses etc. The work would also support the utilization of non lactating cow and its product for sustainable farming and help to increase the income and social livelihood of the local farmers.

Objectives and timelines*:

1. Identification of potent microbes biofertilizer development based on molecular data
2. Selection and cultivable microbes for consortium development
3. Trials of developed bioferilizer for soil and foliar applications on selected crop plants

* Timeline for the specific objectives is proved in timeline section.

Project Intellectual Merit:

Only for a decade, the use of various chemical fertilizers and pesticides increase the crop yield but currently its adverse effects were emerged with detoriation in the quality of soil and change in the microbiome of soil. In continuation of that, these pesticides were entered in food chain and show its adverse impact over them. The traditional organic farming techniques are suitable and sustainable for an environment; it tooks a longer time and technology to nullify the adverse effect of these components. Besides, the biofertilizers available in market are plant and soil specific which required a lag period to express its plant promotional activity. (Mitt and et al. 2021, Carvajal-Muñoz, and Carmona García, 2012). So a sustainble approach is required to isolate such plant growth promoting microbes from a suitable source. By considering this fact, proposed project targets to isolate plant growth promoting microbes from cow dung of local cow breeds i.e. Gyr and Kankarej which had origin of close proximity in the geographical area for local crops (Kale and et al. 2010) So, the exploration of the gut microbiome of cow by omics and wet laboratory techniques will open a new door in this field. The omics techniques allow to find out novel microorganisms and its potential role in nutrient recycling while wet laboratory technique will help to prepare a consortium for plant growth promotion. The field trial study

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confirms its economical feasibility and sustainability this consortium in environment. (Gupta and et al. 2016)

Project Broader Impacts:

Much of the traditional and current research has focused on the direct application of the cow dung in field, without knowing its actual plant growth promoting mechanism. It is the microbes, present in gut region are responsible for digestion of lignocellulosic material and generation of excretory product (Harma et al., 2022). So a new approach is required to reduce the time period and shows a promising sustainable impact over environment. So, direct identification of microorganisms from such sources like cow dung will help to promote the plant growth rapidly with less time duration. The exploration, identification and consortial application of these microorganisms will reduce the time; contribute in soil metabolism and rapid plant growth with yield. The successful product development may also help to conserve the indigenous cow breeds. The project outcome will also help to increase the social livelihood and increase of the farmer's income by utilizing the potential of non lactating cow for biofertilzer development.

Outputs and Outcomes of the Proposal:

The outputs of this project is as follows

- Identification of cultivable microbes for consortia development
- Successful development of biofertilizer formulation for selected crop plants along with identification of the potent microbes for consortium preparation.
- Utilization of non- lactating indigenous cows breeds for sustainable agriculture, increase of social lively hood and income of cattle and agriculture farmers.

Procedure:

Literature review

↓

Sampling of cow dung samples of different ages (Gir and Kankrej breeds) (Devaki et al., 2013)

↓

Isolation of metagenomic DNA and Cultivation of microbes from samples

↓

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Next generation sequencing of samples and identification of functional diversity (Kim et al., 2017)

↓

Culturing of cultivable microbes along with their biochemical characterization

↓

Consortia preparation

↓

Formulation development and controlled trials (Bello et al., 2019)

↓

Final data analysis and report preparation

Project team expertise:

Dr Rohan Pandya, Principal investigator of this project had 6 years of post Ph.D. experience in molecular techniques. In his research duration he worked on isolation of DNA from various samples like plants, animals, microbes and soil. He handled more than 3500 plant bar coding sequences, 50 animal sequences, 5 whole genome sequences of bacteria and 1 mitochondrial DNA sequence of lion. Along with this Dr Rohan Pandya also got a patent over extraction of plant hormones from sea weeds, while Dr Abhijeet Joshi, Co-Principal investigator of this project had 4.5 years of research exposure in isolation of bacteria from rhizosphere of plants, identification of bacteria by systematic approach and performed plant growth promotion assay in laboratory and in field conditions. Along with this Dr Abhijeet Joshi also completed a certification course on python and can handle computational tools like QIIME2, MetaCys, String, MINITAB etc...

Specific roles of Co-PI(s):

Dr Rohan Pandya, Principal investigator of this project had 6 years of post Ph.D experience in molecular techniques like isolation of DNA from various samples, its purification and analysis of DNA by various computational tools while Dr Abhijeet Joshi, Co-Principal investigator of this project had 4.5 years of research exposure in isolation, identification and to perform plant growth promotion assay. With our expertise in our field the metagenome work will be handled by Dr Rohan Pandya while potent organisms screening will be handled by Dr Abhijeet Joshi. The submission of UTC, scientific communication of research work and regular progression of the project will be taken care by principal investigator while co-princpal investigator will take care about laboratory related work, its applications in controlled trails and to generate raw data for submission.

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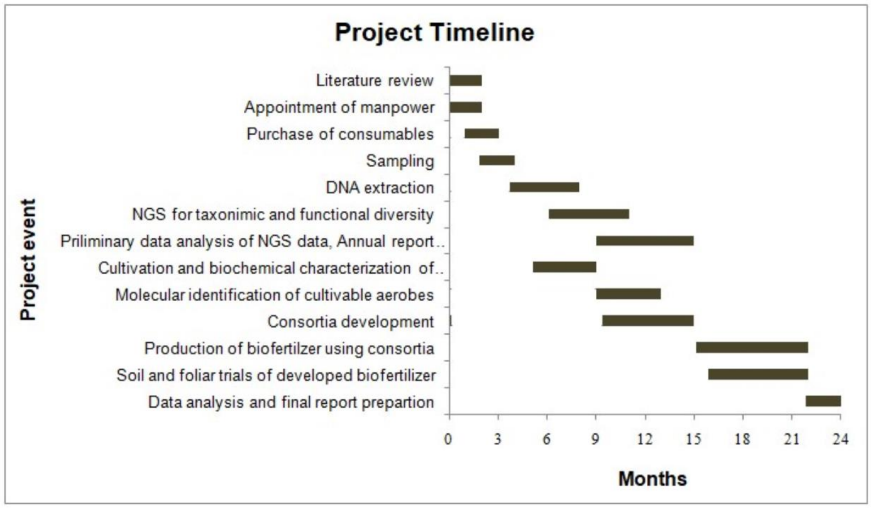
Timelines:



The proposed timeline is define for 2 years (24 months) duration where 1st report will be prepared at completion of 1 year (12 months) followed by final report preparation at end of the project. All three major objectives shall be achieved at the duration of 15, 16 and 23 months of time interval.

References:

- Gupta, K.K., Aneja, K.R. & Rana, D. Current status of cow dung as a bioresource for sustainable development. Bioresour. Bioprocess. 3, 28 (2016). https://doi.org/10.1186/s40643-016-0105-9
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- Carvajal-Muñoz, Juan & Carmona García, Charlie. (2012). Benefits and limitations of biofertilization in agricultural practices. Livestock Research for Rural Development. 24.
- Kale, D. & Rank, D.N. & Joshi, Chaitanya & Yadav, Br & Koringa, Prakash & Thakkar, K. & Tolenkhomba, T. & Solanki, J.. (2010). Genetic diversity among Indian Gir, Deoni and Kankrej cattle breeds based on microsatellite markers. Indian Journal of Biotechnology. 9. 126-130.

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- Harma, P.B., Kumar, P., Tiwari, S., Kumari, S., Singh, M. (2022). The Potential of Cow's Dung in Sustainable Agriculture and Environmental Health. In: Mahajan, S., Varma, A. (eds) Animal Manure. Soil Biology, Vol 64. Springer, Cham. https://doi.org/10.1007/978-3-030-97291-2_6
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- Sasya Veda: (पु रतन्कृ ष्रिा) - Ancient Agricultural Science (2018) Edited by Dr. Shri Krishn Jugnu, Chowkhamba Krishnadas Academy Pub.

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2022-23 IKS Budget

S. N.	Budget Head	Year 1 (Rs.)	Year 2 (Rs.)	Total (Rs.)
1	Salary	216000.00	216000.00	432000.00
2	Supplies	600000.00	40000.00	1000000.00
3	Equipment/Facilities	0.00	0.00	0.00
4	Travel and conferences	10000.00	10000.00	20000.00
5	Contingencies	20000.00	20000.00	40000.00
6	Overhead	42300.00	14300.00	51100.00
	Total (Rs.):	888300.00	300300.00	1566600.00
Fifteen Lacks Sixty Six thousand and Six Hundred Only				

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ATMIYA UNIVERSITY
(Established under the Gujarat Private University Act 11, 2018)
Yogidham Gurukul, Kalawad Road, Rajkot - 360005, Gujarat (INDIA)

Certificate from the Investigator

Project Title: **Development of quality biofertilizer using cow dung: Metagenomic studies of Gir and Kankrej breed**

It is certified that

1. The same project proposal has not been submitted elsewhere for financial support.
2. I undertake that spare time on equipment procured in the project will be made available toother users.
3. I agree to submit ethical clearance certificate from the concerned ethical committee, if theproject involves field trails/experiments/exchange of specimens, human & animal materials etc.
4. The research work proposed in the scheme/project does not in any way duplicate the workalready done or being carried out elsewhere on the subject.
5. I agree to abide by the terms and conditions of IKS Division of MoE @AICTE grant.

Signature of the PI:
Name of the PI: Dr. Rohan Pandya
Affiliation of the PI : Atmiya University
Date: February 24, 2023
Place: Rajkot

Signature of the Co-PI:
Name of the Co-PI: Dr. Abhijeet Joshi
Affiliation of the Co-PI : Atmiya University
Date: February 24, 2023
Place: Rajkot

+91 281 2563445 +91 281 2563952 admin@atmiyauni.ac.in www.atmiyauni.ac.in

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ATMIYA UNIVERSITY
(Established under the Gujarat Private University Act 11, 2018)
Yogidham Gurukul, Kalawad Road, Rajkot - 360005, Gujarat (INDIA)

Endorsement from the Head of the Institution

This is to certify that:

1. Certified that the Institute welcomes participation of **Dr. Rohan Pandya, Associate Professor, Department of Microbiology, Atmiya University** as the **Principal Investigator** and **Dr. Abhijeet Joshi, Assistant Professor, Department of Microbiology, Atmiya University** as the **Co-Investigator** for the project titled **"Development of quality biofertilizer using cow dung: Metagenomic studies of Gir and Kankrej breed"**, and that in the unforeseen event of discontinuance by the Principal Investigator, the Principal Co-Investigator will assume the responsibility of the fruitful completion of the project with due information to IKS Division of MoE @AICTE.
2. The date of project starts from the date on which the Institute receives the grant from Indian Knowledge Systems Division of MoE @ AICTE New Delhi.
3. The investigator will be governed by the rules and regulations of Institute and will be under administrative control of the Institute for the duration of the project.
4. The grant-in-aid by the IKS Division of MoE @AICTE, New Delhi will be used to meet the expenditure on the project and for the period for which the project has been sanctioned as mentioned in the sanction order.
5. No administrative or other liability will be attached to the IKS Division of MoE @AICTE, New Delhi at the end of the project.
6. The Institute will provide basic infrastructure and other required facilities to the investigator for undertaking the research project.
7. The Institute will take into its books all assets created in the above project and its disposal would be at the discretion of the IKS Division of MoE @AICTE, New Delhi.
8. The Institute assumes to undertake the financial and other management responsibilities of the project.

Date: February 24, 2023

Atmiya University Rajkot

Head of the Institution

Director
Research, Innovation & Translation
Atmiya University, Rajkot

+91 281 2563445 +91 281 2563952 admin@atmiyauni.ac.in www.atmiyauni.ac.in

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Gmail

Preetam Joshi <preetam.joshi@atmiyauni.ac.in>

Confirmation for GSBTM FDP @ ICAR-IARI , New Delhi.

1 message

skill vigyan <skillvigyan@gmail.com> Fri, Jan 27, 2023 at 4:56 PM
To: mnbtm3@gujarat.gov.in
Bcc: preetam.joshi@atmiyauni.ac.in

Dear Applicant,

Greetings from GSBTM,

We are pleased to inform you that you are shortlisted for attending the Faculty Development Program on "CRISPR/Cas9 - mediated Genome Editing for Crop Improvement" at ICAR-Indian Agricultural Research Institute, Pusa Campus, New Delhi. Program will commence from **13th February 2023 at 10:00 am onwards.**

Please confirm your registration through the given link below by 2nd February 2022 (12:00 Noon):
https://forms.gle/LfuhHCDPwGxhHzYe9

Training Support :

1. Candidates will be entitled to get second class railway fare (mail/express) both way from the place of his/her normal residence or from the place of undertaking journey (within India) whichever is nearer, by shortest route. The participant will be reimbursed the travel fare on production of journey proof (travel tickets), after successful completion of training.
2. GSBTM will pay your training fees, Accommodation and food expenses directly to the training institute (ICAR-IARI).

Note: If you fail to confirm by the deadline, Participants from the waitlist will be given preference and invited.

Thank you,

Dr.Daxa Sakhiya

Human Resource Development [HRD]
Gujarat State Biotechnology Mission
Dept. of Science & Technology, Govt. of Gujarat
11/9; Udyog Bhavan
Gandhinagar - 328 017
Ph. No. - 079 23252197/67(Dir.)
Fax No. - 079 23252195
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Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Department of Science & Technology
Government of Gujarat

Government of Gujarat

Gujarat state Biotechnology Mission
Department of Science and Technology
Government of Gujarat

Faculty Development Program

GSBTM
TRANSCRIPTING BRIGHTER BIO FUTURE

Nomination Form

Title of FDP: CRISPR/Cas9 - mediated Genome Editing for Crop Improvement

1. Name: **Dr. Preetam Joshi**
2. Age: 40 Years
3. Mobile No.: 9099357381
4. E-mail ID: preetam.joshi@atmiyauni.ac.in
5. Name & address of the institution currently associated with:
   Department of Biotechnology
   Atmiya University, Kalawad Road
   Rajkot 360005
6. Designation: Associate Professor
7. Academic Qualifications: M.Sc., Ph.D
8. Work Experience (Use extra sheet, if needed)

Sr. No.	Name ofthe organization	Period		Position held
		From	To	
1.	Shree M N Virani Science College, Rajkot	19.07.2012	31.12.2018	Assistant Professor
2.	Atmiya University, Rajkot	**01.01.2019**	**08.12.2022**	**Assistant Professor S.G.**
3.	Atmiya University, Rajkot	**09.12.2022**	**Till now**	Associate Professor

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Atmiya University
Rajkot

Atmiya University Rajkot

9. Have you attended any FDP? ~~YES~~ / NO ✓

If YES, please give the details

Sr. No.	Name of the organization conducted FDP	Period (Date)

10. Brief about your area of expertise:

- My doctoral research was focused on evaluation of the genetic fidelity in tissue culture grown micropropagules of Feronia limonia (wood apple, a medicinal plant) using genetic markers. I am walking away with not just knowledge and skills, but a solid network in the plant biotechnology area which will benefit my career long-term.

11. Please narrate briefly how this Programme will benefit you?

- The flavor, shelf-life, and nutritional quality of peanut seeds and its products are reliant on the proportion of three main fatty acids viz., oleic, linoleic and palmitic acid present in its oil. The palmitic acid is reported to increase the risk for multiple life-threatening diseases such as cardio-vascular diseases (CVD) and atrial-fibrillation. I am trying to improve quality of Groundnut oil for high oleic acid by targeting fatty acid desaturase 2 gene family through CRISPR/Cas-9 gene editing technology. For this targeted research I want my self skilled for this novel and latest technology. This FDP will help me a lot in my future ambitious research projects beneficial to Indian farmers particularly targeted to farmers of Saurashtra region of Gujarat where groundnut is main cash crop.

Place: Rajkot

Candidate's Signature

12. Endorsed by : HOD ✓ / Principal / Director

Name: Dr. Nutan Prakash Vishwakarma

Head of Department
Department of Biotechnology
Faculty of Science
Atmiya University
Rajkot

Date: 10/01/2023

Signature with institute stamp

Note:

- To send your nomination form Scan QR code or click link : https://forms.gle/4ZjzUZLYNMuC3Jhh7
- For more information Visit : https://btm.gujarat.gov.in/fdp.htm
- Contact :9925601725
- Email : mnbtm3@gujarat.gov.in

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Rajkot

Atmiya University Rajkot

TENTATIVE TRAINING SCHEDULE

DAY	TIME	CLASS	TOPIC	FACULTY
Day 1 (13.02.2023, Monday)	9:15 am – 10:00 am	INAUGARTION PROGRAMME		
	10:00 am – 11:15 am	Theory	Pre-CRISPR Era: Methods and Technologies For Controlling Gene Expression In Plants	Dr. Pranjal Yadava, Senior Scientist, Plant Physiology, ICAR-IARI
	11:30 am – 12:45 am	**Theory**	**Landmark Events and The Heroes in CRISPR Biology**	**Dr. Anirban Roy, Principal Scientist, Plant Pathology, ICAR-IARI**
	2:00 pm – 2:30pm	PRE-TRAINING EVALUATION		
	2:30 pm – 3:50 pm	Theory	Basic Principal of Guide RNA Designing	Dr. Archana Watts, Scientist, Plant Physiology, ICAR-IARI
	3:45 pm – 5:30 pm	Practical	Hands-on Training on Single-Guide RNA Designing	Dr. Archana Watts, Scientist, Plant Physiology, ICAR-IARI
Day 2 (14.02.2023, Tuesday)	9:15 am – 9:30 am	GROUP FORMATION		
	9:30 am – 10:30 am	**Theory**	**Genome Editing in Crops: Progress and Prospects**	**Dr. Viswanathan Chinnusamy, Joint Director Research, ICAR-IARI**
	10:30 am – 11:30 am	Theory	Structures and Mechanisms of CRISPR–Cas9 based Genome Editing System	Dr. Soham Ray, Scientist, Plant Physiology, ICAR-IARI
	11:45 am – 12:45 am	Theory	**Application of CRISPR-Cas System in Plant Virology**	**Dr. Anirban Roy, Principal Scientist, Plant Pathology, ICAR-IARI**
	2:00 mm-2:30 pm	PRE-PRACTICAL TALK		Dr. Archana Watts, Scientist, Plant Physiology, ICAR-IARI
	2:30 pm – 5:30 pm	Practical	Practical Considerations on Vector Selection and recombinant vector (sgRNA+Cas9 containing Plant expression vector) construction Strategies	
Day 3 (15.02.2023, Wednesday)	9:15 am – 9:30 am	IMPORTANT ANNOUNCEMENTS AND DISCUSSIONS		
	9:30 am – 10:30 am	Theory	CRISPR/Cas Based Genome Editing Modules: Different Horses for Different Courses	Dr. Soham Ray, Scientist, Plant Physiology, ICAR-IARI
	10:30 am – 11:30 am	Theory	Intellectual Property Landscape of Genome Editing and Standard Operating Procedures (SOPs) for regulatory review of Genome Edited Plants	Dr. Pranjal Yadava, Senior Scientist, Plant Physiology, ICAR-IARI
	11:45 am - 12:45 am	Theory	**Improvement of Nutritional Quality in Crop Plants**	**Dr. Naveen C. Bisht, Staff Scientist V, South Campus, Delhi University**
	2:00 mm-2:30 pm	PRE-PRACTICAL TALK		Dr. Soham Ray, Scientist, Plant Physiology, ICAR-IARI
	2:30 pm - 5:30 pm	Practical	Construction of Genome Editing Cassette Through Overlap-Extension PCR and Golden Gate Assembly	
Day 4 (16.02.2023, Thursday	9:15 am – 9:30 am	IMPORTANT ANNOUNCEMENTS AND DISCUSSIONS		
	9:30 am – 10:30 am	**Theory**	**After 30 Years of GM Crop Commercialization, What Can We Learn for the Future of Genome Edited Crops?**	**Prof. Peter Doerner, The University of Edinburgh**
	10:30 am – 11:30 am	**Theory**	**CRISPR Libary Screen in Plants: Potential and Prospects**	**Dr. Sangram K. Lenka, Associate Professor, Gujarat Biotechnology University**
	1145 am – 12:45 am	**Theory**	**Precision Genome Editing Using Base Editors and Prime Editors**	**Dr. Kutubuddin Molla, Scientist ICAR-NRRI**
	2:00 mm – 2:30 pm	PRE-PRACTICAL TALK		**Dr. Kutubuddin Molla, Scientist ICAR-NRRI**
	2:30 pm – 5:00 pm	**Practical**	**Primer Designing and Cloning Strategies for Base Editing and Prime Editing**	
	5:00 pm - 6:00 pm	Exposure visit	Nanaji Deshmukh Plant Phenomics Facility	Dr Madhurima Das, Scientist, Plant Physiology, ICAR-IARI
Day 5 (17.02.2023, Friday)	9:15 am – 9:30 am	IMPORTANT ANNOUNCEMENTS AND DISCUSSIONS		
	9:30 am – 10:30 am	Theory	Analysis of Putative Transformants for the Identification of Genome Editing Events	Dr. Shivani Nagar, Scientist, Plant Physiology, ICAR-IARI
	10:30 am – 12:45 am	Practical	Mutation Detection and Zygosity Analysis in T0/T1 Transgenic Lines through Sanger Sequencing and CAPS Assay	Dr. Shivani Nagar, Scientist, Plant Physiology, ICAR-IARI
	2:00 mm – 3:00 pm	**Theory**	**Regulatory Scenario of Genome Edited Crop in India**	**DR. K. C. Bansal, Secretary, National Academy of Agricultural Sciences, India**
	3:00 pm – 3:30 pm	POST-TRAINING EVALUATION		
	3:30 pm – 5:00 pm	VALEDICTORY PROGRAMME		
Day 6 (18.02.2023, Saturday)	LOCAL TOUR CUM EXPOSURE VISIT			

Break Fast	Morning Tea	Lunch	Evening Tea	Dinner
8:15 am - 9:15 am	11:30 am – 11:45 am	1:00 pm – 2:00 pm	3:45 pm – 4:00 pm	8:00 pm – 9:00 pm

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FDP on CRISPR CAS9
13th to 18th February 2022

Details of Journey and expenses
Name of Participants: Dr. Preetam Joshi
Institute: Atmiya University Rajkot

S.N	Date	From	To	Mode	Amount
(A) Travel Expenses					
From Rajkot to Delhi					
1.	12 Feb 2022	Rajkot	Ahmedabad	Train CC	Rs. 565
2.	12 Feb 2022	Ahmedabad	New Delhi	Train II AC	Rs. 3390
From New Delhi to Rajkot (Return)					
3.	19 Feb 2022	New Delhi	Ahmedabad	Train II AC	Rs. 3210
4.	20 Feb 2022	Ahmedabad	Rajkot	Bus	Rs. 550
				Total (A)	Rs 7715
(B) *Other expenses					
Registration Money					Rs. 5000
Daily Allowances (@Rs. 1500 per day) X 7					Rs. 10500
Hotel Charges (@Rs. 3112 per day) X 7					Rs. 21785
				Total (B)	Rs. 37285
				Grand Total (A+B)	Rs. 45000/-

* Other expenses will be directly transferred by sponsoring agencies to the host institute

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आज़ादी का अमृत महोत्सव

Faculty Development Program on
"CRISPR/Cas9 mediated Genome Editing for Crop Improvement"

Certificate of Participation

This is to certify that **Dr. Preetam Joshi** has successfully completed training in **Faculty Development Program on "CRISPR/Cas9 mediated Genome Editing for Crop Improvement"** organized by Division of Plant Physiology, ICAR-Indian Agricultural Research Institute, New Delhi from 13th-18th February, 2023.

Viswanathan C.
JD (Reasearch) & Course Director

Anupama Singh
JD (Education) & Dean

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Rajkot

Atmiya University Rajkot

PROPOSAL REFERENCE NO. : BT/EF0013/01/22

FACE SHEET

Applicant Type
Individual
Name of Applicant
Arundhatiba Jethwa
How do you want to apply?
E-Yuva Fellow
Title of Proposal
Customised greywater recycling filter
Category
Industrial Biotechnology (Industrial Products and Process)
No of Team Member
5
Preferred EYCs, in the order of preferences
1'st Preference
Atmiya University Rajkot
2'nd Preference
University of Rajasthan,Jawahar Lal Nehru Marg, Rajasthan University Campus, Talvandi
3'rd Preference
Panjab University, Sector 14, Chandigarh

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Rajkot

Atmiya University Rajkot

TEAM MEMBER DETAILS

Team Member Detail 1
First Name
Arundhatiba
Last Name
Jethwa
Name of Institute/College
Atmiya University
Institute Address
Atmiya University, kalavad road, Rajkot
Semester
4
Year
2
Subject/Specialization/ Course/Programme Being Pursued
B.Sc.Biotechnology
Gender
Female
Roll Number
200601017
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
jjethwaarundhatiba@gmail.com
Personal Address
Ganga jamuna apartment, Jamuna 803, Jamnagar hi way, Rajkot, 360006
District
Rajkot
Aspirational district?
Yes
Mobile Number
9485088888
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
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Rajkot

Atmiya University

Rajkot

Team Member Detail 2
First Name
Faizaan
Last Name
Noyda
Name of Institute/College
Atmiya University
Institute Address
Atmiya University, kalavad road, Rajkot
Semester
4
Year
2
Subject/Specialization/ Course/Programme Being Pursued
B.Sc.Biotechnology
Gender
Male
Roll Number
200601032
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View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
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Personal Address
Street 1, Muralidhar Society, Navagam Ghed
District
Jamnagar
Aspirational district?
Yes
Mobile Number
7879941111
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
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Team Member Detail 3
First Name
Harsh
Last Name
Kansagara
Name of Institute/College
Atmiya University

Registrar
Atmiya University
Rajkot

Atmiya University

Rajkot

Institute Address
Atmiya University, kalavd road, Rajkot
Semester
2
Year
1
Subject/Specialization/ Course/Programme Being Pursued
Biotechnology
Gender
Male
Roll Number
210601023
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
harshkansagra49@gmail.com
Personal Address
Vanavad near ram temple, Dwarka 360530
District
Rajkot
Aspirational district?
Yes
Mobile Number
9408308483
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
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Team Member Detail 4
First Name
Soham
Last Name
Gadhvi
Name of Institute/College
Atmiya University
Institute Address
Atmiya University, kalavd road, Rajkot
Semester
2
Year
1
Subject/Specialization/ Course/Programme Being Pursued

Registrar
Atmiya University
Rajkot

Atmiya University

Rajkot

B.Sc.Biotechnology
Gender
Male
Roll Number
210601015
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
sbgadhvi2514@gmail.com
Personal Address
Sonal Krupa, 8 royal bungalow, 11 Patel colony Jamnagar 361008
District
Rajkot
Aspirational district?
Yes
Mobile Number
9512324499
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
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Team Member Detail 5
First Name
Jeet
Last Name
Rajgor
Name of Institute/College
Atmiya University
Institute Address
Atmiya University, kalavd road, Rajkot
Semester
2
Year
1
Subject/Specialization/ Course/Programme Being Pursued
B.sc.Industrial Chemistry
Gender
Male
Roll Number
210702015
ICard Upload
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Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
jeetrajgor@gmail.com
Personal Address
301,Maruti Complex, opp. roopkala beauty parlour, near bajrangwadi circle, Rajkot
District
Rajkot
Aspirational district?
Yes
Mobile Number
7984005263
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
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Rajkot

Atmiya University Rajkot

Team Representative

Name of representative
Faizaan Noyda

MENTOR DETAILS

Title	Dr.
First Name	Ragini
Last Name	Raghav
Gender	Female
Institue Name	Atmiya University
Designation	Assistant Professor
Email	ragini.raghav@atmiyauni.ac.in
Institute Address	Atmiya University, Kalavad road, Rajkot
District	Rajkot
Aspirational district	Yes
Landline	
Personal Address	shiv Ashish, closed street 1, ram park, kalavad rd
Mobile	8076690370
Undertaking by the mentor (as per prescribed format)	View File

7/8

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Rajkot

Atmiya University Rajkot

PROPOSAL DETAILS

Aim/Objective of the proposal
Our proposal aims to decrease freshwater extraction from rivers and aquifers. an alternative for the usage of freshwater for secondary purposes and reduce the demand for clean water and lessen sewage effluent entering watercourses which can lead to ecological beneficiary.
Unmet Need/Problem statement
The annual water consumption on toilet ?ushing will be over 550 million metric tons Residential water consumption approximately makes up 10 of overall water consumption, preceded only by agricultural irrigation and industrial water consumption, which is concerning. there are macro and micro contaminants in the disposed water which can lead to higher levels of biomagnification throughout the food chain.
Proposed solution
In the face of a limited fresh water supply in the future, greywater recycling and reuse has been identi?ed as one of the methods with extremely high potential and is also considered an important strategy in sustainable water management schemes. Greywater recycling and reuse is done by ?ltering and recycling miscellaneous drain water from daily use and using it in secondary water applications. customised greywater recycling could be more effective.
Hypothesis (Why do you think the solution will work)
We here are trying to build a purifier that can separate water from greywater according to the contaminants it consists of, by clipping bioremediation along with filtration technologies we are trying to make water more usable.
Commercialization Potential and business plan
Business commercialisation model of the proposal: Modification as per demand, cost-efficient sustainable material will be used in. order to spike the gross margin and cope with the high profits along with the social cause.
Work plan (Please upload flow chart or infographics in PDF format)
View File
Identify 4 tangible quarterly milestones
1 Research and Development 2 To make water more usable 3 Evaluation & In house Testing and trials 4 On Field trials and prototype finalization
Final deliverable at the end of one year
A Customised Greywater Filtration system with durability and affordability.
Any specialized infrastructure/ equipment required to run the project
NA
Has any of the team member/mentor received funding for same/similar activities as proposed here from any other source?
Yes
If Yes, Provide Details
A team representative named Faizaan Noyda has been sanctioned Rs.19000 only for a project named AYU-WATER Bio-Filter by Atmiya Institute of Technology & Sciences-Rajkot under the SSIP Scheme Student Startup and Innovation Policy in December 2021.
Any additional information that would facilitate better review of the proposal
our proposal is beneficial for both economic as well as social cause it includes Sustainable development goals like 3 Good health, 6 clean water and sanitation, 9 industry, innovation and infrastructure 11 Sustainable cities and communities 12 Responsible consumption and production

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Atmiya University Rajkot

Title:

Exploration, isolation and characterization of indigenous Rhizobacteria from Trigonella foenum –graecum L. (Fenugreek) rhizosperare as PGPR candidates in producing IAA and Gibberellic acid

Abstract

Indian spices are sought after globally due to their exquisite aroma, texture, taste and medicinal values. It is the world's largest exporter of spices about 50% followed by Vietnam and China. According to International organization of standardization, The size of annual global spice market is $15 billion. The spice industry is expected to increase by 5% every year to reach a market size of $23 billion by 2026. India imports $750 million of raw spices every year. India has also become a major processing centre for spices from other countries. Among whole spices country primarily exports pepper, asafetida, bay leaf, cardamom, cloves, cinnamon, fenugreek, chilli, turmeric, cumin, fennel, nutmeg, and Garcinia indica. Trigonella foenum Graecum L. (fenugreek) is a unique herb and one of the Indian spices which uses in medicinal purposes, in food industry and in cosmetic industry. fenugreek is herb and one of the Indian spices which widely used in in food & beverages industry, in cosmetic industry and also used in medical treatment. Fenugreek yield and growth are damaged by Root soil borne disease. The excessive use of chemical fertilizers for a long period of time, facing severe issues like declining productivity, low fertilizer use efficiencies, the disproportion in between addition and removal of nutrients from the soil, and low soil organic carbon. According to Bairva et al., 2012 in recent years, application of chemical fertilizers was increased. Hence it leads to poor nutrient uptake efficiency and low yield of crops. So it become important to find an alternative option for nutrient management in fenugreek. To reduce the use of chemical fertilizers, for enhancement in growth of crops Plant Growth Promoting Rhizobacteria (PGPR) can be used as an alternative. PGPR has the potential to overcome soil contamination, better growth and yield through various direct and indirect mechanisms such as phytohormone productions. The PGPR produced phytohormone production such as indole-3-acetic-acid (IAA) Gibberellins which plays a key role in enhanced plant growth and development. It is possible that IAA producing bacteria can increased root system, colonize plant roots better than other bacteria. IAA levels weaken plant defence mechanism making colonization easier (Etesami, H.et al., 2015). Gibberellins producing

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bacteria controls major aspects of plant growth such as germination, elongation growth and plant development (Schwechheimer C 2012). The aim of study will involved isolation and screened out potent PGPR for their efficacy to produced IAA and gibberellins from the Rhizospheric soil sample from the different crop field of saurashtra.

Keywords: Fenugreek, PGPR, IAA, Gibberellins

References:

G. Devi, "Production technology of fenugreek (Trigonella foenum-graecum L.).," no. March 2020, 2014.

M. Bairva, S. S. Meena, and R. S. Mehta, "Effect of bio-fertilizers and plant growth regulators on growth and yield of fenugreek (Trigonella foenum-graecum L.) Lkkjka ' k," vol. 2, no. January, pp. 28–33, 2012.

Etesami, H., Alikhani, H. A., & Hosseini, H. M. (2015). Indole-3-acetic acid (IAA) production trait, a useful screening to select endophytic and rhizosphere competent bacteria for rice growth promoting agents. MethodsX, 2, 72-78.

Schwechheimer C (2012) Gibberellin signaling in plants – the extended version. Front. Plant Sci. 2:107. doi: 10.3389/fpls.2011.00107

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Gmail

Dr. Govind Vagadiya <govind.vagadiya@atmiyauni.ac.in>

भारतीय ज्ञान संवाहिनी - १ / IKS Internships 2021-22

1 message

Indian Knowledge System of MoE <coiks@aicte-india.org> Tue, Jun 28, 2022 at 3:10 PM
Bcc: govind.vagadiya@atmiyauni.ac.in

Dear Mentor applicant,
Namaste:
Congratulations!! your project has been selected as a potential project for the IKS internships and is posted on the website with your unique mentor code (https://iksindia.org/internship-form.php).

There were a total of 389 applications out of which we selected 249 proposals and rejected 140 applications. The criteria for selection and rejection are the same as specified in the Internship application brochure we had shared with you all earlier and posted on the website.

NEXT STEPS:
1. Encourage potential internship applicants to apply for internship with your unique mentor code.
2. We will send you the list of applicants on 9th July and
2. You must contact the applicants and send us a list of interns you would like to select by 10th July.
3. Based on your decision, we will administratively process the selected interns and inform them by 13th July.
4. The internship will start on 15th July after an online orientation program.

Thanks & Regards,

Team IKS
Indian Knowledge System, AICTE,
Nelson Mandela Marg, Vasant Kunj, New Delhi.
Tel No: 011 29581523,
Email: coiks@aicte-india.org Website: https://iksindia.org/

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Rajkot

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PROPOSAL REFERENCE NO. : BT/EF0008/01/22

FACE SHEET

Applicant Type
Individual
Name of Applicant
Kacha Brijraj Rajeshkumar
How do you want to apply?
E-Yuva Fellow
Title of Proposal
Ensuring sustainable enhancement in quantity and quality of crops by implementing concepts of Indian agricultural philosophy using modern technologies based on Internet Of Things and artificial intelligence.
Category
Agriculture and allied areas
No of Team Member
4
Preferred EYCs, in the order of preferences
1'st Preference
Atmiya University Rajkot
2'nd Preference
Adamas University, Adamas Knowledge City Barasat-Barrackpore Road, Kolkata
3'rd Preference
Career College, Govindpura, BHEL, Bhopal

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Rajkot

Atmiya University Rajkot

TEAM MEMBER DETAILS

Team Member Detail 1
First Name
Brijraj
Last Name
Kacha
Name of Institute/College
Atmiya University
Institute Address
Atmiya University, Yogidham Gurukul, Kalawad Road, Rajkot - 360005.
Semester
2nd
Year
1st
Subject/Specialization/ Course/Programme Being Pursued
B.Tech. Computer Engineering
Gender
Male
Roll Number
210002051
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
brkacha553@gmail.com
Personal Address
85/86,Street No. 5, Sai Baba Park,B/H Mahatma Gandhi School, Nana Mauva Road, Rajkot.
District
Rajkot
Aspirational district?
No
Mobile Number
8320380483
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
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Rajkot

Team Member Detail 2
First Name
Priyanka
Last Name
Dobariya
Name of Institute/College
Atmiya University
Institute Address
Atmiya University, Yogidham Gurukul, Kalawad Road, Rajkot - 360005.
Semester
2nd
Year
1st
Subject/Specialization/ Course/Programme Being Pursued
B.Tech. Computer Engineering
Gender
Female
Roll Number
210002031
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
priyankadobariya2003@gmail.com
Personal Address
Bramani Krupa, Dipati Nagar 180 Feet Main Road,B/H Hudko Police Choki, Rajkot-360002.
District
Rajkot
Aspirational district?
No
Mobile Number
8469490493
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

Team Member Detail 3
First Name
Rajkumar
Last Name
Pipariya
Name of Institute/College
Atmiya University

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Institute Address
Atmiya University, Yogidham Gurukul, Kalawad Road, Rajkot - 360005.
Semester
4th
Year
2nd
Subject/Specialization/ Course/Programme Being Pursued
B.Sc. BioTechnology
Gender
Male
Roll Number
200601038
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
rajpipariya66@gmail.com
Personal Address
Khodapipar
District
Rajkot
Aspirational district?
No
Mobile Number
7990904435
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

Team Member Detail 4
First Name
Rakshit
Last Name
Rathod
Name of Institute/College
Atmiya University
Institute Address
Atmiya University, Yogidham Gurukul, Kalawad Road, Rajkot - 360005.
Semester
2nd
Year
1st
Subject/Specialization/ Course/Programme Being Pursued

Registrar
Atmiya University
Rajkot

Atmiya University

Rajkot

B.Tech. Mechanical
Gender
Male
Roll Number
210005005
ICard Upload
View File
Indian Citizen
Yes
Upload Proof (Adhaar/any other)
View File
Email Address
rakshithrathod11603@gmail.com
Personal Address
Safal Gold, A-Wing, 103, Behind Mota Mava, Amarnath Society, Kalawad Road, City: Rajkot, 360005.
District
Rajkot
Aspirational district?
No
Mobile Number
9408450162
Authorization Letter provided by the E-Cell of College/Institute (as per prescribed format)
View File

Registrar
Atmiya University
Rajkot

Atmiya University Rajkot

Team Representative

Name of representative
Brijraj Kacha

MENTOR DETAILS

Title	Dr.
First Name	Ashish
Last Name	Kothari
Gender	Male
Institue Name	Atmiya University
Designation	Professor, E&C Engg.
Email	dy.registrar@atmiyauni.ac.in
Institute Address	Atmiya University, Yogidham Gurukul, Kalawad Road, Rajkot - 360005.
District	Rajkot
Aspirational district	No
Landline	0281-2365445
Personal Address	Swagatam, 1-Dwarkadhish Society,Rajkot-4.
Mobile	9898374961
Undertaking by the mentor (as per prescribed format)	View File

6/8

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PROPOSAL DETAILS

Aim/Objective of the proposal
â€¢Smart temperature & humidity and soil Nutrition and soil fertility monitoring & controlling sys. â€¢Sustainable energy for powering up sys. â€¢Smart irrigation sys. â€¢Optimum condition for every crops monitoring system using AI & IOT. â€¢Optimum usage of water. â€¢ Achieving SDG-3,7,8,9,13,17
Unmet Need/Problem statement
a. Manual measurement of temperature and humidity of the surrounding of agricultural area cannot be accurate. Temperature can only be predicted and based on that the switching of fogging machine is done which is inefficient way of maintaining the temperature and humidity of the surrounding. Also it requires the presence of human resources at all time. b. Unavailability of soil Moisture and nutrition measurement. c. Manual and inefficient water distribution system. d. Unavailability of continuous AC power and uneven distribution of the same. e. Affecting environmental sustainability. f. Harvesting and cultivation of crops on premature time.
Proposed solution
a. IOT based monitoring and controlling system using smart temperature and humidity sensor that monitors the values of temperature and humidity of the surrounding and controls the switching of the fogging machine at the level suitable for the growth of the crop. b. Smart irrigation system with monitoring the soil moisture and nutrients and controlling the type, amount and flow of water according to the need of the soil. c. IOT based water distribution system with automatic and need based opening and closing of water supply to a particular part of the agricultural area can be developed. d. Source of DC power is naturally available hence can be collected by using solar panels and used for powering up the system and charging batteries which in turn can be used in the absence of solar energy. e. Sustainable environment is being maintained by applying concepts of Indian philosophical agricultural system and implementation of smart system using modern technological tools. f. IOT based harvesting and cultivation of crops on perfect time by applying optimum monitoring system on crops.
Hypothesis (Why do you think the solution will work)
â€¢ The identified problems and proposed solutions based on automation using concepts of IOT and artificial intelligence will definitely enhance the quality and quantity of the crops, through continues cmonitoring various environmental and soil conditions with the help of sophisticated system which includes microcontroller, sensors and actuators.
Commercialization Potential and business plan
Key partner,Key activities,Value Propositions,Customer relationship,Customer segments,Cost structure,Revenue streams, Key resources, Channels The elaborated Business plan is available at this link: https://bit.ly/BIRAC_Agriculture_Business_Plan
Work plan (Please upload flow chart or infographics in PDF format)
View File
Identify 4 tangible quarterly milestones
a. Smart switching of fogging machine and controlling temperature & humidity. b. Generation and usage of clean energy system through Solar panels, batteries and other Components. c. Smart irrigation system based on soil moisture & Nutrients analysis. d. Crop monitoring using Artificial intelligence
Final deliverable at the end of one year

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Atmiya University, Rajkot-Gujarat-India

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â€¢Prototype of smart agricultural system based on Indian philosophy and Internet Of Things.
Any specialized infrastructure/ equipment required to run the project
â€¢The prototype development will require no special infrastructure or equipment.
Has any of the team member/mentor received funding for same/similar activities as proposed here from any other source?
No
Any additional information that would facilitate better review of the proposal
Two of the team members are from farming background. University promotes agricultural innovation and hence already arranged many expert talks & workshops on the theme of natural agriculture, organic agriculture and cow based agriculture. Above two reasons will help carrying out the proposed system.

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Exploring 3D printing technology for the development of nanomiceller formulation and efficacy testing in 3D tumorospheres of colon cancer

Reference No. : 492022000641
Saved By : Dr. Rajeshri Dineshbhai Patel
Saved Date : 28-Jan-2022

Exploring 3D printing technology for the development of nanomiceller formulation and efficacy testing in 3D tumorospheres of colon cancer

Research Plan - Objectives and timeline

1) Learning theory, operation, screw design of hot melt extrusion (HME), Material characteristics, 3D design software and 3D printing - 1 month
2) Preparation and characterization of Sorafenib (Anticancer drug) loaded polymeric filament using hot melt extrusion – 1 month
3) Preparation of 3D printed tablet of different printing pattern, dimension and dose, optimization for drug release – 2 months
4) Anticancer efficacy evaluation of formulation in colon cancer 3D tumor spheroid (HT-29, Human colorectal cancer cell line) – 2 months

1.1. Methodology

➢ A pH-dependent polymer, a graft copolymer (which can form an in-situ nanosystem) with 5, 10, 15 %w/w anticancer drug (Sorafenib) will be blended using Turbula® mixer (Willy A. Bachofen, Switzerland). An 11 mm parallel twin screw extruder (Process 11, Thermo Scientific, Waltham, MA) will be used for hot melt extrusion (HME). For optimum mixing and shear, the screw design will be configured to have 3 kneading zones having forward kneading elements distanced equally with a series of conveying elements. Feed rate and rpm for extrusion will be determined based on physicochemical properties viz. flow, melt viscosity, glass transition (Tg) of the blend, etc. An extrusion die of 1.55 mm will be used to extrude/obtain 3D-printable filaments. A conveyor belt will be used to collect the filaments and clear resealable bags will be used to store the filaments. Solid state characterization of the formulations will be performed using differential scanning calorimetry and x-ray powder diffraction.

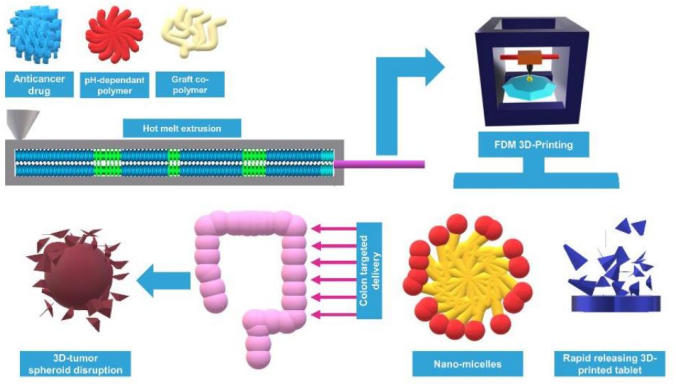

Figure 1. Schematic representation for development of colon-targeted in situ nano-micelle forming 3D printed dose customizable tablets

➢ Sorafenib loaded filament prepared using HME will be used as feed material for 3D printer. For 3D printing, a single nozzle fused deposition modelling 3D printer will be used. A 3D design will be created using TinkerCad and the file will be exported in .stl format. Printing parameters will be optimized to achieve a uniform layer-by-layer deposition of molten material from a preheated nozzle. Printlets will be characterized for % assay and weight variation. Printlets of different printing pattern and dimension will be prepared to achieve optimized printlet with desired solubility and dissolution. *In vitro* dissolution studies will be carried out in biorelevant media viz. fasted and fed state gastric fluid (FassGF and FeSSGF), and fasted and fed state intestinal fluid extraction (FaSSIF and FeSSIF) and FeSSCoF is a biorelevant dissolution medium that simulates human fed state colonic fluid.

➢ For anticancer efficacy of formulation, multicellular 3D spheroid of HT29 cells will be prepared by seeding 2500 cells/well in ultra-low attachment 96 well plate. Once spheroids developed rigid circumference, they will be treated with different concentration of drug in DMSO and formulation for 8 days. Simultaneously, the growth of spheroids will be evaluated every alternate day based on the change in diameter and surface area using Evos imaging system.

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Justification of research plan proposed. *(Maximum 1 page)*

The proposed project is well-defined to provide comprehensive research exposure to visiting scholar – Dr. Rajeshri Patel. Dr. Ketan Patel and Dr. Rajeshri Patel had discussed several ideas for integrating 3D technology with cancer nanomedicine and 3D tumorspheroid cell culture.

Colon cancer (CC) is the one of cancer has been extensively researched and therefore can be treated well if diagnosed on time. In fact, cancer of the colon is considered to be the third most common cancer diagnosed in both men and women. Until now, CC used to be a disease that affects people after the age 50, but in the last decade there has been a sharp increase in the number of cases among the younger population. Due to poor lifestyle habits among youngsters it is quite likely to diagnose under the age of 40 years. The prevalence of CC is lower in India than in western countries, however the mortality rates in India much higher as compare to western countries due to limited resources and inadequate health infrastructure.

Customized treatment has been recently emerged in the era of medical sciences for satisfying individual needs, characteristics, and preferences of each patient. Nevertheless, personalized dosage is extremely challenging because of the availability of limited strengths of a dosage forms in market. Currently, 3D printing technology has set the platform for patient-tailored dosage form where fabrication of dosage form can be carried out in desired dose, shape and size, which is difficult to achieve using traditional method. Now a day, the research utilizing fused deposition modeling (FDM) based 3D printing technology has gained attention to design oral dosage forms as per the individual needs. Due to this, 3D printing can prove to be a perfect technique for individualized therapy by formulating a robust nanomedicine formulation.

Cell culture technology has become a focus of research in tumor cell biology, using a variety of methods and materials to mimic the *in vivo* microenvironment of cultured tumor cells *ex vivo*. These 3D tumor cells have demonstrated numerous different characteristics compared with traditional 2D culture. 3D cell culture provides a useful platform for further identifying the biological characteristics of tumor cells, particularly in the drug sensitivity area of the key points of translational medicine. It promises to be a bridge between traditional 2D culture and animal experiments, and is of great importance for further research in the field of tumor biology.

The international research training will definitely explore 3D printing technology and nanomedicine for the development of a tailored-made formulation for the treatment of colon cancer. During this tenure, I would be able to complete a well-defined project on the formulation of 3D printed tablet of nanomicelle forming polymeric material using hot melt extrusion method. This work will be extended the characterization of the formulation and test it in multicellular 3D spheroid of colon cancer. This kind of multicellular 3D spheroid study will be less explored currently in India and it would be uplifted me with this research activity. Dr. Patel's work is concerned with conducting and promoting innovative pharmaceutical research to study and solve the major health problems in the world, especially various cancers. Along with research techniques, there will be a exposure to grant writing, research logistics, and mentoring skill to make me an independent investigator in the future. This training will provide good collaboration with foreign institute and it will be benefited mutually for the growth of the country.

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Qualifications Details (from Bachelor degree onwards)

Ph.D. , Pharmaceutics (2021)

Department of Pharmaceutical Sciences, Saurashtra University, Rajkot Gujarat, India.
Class/Division :

M. Pharma , Quality Assurance (2012)

Saurashtra University, Rajkot, Gujarat, India
Class/Division :
Marks : 8.52 CGPA
University 1st rank in Master in Pharmacy(GOLD MEDALIST)

B. Pharma , Pharmacy (2007)

Sardar Patel University, Vidhyanagar, Gujarat, India
Class/Division : First
Marks : 64.90 Percentage

Details of National / International Fellowship(s) / training(s)

1. comprehensive online intellectual property rights (IPR) [06 Jul, 2020 to 14 Sep, 2020] **2 Month(s) 9 Day(s)**

Saurashtra University, Rajkot
India
Mentor Name : Na
Source of Funding : Gujarat Student Startup and Innovation Hub (i-HUB)

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2. DST-INSPIRE Fellow (SRF) [24 Jun, 2016 to 28 Feb, 2019] **2 Year(s) 8 Month(s) 7 Day(s)**

Saurashtra University, Rajkot, Gujarat, India
India
Mentor Name : Dr. Mihir Raval
Source of Funding : Department of Science and Technology, New Delhi

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3. DST-INSPIRE Fellowship (Junior Research Fellow) [01 Mar, 2014 to 23 Jun, 2016] **2 Year(s) 3 Month (s) 23 Day(s)**

Saurashtra University, Rajkot, Gujarat, India
India
Mentor Name : Dr. Mihir Raval
Source of Funding : Department of Science and Technology, New Delhi

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Details of Short/Long term International visits (if any)

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Atmiya University
Rajkot

Atmiya University Rajkot

Details of employment/position

1. **Assistant Professor** [18 Aug, 2021 to 03 Feb, 2022] **5 Month(s) 17 Day(s)**
   Permenant
   School of Pharmaceutical Sciences, Atmiya University, Rajkot, Gujarat
   Nature of work:
   Academic and administrative duties

2. **Assistant Professor** [20 Jun, 2019 to 17 Aug, 2021] **2 Year(s) 1 Month(s) 28 Day(s)**
   Contractual based
   Department of Pharmaceutical Sciences, Saurashtra University, Rajkot
   Nature of work:
   Administrative and academic duties

3. **Ph.D scholar** [01 Mar, 2014 to 01 Mar, 2019] **5 Year(s) 1 Day(s)**
   Research Fellow
   Department of Pharmaceutical Sciences, Saurashtra University, Rajkot
   Nature of work:
   Research activity

4. **Assistant Professor** [11 May, 2012 to 28 Feb, 2014] **1 Year(s) 9 Month(s) 21 Day(s)**
   Permanent
   S.S. Institute of Pharmaceutical Education & Research, Rajkot, Gujarat, India
   Nature of work:
   Education purpose, teaching to B.Pharm students

Awards/Honours

1. **Co-coordinator in the two days refresher course for registered pharmacists (2019)**
   Organized by Department of Pharmaceutical Sciences, Saurashtra University, Rajkot

2. **First prize in poster presentation (2018)**
   in International conference, Nirma University, Ahmedabad, Gujarat

3. **DST-INSPIRE Fellowship as a Senior Research Fellow (2016)**

4. **First prize in poster presentation in International conference (2014)**
   Nirma University, Ahmedabad, Gujarat

5. **DST-INSPIRE Fellowship as a Junior Research Fellow (2014)**

6. **First rank holder in M.Pharm (2012)**

7. **GPAT (2010)**
   Qualify the examination from AICTE

List of all peer reviewed journal publications

1. Tamoxifen: An Investigative Review For Nano Dosage Forms And Hyphenated Techniques (2021)

Rajeshri Dineshbhai Patel*, Yamini Anilbhai Bhalani , Dhruti Sanjaybhai Sudani , Lipsa Ashvinbai Vachhani

Journal Name :	International journal of pharmaceutical investigation
Journal Volume :	11
Journal Issue :	4
Start & End Page :	1 to 6
Corresponding Author	Yes

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2. Application of a Validated RP-HPLC Method in Solubility and Dissolution Testing for Simultaneous Estimation of Diacerein and its Active Metabolite Rhein in Presence of Coformers in the Eutectic Tablet (2021)

Rajeshri D Patel, Mihir K Raval, Trupesh M Pethani

Journal Name :	JOURNAL OF CHROMATOGRAPHIC SCIENCE
Journal Volume :	59
Journal Issue :	8
Start & End Page :	697 to 705
Corresponding Author	Yes

---

3. Formulation of Diacerein Cocrystal using -Resorcylic acid for Improvement of Physicomechanical and Biopharmaceutical Properties. Organic Process Research & Development (2020)

Rajeshri D Patel, Mihir K Raval

Journal Name :	ORGANIC PROCESS RESEARCH & DEVELOPMENT
Journal Volume :	25
Journal Issue :	3
Start & End Page :	384 to 394
Corresponding Author	Yes

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4. Influence of eutectic mixture as a multi-component system in the improvement of physicomechanical and pharmacokinetic properties of diacerein (2020)

Rajeshri D Patel, Mihir K Raval, Trupesh M Pethani, Navin R Sheth

Journal Name :	ADVANCED POWDER TECHNOLOGY
Journal Volume :	31
Journal Issue :	4
Start & End Page :	1441 to 1456
Corresponding Author	No

---

5. Formation of Diacereinfumaric acid eutectic as a multi-component system for the functionality enhancement (2020)

RD Patel, MK Raval, NR Sheth

Journal Name :	JOURNAL OF DRUG DELIVERY SCIENCE AND TECHNOLOGY
Journal Volume :	58
Journal Issue :	
Start & End Page :	101562 to 101562
Corresponding Author	No

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Rajkot

6. Functionality improvement of Nimesulide by eutectic formation with nicotinamide: Exploration using temperature-composition phase diagram (2019)

RD Patel, MK Raval, AA Bagathariya, NR Sheth

Journal Name :	ADVANCED POWDER TECHNOLOGY
Journal Volume :	30
Journal Issue :	5
Start & End Page :	961 to 973
Corresponding Author	No

---

7. UV-Spectrophotometric Simultaneous Determination of Ibuprofen and Famotidine in Combined Tablet Dosage Form (2017)

Patel Rajeshri Dineshbhai, Raval Mihir Kishorchandra, Shukla Riddhi Hiteshbhai, Buch Prakruti Rajeshbhai, Sharma Tejas Prakashbhai, Gadhiya Dolly Tulsibhai

Journal Name :	World Journal of pharmaceutical and life sciences
Journal Volume :	3
Journal Issue :	1
Start & End Page :	505 to 515
Corresponding Author	No

Details of the patent filed, granted or commercialized

1. A Crystallo Co- Agglomerate of Praziquantel and Process or Preparing the Same

Patent Status :	Filed
Country :	India
Name of Inventor(s)	Rajeshri Patel, Sejal Chauhan, Mihir Raval
Patent Number :	IN 202121031020
Description :	
Date of Filing	21 Oct, 2021

Details of the Other Projects Submitted / Implemented

Details of the International Research Collaboration in past

Registrar
Atmiya University
Rajkot

Ref No.: 49202200064 | Page 8 of 24

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BIO-DATA

1. Name and full correspondence address
   Dr. Rajeshri Dineshbhai Patel
   Assistant Professor,
   School of Pharmaceutical Sciences,
   Atmiya University,
   Rajkot-360005, Gujarat, India
2. Email(s) and contact number(s)
   rajeshripatel.2504@gmail.com and 09427744566
3. Institution
   Atmiya University, Rajkot-360005, Gujarat, India
4. Date of Birth
   25th April, 1986
5. Gender (M/F/T)
   Female
6. Category Gen/SC/ST/OBC
   Gen
7. Whether differently abled (Yes/No)
   No
8. Academic Qualification (Undergraduate Onwards)

	Degree	Year	Subject	University/Institution	% of marks
1.	B.Pharm	2007	Pharmacy	Sardar Patel University, Vidhyanagar, Gujarat, India	64.90
2.	M.Pharm	2012	Quality Assurance	Saurashtra University, Rajkot, Gujarat, India	8.52*/73.89 %
3.	Ph.D.	2021	Pharmaceutics	Saurashtra University, Rajkot, Gujarat, Indi	Degree awarded

***University 1st rank** in Master in Pharmacy**(GOLD MEDALIST).**
Note: **Qualified GPAT 2010 Examination**.

9. Ph.D thesis title, Guide's Name, Institute/Organization/University, Year of Award.
   Ph.D thesis Title: Improvement of Physicochemical and Pharmacokinetic Properties of Active Pharmaceutical Ingredient using Crystal Engineering Approaches.
   Guide's name: Dr. Mihir K. Raval
   Institute: Department of Pharmaceutical Sciences, Saurashtra University, Rajkot Gujarat, India.
   Year of award: 2021

10. Work experience (in chronological order).

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Sr.No.	Position sheld	Name of the Institute	From	To	Pay Scale
1.	Assistant Professor	S.S. Institute of Pharmaceutical Education & Research, Rajkot, Gujarat, India	11.05.2012	28.02.2014	8.000/--275-13.500
2.	DST-INSPIRE Fellow (JRF)	Department of Pharmaceutical Sciences, Saurashtra University, Rajkot, Gujarat, India	01.03.2014	23.06.2016	25,000 + HRA (20%)
3.	DST-INSPIRE Fellow (SRF)	Department of Pharmaceutical Sciences, Saurashtra University, Rajkot, Gujarat, India	24.06.2016	28.02.2019	28,000 + HRA (20%)
4.	Assistant Professor (11 month contractual base)	Department of Pharmaceutical Sciences, Saurashtra University, Rajkot, Gujarat, India	20.06.2019	17.08.2021	25,000
5.	Assistant Professor	School of Pharmaceutical Sciences, Atmiya University, Rajkot, Gujarat, India	18.08.2021	Till date	15,600-39,100 (Gross salary: 34, 740/-)

11. Professional Recognition/ Award/ Prize/ Certificate, Fellowship received by the applicant.

Sr. No	Name of Award	Awarding Agency	Year
1.	GPAT examination	AICTE, New Delhi	2012
2.	First Rank holder in M.Pharm	Saurashtra University, Rajkot, Gujarat	2014
3.	First prize in poster presentation in International conference	Nirma University, Ahmedabad, Gujarat	2014
4.	DST-INSPIRE Fellow (Junior Research Fellow)	Department of Pharmaceutical Sciences, Saurashtra University, Rajkot	2014

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5.	DST-INSPIRE Fellow (Senior Research Fellow)	Department of Pharmaceutical Sciences, Saurashtra University, Rajkot	2016
6.	First prize in poster presentation in International conference	Nirma University, Ahmedabad, Gujarat	2018
7.	Co-coordinator in the two days refresher course for registered pharmacists	Department of Pharmaceutical Sciences, Saurashtra University, Rajkot	2019
8.	Successfully completed online IPR course on comprehensive online intellectual property rights (IPR)	Online mode in Department of Pharmaceutical Sciences, Saurashtra University, Rajkot	2020

12. Publications *(List of papers published in SCI Journals, in year wise descending order).*

Sr. No	Author(s)	Title	Name of Journal	Volume	Page	Year
1.	Rajeshri D Patel, Mihir K Raval, Trupesh M Pethani	Application of a Validated RP-HPLC Method in Solubility and Dissolution Testing for Simultaneous Estimation of Diacerein and its Active Metabolite Rhein in Presence of Coformers in the Eutectic Tablet Formulation	Journal of Chromatographic Science	59 (8)	697-705	2021
2.	Rajeshri D Patel, Mihir K Raval	Formulation of Diacerein Cocrystal using β-Resorcylic acid for Improvement of Physicomechanical and Biopharmaceutical Properties.	Organic Process Research & Development	25 (3)	384-394	2020
3.	RD Patel, MK Raval, NR Sheth	Formation of Diacerein–fumaric acid eutectic as a multi-component system for the functionality enhancement.	Journal of Drug Delivery Science and Technology	58	101562	2020
4.	Rajeshri D Patel, Mihir K Raval, Trupesh M Pethani, Navin R Sheth	Influence of eutectic mixture as a multi-component system in the improvement of physicomechanical and pharmacokinetic properties of diacerein.	Advanced Powder Technology	31 (4)	1441-1456	2020
5.	RD Patel, MK Raval, AA Bagathariya, NR Sheth,	Functionality improvement of Nimesulide by eutectic formation with nicotinamide: Exploration using temperature-composition phase diagram.	Advanced Powder Technology,	30 (5)	961-973	2019
6.	Rajeshri Patel, Rupal Tanna, Kashyap Thumar	HPTLC Method for Simultaneous Estimat of Ibuprofen and Famotidine from Tabl Dosage Form.	Inventi Rapid – Pharm Analysis & Quality	3,	1-6	2014

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			Assurance,.			
7.	Patel Rajeshri Dineshbhai, Raval Mihir Kishorchandra, Shukla Riddhi Hiteshbhai, Buch Prakruti Rajeshbhai, Sharma Tejas Prakashbhai, Gadhiya Dolly Tulsibhai	UV-Spectrophotometric Simultaneous Determination of Ibuprofen and Famotidine in Combined Tablet Dosage Form	World Journ Pharmaceuti and Life Scie	3 (1),	505-515	2017
8.	Patel Rajeshri Dineshbhai, Shukla Riddhi Hiteshbhai, Buch Prakruti Rajeshbhai	Spectrophotometric Method Development and Validation for Estimation of Ibuprofen and Famotidine in the pharmaceutical formulation	Research In Pharmacy, 6, 9-16, 2016.			
9.	Rajeshri D. Patel, Harshil Y. Majethiya, Ashish B. Sakariya, Yashpal Jadav	A Short Review On Analysis Of Itraconazo Bulk Drug And In Pharmaceutical Dosa Form,	Inventi Rapid: Pharm Analysis	2021 (3),	1-6	2021
10.	Rajeshri D. Patel, Kushani N. Desai, Dhruvi B. Godhani, Prachi A. Panchal	A Concise Review On Characteristics Analytical Methods Of Paroxetine,	Inventi Rapid: Pharm Analysis	2021 (3),	1-5	2021

13. Detail of patents.

Sr.No	Patent Title	Name of Applicant(s)	Patent No.	Award Date	Agency/Country	Status
1.	A Crystallo Co-Agglomerate of Praziquantel and Process or Preparing the Same	Rajeshri Patel, Sejal Chauhan, Mihir Raval	202121031020	10.07.2021	Indian Patent	Provisional patent
			IN 202121031020	21.10.2021		Filed fully patent

14. Books/Reports/Chapters/General articles etc. (Communicated)

Sr.No	Title	Author's Name	Publisher	Year of Publication
1.	Tamoxifen: An Investigative Review For Nano Dosage Forms And Hyphenated Techniques	Rajeshri Dineshbhai Patel*, Yamini Anilbhai Bhalani, Dhruti Sanjaybhai Sudani,	International Journal of Pharmaceutical Investigation	2022 (Final proof ready after revision)

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		Lipsa Ashvinbai Vachhani		
2.	RP-HPLC Method Development, Validation, and its Pharmacokinetic Applicability in Preclinical Evaluation of Rhein Treated with Novel Diacerein Eutectics	Rajeshri D. Patel *, Mihir K. Raval, Trupesh M. Pethani, Riddhi H. Shukla, Prakruti R. Buch,Tejas P. Sharma, Vishal A. Airao	Biomedical Chromatography	2022 (First revision submitted)
3.	Differential Scanning Calorimetry: A Screening tool for the Development of Diacerein Eutectics	Rajeshri D. Patel, Mihir K. Raval	Results in Chemistry	2022 (Submitted revision)

15. Any other Information (maximum 500 words)

- **Research activity:** I have co-guided three M.Pharm students
- **Consultancy projects:** I have been taking care of all the consultancy projects and sample analysis of GC-MS/MS instrumentfrom 2020 to 2021.
- **Administrative duties:**
  - ✓ PCI and NAAC inspection related duties
  - ✓ As a nodal officer for B.Pharm and M.Pharm course through ACPC admission process in academic year 2016-2018
  - ✓ Syllabus Drafting (Master in Pharmacý Management and M.Pharm.)
  - ✓ As a secretary of Student grievance cell, Gender sensitization cell, Women harassment cell, Anti-discrimination cell, Anti-ragging cell
  - ✓ External examination related duties in B.Pharm, M.Pharm, Pharm.D, and CCDT
  - ✓ Duties related Examiner's orders of B.Pharm, M.Pharm, Pharm.D, CCDT, and PGDCR
  - ✓ Duties related to reassessment process for students
  - ✓ As a committee member in placement cell and Alumni meet
  - ✓ Served as an organizing committee member in various National and International conferences held at the department
  - ✓ As a co-ordinator in Annual day function (2016 to 2018)
  - ✓ Served as a class teacher for 5 years

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Rajkot

Atmiya University Rajkot

ATMIYA UNIVERSITY

(Established under the Gujarat Private University Act 11, 2018)

Yogidham Gurukul, Kalawad Road, Rajkot - 360005, Gujarat (INDIA)

Endorsement Letter

This is to certify that:

i) The Institute welcomes participation of **Dr. Rajeshri D. Patel**, Assistant Professor, School of Pharmaceutical Sciences, Faculty of Paramedical Sciences, Atmiya University, Rajkot, India as SIRE applicant for the proposed work titled **"Exploring 3D printing technology for the development of nanomiceller formulation and efficacy testing in 3D tumorospheres of colon cancer"** for a duration of **six** months in **College of Pharmacy and Health Sciences, St. John's University, NY, USA** under SIRE scheme.

ii) The applicant will be governed by the rules and regulations of the Institution.

iii) The fund sanctioned by the SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi will be utilized for the purpose for which it was sanctioned.

iv) No administrative or other liability will be attached to SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi at the end of the programme.

v) The Institution assumes to undertake the financial and other management responsibilities of the proposed work.

vi) If the fellowship is awarded to her, **Dr. Rajeshri D. Patel** will be relieved from **School of Pharmaceutical Sciences, Faculty of Paramedical Sciences, Atmiya University, Rajkot, India** duties for said period from the date of her joining for research fellowship under SIRE Fellowship Programme. During this period, the continuity of employment on the post presently held by her would continue to be applicable and rules governing payment of salary (basic pay and all allowances), leave, medical benefits, gratuity, GPF, GIS, and pension etc. would continue to be applicable during the entire period of fellowship and she will join her present post on completion of tenure of her fellowship.

4/2/2022

DR. DIVYANG VYAS
Registrar,
Atmiya University
Rajkot, Gujarat, India-360005
Phone No. +91 75729 70006
E-mail: dean.tracademics@atmiyauni.ac.in

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Atmiya University Rajkot

ST. JOHN'S UNIVERSITY
College of Pharmacy and Health Sciences

KETANKUMAR PATEL, Ph.D.
Associate Professor of Pharmaceutics
College of Pharmacy and Health Sciences

Date: February 1, 2022

Consent letter

1. I, **Dr. Ketan D. Patel** (Associate Professor, College of Pharmacy and Health Sciences, St. John's University, New York, USA) will be hosting **Dr. Rajeshri D. Patel** (Assistant Professor, School of Pharmaceutical Sciences, Atmiya University, Rajkot, Gujarat, India) under SIRE Scheme of Science and Engineering Research Board, Ministry of Science and Technology, Govt. of India for her visit to my lab/institute for undertaking the proposed research work titled **"Exploring 3D printing technology for the development of nanomiceller formulation and efficacy testing in 3D tumorospheres of colon cancer"** for a duration of **six** months.

2. The applicant from India will be supported her fellowship by Science and Engineering Research Board, Ministry of Science and Technology, Govt. of India.

3. I agree to defray the research cost involved with her research stay in my laboratory.

Date – 2/2/2022

Place – New York, USA

Sincerely,

Ketankumar Patel, PhD
Department of Pharmaceutical Sciences
College of Pharmacy and Health Sciences
St. Albert Hall, B49, St. John's University
8000 Utopia Parkway, Queens, NY 11439
Office phone - +1 718 990 6828
Mobile - +1 850 524 8586
Fax- +1 718-990-1877
Email - patelk2@stjohns.edu

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Rajkot

Atmiya University Rajkot

ST. JOHN'S UNIVERSITY
College of Pharmacy and Health Sciences

KETANKUMAR PATEL, Ph.D.
Associate Professor of Pharmaceutics
College of Pharmacy and Health Sciences

Date: February 1, 2022

To,
The Secretary,
SERB,
New Delhi

RE: Letter of support to host Dr. Rajeshri Patel as visiting scholar at St. John's University, NY

Department of Pharmaceutical Sciences at St. John's University has globally recognized graduate program for translational research for the treatment of various diseases. There are 39 research laboratories with over 100 graduate students in the department. My laboratory is National Institute of Health funded laboratory for research on novel class of anticancer molecules, nanomedicineand 3D printing technology. We encourage brilliant and accomplished international vising research scholars like Dr. Rajeshri Patel to improve the intellectual exchange and productive research in the emerging areas.

Dr. Rajeshri Patel has excellent academic credential with gold medal in M. Pharm. She is an early-stage researcher with mentoring experience and publication in the field of pharmaceutics. She attended my talk on 3D printing technology at GTU. She approached me with strong commitment and keen interest to learn 3D printing technology, customized nanoformulation and 3D cancer cell culture for evaluation of anticancer nanoformulation.

3D printing technology and nanomedicine are rapidly emerging area of research with strong potential in health care system. During her tenure in my laboratory (6 months), she would be able to complete a well define project on formulation of 3D printed tablet of nanomicelle forming polymeric material. She will characterize the formulation and test it in multicellular 3D spheroid of colon cancer. Dr. Patel's work is concerned with conducting and promoting innovative pharmaceutical research to study and solve the major health problems in the world, especially cancer and diseases with unmet needs. Along with research techniques, she will get an exposure to grant writing, research logistics and mentoring to make her an independent investigator in future.

Feel free to contact me anytime, if you have further questions.

Sincerely,

Ketankumar Patel, PhD
Department of Pharmaceutical Sciences
College of Pharmacy and Health Sciences
St. Albert Hall, B49, St. John's University
8000 Utopia Parkway, Queens, NY 11439
Office phone - +1 718 990 6828
Mobile - +1 850 524 8586
Fax- +1 718-990-1877
Email - patelk2@stjohns.edu

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Rajkot

Atmiya University Rajkot

Certificate from the applicant

It is certified that,

i) I, **Dr. Rajeshri D. Patel** (Atmiya University, Rajkot, Gujarat) in collaboration with **Dr. Ketan D. Patel** (St. John's University, NY, USA) as SIRE applicant will undertake research as approved in the SIRE scheme.

ii) I agree to submit a certificate from Institutional Biosafety Committee, if the program involves the utilization of genetically engineered organisms.

iii) I also declare that while conducting experiments, the Biosafety Guidelines of Department of Biotechnology, Department of Health Research, GOI would be followed strictly.

iv) I agree to submit ethical clearance certificate from the concerned ethical committee, if the project involves field trails/experiments/exchange of specimens, human & animal materials, etc.

v) I agree to abide by the terms and conditions of SERB grant.

R.D. Patel

Dr. Rajeshri D. Patel
Date: 02/02/2022
Place: Rajkot

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Atmiya University
Rajkot

Atmiya University Rajkot

Ketankumar Patel, PhD
Associate Professor of Pharmaceutical Sciences, St. John's University, NY
eRA COMMONS USER NAME: patelk2
Email-patelk2@stjohns.edu

Research Expertise –
I am an Associate Professor of Pharmaceutical Sciences at St. John's University, NY. Prior to joining St. John's University as tenure track faculty in Fall 2016, I had completed my Post-doc from Florida A&M university, FL and Ph.D. in Pharmaceutics from the Institute of Chemical Technology, Mumbai, India. The major focus of my graduate and postdoctoral training was; Formulation development and characterization, preclinical testing of novel and commercially viable nanomedicine of anticancer agents, and strategies to overcome tumor stromal barrier for enhanced delivery of tumor targeted nanoparticles. During post-doctoral fellowship, I gained extensive hands-on experience *in vitro* cell culture assays, tumor targeted nanoformulations, pharmacokinetic studies and *in vivo* anticancer efficacy studies in various tumor xenograft models of melanoma, tyrosine kinase inhibitor resistant lung cancer and triple negative breast cancer.

As a young independent investigator, I decided to continue contributing my intellect, expertise and efforts for the investigating therapeutics strategies for the treatment of drug resistant solid tumors. Overall, my research laboratory is engaged in exploring combination of novel class of anticancer molecules, preformulation studies, Development of translation formulation (Nanoparticles, Gene delivery carrier, Extended-release depot, Vaginal film and 3D printed tablets) and Anticancer efficacy testing in human tumor xenograft models. I have mentored/mentoring 8 PhDs, 5 MS and 7 undergraduate students in my laboratory while serving on PhD thesis committee of over 40 students. I have co-authored over 65 research papers and 100 oral/poster presentations (25 of them received awards) demonstrating role of advanced formulation technologies in improving efficacy and patient compliance have been published in last 10 years. I have five US patents on innovative formulation technologies. I received a Melanoma Research Scholar Award from Outrun the Sun, Inc. and a National Institutes of Health grant (NIH SC2) for research on development of nanomedicine of Proteolysis Targeting Chimera (PROTAC) for the treatment of metastatic melanoma.

EDUCATION
Postdoctoral fellow - Florida A&M University, Tallahassee, FL, USA. 2014-2016
PhD (Pharmaceutics) - Institute of Chemical Technology, Mumbai, India. 2009-2013
M.Pharm (Pharmaceutics) - Bombay College of Pharmacy, Mumbai University, Mumbai, India. 2007-2009
B.Pharm - Anand Pharmacy College, Anand, SP University, India. 2003-2007

FELLOWSHIPS AND AWARDS
- Faculty recognition award, St. John's University, NY 2020
- Faculty recognition award, St. John's University, NY 2019
- Faculty recognition award, St. John's University, NY 2018
- Faculty recognition award, St. John's University, NY 2017
- Melanoma research scholar award, Outrun the sun inc. IN 2016
- AAPS Dermatopharmaceutics Travelship award 2015
- Best oral presentation award at GRASP 2015, Mercer University, Atlanta, GA 2015
- Best poster presentation award at Nanobio 2013, Institute of Chemical Technology, Mumbai, India 2013 Best oral presentation award at South Asian chapter of American College of Clinical Pharmacology 2013 (ACCP), Mumbai, India
- Merit Poster Award at Controlled Release Society-Indian Chapter Symposium, Mumbai, India 2013
- Third prize at BEST ABLE India 2013 for innovative idea presentation, Bangalore, India 2013
- Best poster in pharmaceutics award at Indian Pharmaceutical Congress, Bangalore, India 2012
- Oral presentation award at Indian Pharmaceutical Congress, Chennai, India 2012
- Best poster in pharmaceutics award at Indian Pharmaceutical Congress, Chennai, India 2012 (My work was presented by a junior)
- **UGC-SAP Fellowship for securing all India first rank in ICT PhD entrance test -2009**
- **AICTE Fellowship for securing all India first rank in Graduate Aptitude Test in Engineering GATE-2007**

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PUBLICATIONS (Recent and relevant)
https://scholar.google.com/citations?user=UK3F1XcAAAAJ&hl=en

1. Aishwarya Saraswat, Hari Priya Vemana, Vikas V Dukhande, Ketan Patel. Galactose-decorated liver tumor-specific nanoliposomes incorporating selective BRD4-targeted PROTAC for hepatocellular carcinoma therapy. Heliyon. 2021.
2. Yige Fu, Aishwarya Saraswat, Jasmin Monpara, Ketan Patel. Stromal disruption facilitating invasion of a 'nano-arsenal' into the solid tumor. Drug Discovery Today. 2021. (IPR, Elsevier, Impact factor 7.8)
3. Aishwarya Saraswat, Richa Vartak, Manali Patki, and Ketan Patel. Cannabidiol Inhibits *In Vitro* Human Liver Microsomal Metabolism of Remdesivir: A Promising Adjuvant for COVID-19 Treatment. Cannabis and Cannabinoid Research. 2021. (IPR, Mary Ann Liebert, Impact factor 5.7)
4. Suvidha Menon, Xiuyi Liang, Richa Vartak, **Ketan Patel**, Antonio Di Stefano, Ivana Cacciatore, Lisa Marinelli, Blase Billack. Antifungal Activity of Novel Formulations Based on Terpenoid Prodrugs against C. albicans in a Mouse Model. Pharmaceutics. 2021. (IPR, MDPI, Impact Factor 6.32)
5. Manali Patki, Siddhant Palekar, Sandra Reznik, **Ketan Patel.** Self-injectable extended release formulation of Remdesivir (SelfExRem): A potential formulation alternative for COVID-19 treatment. International journal of pharmaceutics 597 (2021): 120329. (IPR, Elsevier, Impact factor 5.87)
6. Richa Vartak, Suyash M Patil, Aishwarya Saraswat, Manali Patki, Nitesh K Kunda, **Ketan Patel**. "Aerosolized nanoliposomal carrier of remdesivir: an effective alternative for COVID-19 treatment in vitro." Nanomedicine, 2021 (IPR, Future Medicine, Impact factor 5.30)
7. Suvidha Menon, Richa Vartak, **Ketan Patel**, Blase Billack. "Evaluation of the Antifungal Activity of an Ebselen-loaded Nanoemulsion in a Mouse Model of Vulvovaginal Candidiasis." Nanomedicine: Nanotechnology, Biology, and Medicine. 2021. (IPR, Elsevier, Impact Factor: 6.45)
8. Manali Patki, Aishwarya Saraswat, Shraddha Bhutkar, Vikas Dukhande, Ketan Patel. "In vitro assessment of a synergistic combination of Gemcitabine and Zebularine in pancreatic cancer." Experimental Cell Research. 2021; 112660. (IPR, Elsevier, Impact Factor 3.90)
9. Hemanth K. Mamidi, Siddhant Palekar, Pavan Kumar Nukala, Saurabh M. Mishra, Manali Patki, Yige Fu, Piyush Supner, Gautam Chauhan, **Ketan Patel**. "Process optimization of twin-screw melt granulation of fenofibrate using design of experiment (DoE)." International Journal of Pharmaceutics 593 (2021): 120101. (IPR, Elsevier, Impact factor 5.87)
10. Yige Fu, Aishwarya Saraswat, Zenghui Wei, Manas Yogendra Agrawal, Vikas V. Dukhande, Sandra E. Reznik, and **Ketan Patel**. Development of Dual ARV-825 and Nintedanib-Loaded PEGylated Nano-Liposomes for Synergistic Efficacy in Vemurafenib-resistant Melanoma. Pharmaceutics. 2021; 13, 1005. (IPR, MDPI, Impact factor 6.32)
11. Hari Priya Vemana, Aishwarya Saraswat, Shraddha Bhutkar, Vikas V Dukhande, **Ketan Patel**. A novel gene therapy for neurodegenerative Lafora disease via EPM2A-loaded DLinDMA lipoplexes. Nanomedicine - Future Medicine. 2021; 16(13):1081-109. (IPR, Future Medicine, Impact factor 5.30)
12. Arvind Bagde, Nilkumar Patel, **Ketan Patel**, Ebony Nottingham & Mandip Singh. Sustained release dosage form of noscapine HCl using hot melt extrusion (HME) technique: formulation and pharmacokinetics. Drug Delivery and Translational Research. 2020. (IPR, Springer, Impact factor 4.61)
13. Zhuo-Xun Wu, Yuqi Yang, Jing-Quan Wang, Wen-Min Zhou, Junyu Chen, Yi-Ge Fu, **Ketankumar Patel**, Zhe-Sheng Chen and Jian-Ye Zhang. Elevated ABCB1 Expression Confers Acquired Resistance to Aurora Kinase Inhibitor GSK-1070916 in Cancer Cells. Frontiers in Pharmacology. 2020; 11: 615824. (IPR, Frontiers, Impact factor 5.81)
14. Richa Vartak, Manali Patki, Suvidha Menon, Joseph Jablonski, Sonia Mediouni, Yige Fu, Susana T. Valente, Blase Billack and **Ketan Patel**. β-cyclodextrin polymer/Soluplus® encapsulated Ebselen ternary complex (EβpolySol) as a potential therapy for vaginal candidiasis and pre-exposure prophylactic for HIV. International Journal of Pharmaceutics. 2020;589:119863 (Elsevier, Impact Factor 5.87)

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15. Yige Fu, Drishti Rathod, **Ketan Patel**. Protein Kinase C Inhibitor Anchored BRD4 PROTAC PEGylated Nanoliposomes for the Treatment of Vemurafenib-resistant Melanoma. Experimental Cell Research 2020;396. (IPR, Elsevier, Impact Factor 3.90)
16. Aishwarya Saraswat, Manali Patki, Yige Fu, Shrikant Barot, Vikas Dukhande, Ketan Patel. Nanoformulation development of a novel BRD4-degrading PROTAC to target the "undruggable" c-Myc oncogene for pancreatic ductal adenocarcinoma therapy. 2020;18. Nanomedicine. (IPR, Future Medicine, Impact factor 5.30)
17. Richa Vartak, Suvidha Menon, Manali Patki, Blase Billack, and **Ketan Patel**. Ebselen nanoemulgel for the treatment of topical fungal infection. European Journal of Pharmaceutical Sciences. 2020; 105323. (IPR, Elsevier, Impact Factor 4.38)
18. Manali Patki, Richa Vartak, Joseph Jablonski, Sonia Mediouni, Tasneem Gandhi, Yige Fu, Eylul Cetindag, Rajesh Dave, Susana T. Valente, **Ketan Patel.** Efavirenz Nanomicelles Loaded Vaginal Film (EZ film) for Preexposure Prophylaxis (PrEP) of HIV. Colloids and Surfaces B: Biointerfaces. 2020; 111174 (IPR, Elsevier, Impact Factor 5.27)
19. Zhuo-Xun Wu, Zheng Peng, Yuqi Yang, Jing-Quan Wang, Qiu-Xu Teng, Zi-Ning Lei, *Yige Fu (GRAD),* **Ketan Patel**, Lili Liu, Lizhu Lin, Chang Zou and Zhe-Sheng Chen. M3814, a DNA-PK Inhibitor, Modulates ABCG2-Mediated Multidrug Resistance in Lung Cancer Cells. Frontiers in Oncology. 2020;10:674 (IPR, Frontiers, Impact factor 6.24)
20. Pavan Kumar Nukala, Siddhant Palekar, Manali Patki, Yige Fu, and **Ketan Patel**. Multi-dose oral abuse deterrent formulation of loperamide using hot melt extrusion. International Journal of Pharmaceutics. 2019; 118629. (Elsevier, Impact Factor 5.87)
21. Yige Fu, Drishti Rathod, Ehab M. Abo-Ali, Vikas V. Dukhande, and **Ketan Patel.** EphA2-Receptor Targeted PEGylated Nanoliposomes for the Treatment of BRAFV600E Mutated Parent-and Vemurafenib-Resistant Melanoma. Pharmaceutics. 2019; 504. (MDPI, Impact Factor 6.32)
22. Drishti Rathod, Yige Fu, and **Ketan Patel**. BRD4 PROTAC as a novel therapeutic approach for the treatment of vemurafenib resistant melanoma: preformulation studies, formulation development and in vitro evaluation. European Journal of Pharmaceutical Sciences. 2019; 105039. (Elsevier, Impact Factor 4.38)
23. Siddhant Palekar, Pavankumar Nukala, Saurabh Mishra, Thomas Kipping, **Ketan Patel**. Application of 3D printing technology and quality by design approach for development of age-appropriate pediatric formulation of baclofen. International Journal of Pharmaceutics, 2019, 556;106-116. (Elsevier, Impact factor 5.87)
24. Tasneem Gandhi, Manali Patki, Jing Kong, Jagadish Koya, Sabesan Yoganathan, Sandra Reznik, **Ketan Patel**. Development of an Arginine Anchored Nanoglobule with Retrograde Trafficking Inhibitor (Retro-2) for the Treatment of an Enterohemorrhagic Escherichia coli Outbreak. Molecular pharmaceutics, 2019; 16(10), 4405-4415 (ACS, Impact factor 4.94)
25. Manali Patki, Kiersten Giusto, Samir Gorasiya, Sandra E Reznik, **Ketan Patel**. 17-α Hydroxyprogesterone Nanoemulsifying Preconcentrate-Loaded Vaginal Tablet: A Novel Non-Invasive Approach for the Prevention of Preterm Birth. Nanomedicine, 2019; 11(7), 335 (Future medicine, Impact factor 5.30)
26. Kiersten Giusto, Manali Patki, Jagadish Koya, Charles R Ashby Jr, Swapna Munnangi, **Ketan Patel**, Sandra E Reznik. A vaginal nanoformulation of a SphK inhibitor attenuates lipopolysaccharide-induced preterm birth in mice. Pharmaceutics, 2019; 14(21), 2835-2851 (MDPI, Impact factor 6.32)
27. Arvind Bagde, **Ketan Patel**, Shallu Kutlehria, Nusrat Chowdhury & Mandip Singh. Formulation of topical ibuprofen solid lipid nanoparticle (SLN) gel using hot melt extrusion technique (HME) and determining its anti-inflammatory strength. Drug delivery and translational research; 2019; 9 (4), 816-827.
28. **Ketan Patel**, Ravi Doddapaneni, Manali Patki, Vasanthkumar Sekar, Arvind Bagde, Mandip Singh. Erlotinib-Valproic Acid Liquisolid Formulation: Evaluating Oral Bioavailability and Cytotoxicity in Erlotinib-Resistant Non-small Cell Lung Cancer Cells. AAPS PharmSciTech, 2019; 20(3), 135.
29. Shallu Kutlehria, Imran Vhora, Arvind Bagde, Nusrat Chowdhury, Gautam Behl, **Ketan Patel** & Mandip Singh. Tacrolimus Loaded PEG-Cholecalciferol Based Micelles for Treatment of Ocular Inflammation. Pharmaceutical Research; 2018; 35:117.

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30. Shallu Kutlehria, Gautam Behl, **Ketan Patel**, Ravi Doddapaneni, Imran Vhora, Nusrat Chowdhury, Arvind Bagde & Mandip Sing. Cholecalciferol-PEG Conjugate Based Nanomicelles of Doxorubicin for Treatment of Triple-Negative Breast Cancer. AAPS PharmSciTech, 2018.
31. Ravi Doddapaneni, **Ketan Patel**, Nusrat Chowdhury & Mandip Singh. Reversal of drug-resistance by noscapine chemo-sensitization in docetaxel resistant triple negative breast cancer. Scientific Reports; 2017; 7,15824.
32. Dhawal Chobisa, **Ketan Patel,** Jasmin Monpara, Mayank Patel, Pradeep Vavia. Development and characterization of an organic solvent free, proliposomal formulation of Busulfan using quality by design approach. International Journal of Pharmaceutics 2017, 535;360-370.
33. Nusrat Chowdhury, Imran Vhora, **Ketan Patel**, Ravi Doddapaneni, Arindam Mondal, Mandip Singh. Treatment Of Lung Cancer Using Cationic Nanolipid Carriers of Docetaxel and 6-Phosphofructo-2-Kinase/Fructose-2,6-Biphosphatase 3(Pfkfb3). Pharmaceutical Research; 2017; 34,2371–2384.
34. **Patel K**, Doddapaneni R, Sekar V, Chowdhury N, Singh M. Combination Approach of YSA Peptide Anchored Docetaxel Stealth Liposomes with Oral Antifibrotic Agent for the Treatment of Lung Cancer. Mol Pharm. 2016; 6;13(6):2049-58.
35. Boakye CHA, **Patel K**, Doddapaneni R, Bagde A, Marepally S, Singh M. Novel amphiphilic lipid augments the co-delivery of erlotinib and IL36 siRNA into the skin for psoriasis treatment. J Control Release. 2017; 246(28):120–132.
36. Boakye CHA, **Patel K**, Doddapaneni R, et al. Ultra-flexible nanocarriers for enhanced topical delivery of a highly lipophilic antioxidative molecule for skin cancer chemoprevention. Colloids Surfaces B Biointerfaces. 2016;143:156-167.
37. Doddapaneni R, **Patel K**, Chowdhury N, Singh M. Noscapine chemosensitization enhances docetaxel anticancer activity and nanocarrier uptake in triple negative breast cancer. Exp Cell Res. 2016; 1;346(1):65-73.
38. **Patel K**, Doddapaneni R, Chowdhury N, Boakye CHA, Behl G, Singh M. Tumor stromal disrupting agent enhances the anticancer efficacy of docetaxel loaded PEGylated liposomes in lung cancer. Nanomedicine. 2016;11(11):1377-1392.
39. Lacey A, Hedrick E, Li X, et al. Nuclear receptor 4A1 (NR4A1) as a drug target for treating rhabdomyosarcoma (RMS). Oncotarget. 2016.
40. Cheriyan VT, Muthu M, **Patel K**, et al. CARP-1 functional mimetics are novel inhibitors of drug-resistant triple negative breast cancers. Oncotarget. 2016.
41. Boakye CHA, **Patel K**, Singh M. Doxorubicin liposomes as an investigative model to study the skin permeation of nanocarriers. Int J Pharm. 2015;489(1):106-116.
42. **Patel K**, Chowdhury N, Doddapaneni R, Boakye CHA, Godugu C, Singh M. Piperlongumine for Enhancing Oral Bioavailability and Cytotoxicity of Docetaxel in Triple-Negative Breast Cancer. J Pharm Sci. 2015;104(12):4417-4426.
43. Doddapaneni R, **Patel K**, Owaid IH, Singh M. Tumor neovasculature-targeted cationic PEGylated liposomes of gambogic acid for the treatment of triple-negative breast cancer. Drug Deliv. 2015:1-10.
44. **Patel K**, Tyagi M, Monpara J, Vora L, Gupta S, Vavia P. Arginoplexes: an arginine-anchored nanoliposomal carrier for gene delivery. J Nanoparticle Res. 2014;16(4):1-10.
45. **Patel K**, Patil A, Mehta M, Gota V, Vavia P. Oral delivery of paclitaxel nanocrystal (PNC) with a dual Pgp-CYP3A4 inhibitor: preparation, characterization and antitumor activity. Int J Pharm. 2014;472(1):214-223.
46. Vora L, Tyagi M, **Patel K**, Gupta S, Vavia P. Self-assembled nanocomplexes of anionic pullulan and polyallylamine for DNA and pH-sensitive intracellular drug delivery. J Nanoparticle Res. 2014;16(12):1-13.
47. **Patel K**, Patil A, Mehta M, Gota V, Vavia P. Medium chain triglyceride (MCT) rich, paclitaxel loaded self nanoemulsifying preconcentrate (PSNP): a safe and efficacious alternative to Taxol®. J Biomed Nanotechnol. 2013;9(12):1996-2006.

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GRANTS RECEIVED

1. **NIH/NIGMS/SC2** – $328,000.00 (Two Years), 2020-2021
   Oral nanoformulation for the treatment of BRAF inhibitor resistant melanoma.
2. **Summer Support of Research Program (SSR)-2019,** Internal (SJU). Novel multifunctional formulation of vaginal and rectal microbicides for pre-exposure prophylaxis (PrEP) of HIV, $10,000.00 (Two months).
3. **Neofluidics LLC.** Preparation of nanoliposomal formulation using a microfluidic platform. $10,000.00 (One year).
4. **SEED grant-2018**, Internal (SJU). 3D Printed egg-shaped tablet for opioid abuse deterrent. $5,000.00 (One year)
5. **Summer Support of Research Program (SSR)-2017,** Internal (SJU). Evaluating cytotoxic interaction of BRAF inhibitor and TGF-β1 inhibitor in BRAF-mutated metastatic melanoma cell lines, $10,000.00 (Two months).
6. **SEED grant-2017**, Internal (SJU). Screening of co-processed excipient and development of self-nanoemulsifying vaginal tablet for the treatment of preterm labor, $5,000.00 (One year),
7. **Melanoma Research Scholar Award**, Outrun the Sun Melanoma, Inc., YSA Peptide Anchored Stealth Nanoliposomes for Metastatic Melanoma Tumor Specific Delivery of a MEK inhibitor (October 2016), $10,000.00 (One Year).
8. Equipment Grant (October 2016). $25,100.00 (PDA detector for HPLC system). **Waters Corporation Academic Research Support Award**, Waters Corporation.

PATENTS

1. Formulations for the topical treatment of psoriasis, US62/210,715
2. Composition for improving bioavailability and efficacy of taxane, US62/210, 206
3. Self-emulsifying formulation of CARP-1 functional mimetics, US10/220, 025
4. Composition for subcutaneous delivery of Remdesivir, US patent pending
5. Composition for an oral abuse deterrent film formulation, US patent pending

Registrar
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Rajkot

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Undertaking by the Principal Investigator

To
The Secretary,
SERB,
New Delhi

Sir

I, **Dr. Rajeshri D. Patel** herby certify that the research proposal titled **"Exploring 3D printing technology for the development of nanomiceller formulation and efficacy testing in 3D tumorospheres of colon cancer** submitted for possible funding by SERB, New Delhi is my original idea and has not been copied/taken verbatim from anyone or from any other sources. I further certify that this proposal has been checked for plagiarism through a plagiarism detection tool i.e. **Urkund** approved by the Institute and the contents are original and not copied/taken from any one or many other sources. I am aware of the UGCs Regulations on prevention of Plagiarism i.e. University Grant Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulation, 2018. I also declare that there are no plagiarism charges established or pending against me in the last five years. If the funding agency notices any plagiarism or any other discrepancies in the above proposal of mine, I would abide by whatsoever action taken against me by SERB, as deemed necessary.

R.D. Patel 02/02/22

Dr. Rajeshri D. Patel
Assistant Professor,
School of Pharmaceutical Sciences,
Atmiya University, Rajkot-360005,
Gujarat, India.

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Rajkot

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IKS INTERNSHIP 2022-23

Internship Proposal

Name of Mentor	Ms. Rachana H. Joshi
Contact No.	8000235887
Email	rachana.joshi@atmiyauni.ac.in
Mentor's area of IKS for Internship	Holistic medicine & wellness
Designation	Assistant Project
Title of the project for Internship	Health and Lifestyle awareness during Covid – 19 pandemic.
Minimum Expected background for your interns	Graduate student of program like: B.Pharm., B.Pharm. (Ayu.), BAMS
Special/preferred skills of interns for this project	Interns should able to interact/communicate with common people
No. of interns you would like to guide	2
Abstract/ Description of the project with clear statement of goals and outputs	Covid-19 has become a global pandemic infecting the people all over the world and leading to 2 million deaths by the end of year 2021. During the outbreak of Covid – 19, it has brought unprecedented challenges and fear among the people. Though many people decently followed the guidelines given by government for preventive measures viz. social distancing, wearing masks, sanitization and hygiene, boosting Immune system etc., covid seems to affect the lives of them and posed serious health issues. Recent studies indicated that older adults and those with systemic comorbidities (e.g. cardiovascular diseases, cancer, diabetes, hypertension) are more vulnerable to serious complications and death caused by COVID-19 infection. Given that elderly is also more prone to having these health comorbidities, the mortality risk of COVID-19 would be higher in elderly population than middle-aged or younger individuals. All the health workers working all over the world from different field of specialization came forward with their best possible inputs and guidelines. Different medications, lifestyle choices, foods, social awareness programs were made accessible. These all efforts made the fight less threating and saved many lives but none of them seems to work efficiently in giving absolute results.

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	Looking at the health of people in Post corona phase, there seems to influence many factors like Type of medication used for the treatment of infection (Allopathy/Indigenous system of medicines), Food habits, Exercise, Yoga or Physical movement, Sleeping schedule, Addiction, Mental status, Social Connections, stress management etc in making the overall health of a person. Research shows that most of the chronic diseases (Viz. Diabetes, Hypertension, Cancer etc.) are having the same underlying mechanisms like Chronic Inflammation, changes in immune functions, oxidative stress, angiogenesis, telomere length which are the direct functions of diet, sleep, addiction, mental health and stress conditions of a person. Many people having same diseased condition and followed different systems of medications and treatment shows different symptoms in post covid – 19 phase. At the same time, Many patients having followed the same regiment for the covid-19 treatment shows different health levels due to the above listed lifestyle factors. The objective of current work is aiming to explore and compare the life, especially health level in post corona phase of the patient treated with Indigenous system (Ayurvedic, Homeopathy, Siddha, Unani etc.) and Allopathy/Modern system of Medicines as well as different lifestyle elements affecting the overall health. The outcomes will show the impact of types of medicines and other lifestyle factors influencing overall health of a person in a long term.

Name and Signature of Applicant:

Ms. Rachana H. Joshi

Name and Signature of HoD:

Mr. Falgun Dhabaliya

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IKS INTERNSHIP 2022-23

Internship Proposal

Name of Mentor	Dr. Samixa Rameshbhai Patel
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Email	samixa.patel@atmiyauni.ac.in
Mentor's area of IKS for Internship	Holistic medicine & wellness
Designation	Assistant Professor
Title of the project for Internship	Comparative study of the health condition in diabetic patient taking Indigenous and Allopathy medicines
Minimum Expected background for your interns	Graduate student of program like: B.Pharm.,B.Pharm. (Ayu.), BAMS
Special/preferred skills of interns for this project	Interns should able to interact with common people
No. of interns you would like to guide	2
Abstract/ Description of the project with clear statement of goals and outputs	Diabetic Mellitus (DM) is a metabolic disorder that has attracted worldwide concern. DM is caused due to lack of insulin or ineffective production of insulin in the pancreas. A total of 463 million people have diabetes mellitus in 2019 and it was predictedto raise upto 578 million by 2030 and 700 million by 2045. High blood sugar gives rise to many complications like diabetic retinopathy, diabetic nephropathy, atherosclerosis, hypercoagulability, cardiovascular disease, coronary heart disease, abdominal obesity, hypertension, hyperlipidaemia, cerebrovascular disease, coronary artery disease, foot damage, skin complications, Alzheimer's disease, hearing impairment, and depression. These life-threatening complications make diabetes more severe than other diseases. Many synthetic drugs are developed, but still cure is not provided by any of the molecules

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	up to this date. Continuous use of some synthetic agents caused many severe side effects, and thus the demands for non-toxic, affordable drugs are still awaited. The World Health Organization (WHO) has listed a total of 21,000 plants, which are used for medicinal purposes around the world, among them more than 400 plants are available for the treatment of diabetes. Despite the fact that there are many herbal drugs are available for treating diabetes, only a small number of these plants have received scientific and medical evaluation to assess their efficacy. Along with Allopathic and herbal medicine, Healthy eating is a cornerstone of healthy living with or without diabetes. But if you have diabetes, you need to know how foods affect your blood sugar levels. It's not only the type of food you eat, but also how much you eat and the combinations of food types you eat. Physical activity is another important part of your diabetes management plan. When you exercise, your muscles use sugar (glucose) for energy. Regular physical activity also helps your body use insulin more efficiently. These factors work together to lower your blood sugar level. The more strenuous your workout, the longer the effect lasts. But even light activities such as housework, gardening or being on your feet for extended periods can improve your blood sugar. If you're stressed, the hormones your body produces in response to prolonged stress may cause a rise in your blood sugar level. Additionally, it may be harder to closely follow your usual diabetes management routine if you're under a lot of extra pressure. The present project work is aimed to provide the comparative study among 1. Patients getting treatment with allopathy medicines, 2. Patients taking care of other lifestyle factors like diet, exercise, stress etc. along with allopathic treatment 3. Patients taking Indigenous medicines for the treatment. The pre

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	and post diagnostic and treatment conditions are also to be studied. WHO in its World Health Assembly put forth an Action Plan of Global Strategy for the Prevention and Control of Diabetic Mellitus. To knock the abilities of our indigenous systems of medicine and other popular systems of medicine it is essential to measure the awareness amongst society and create attempts to promote ISM concerning prevent various communicable and NCDs.

Dr. Samixa Patel

Name and signature of applicant:

Mr. Falgun Dhabaliya

Name and Signature of HoD

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IKS INTERNSHIP 2022-23

Internship Proposal

Name of Mentor	Dr. Kevinkumar Garala
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Mentor's area of IKS for Internship	Holistic medicine & wellness
Designation	Assistant Professor
Title of the project for Internship	Health consciousness and popularity of Indian systems of medicines
Minimum Expected background for your interns	Graduate student of program like: B.Pharm., B.Pharm. (Ayu.), BAMS
Special/preferred skills of interns for this project	Interns should able to interact with common people
No. of interns you would like to guide	2
Abstract/ Description of the project with clear statement of goals and outputs	Non-communicable diseases (NCDs), moreover known as chronic diseases, majorly tend to be of distant period and they mainly because of a blend of physiological, genetic, behavioural and environmental issues. The foremost categories of NCD are cardiovascular diseases (such as stroke and heart attacks), respiratory diseases (such as asthma and chronic obstructive pulmonary disease, (COPD)), diabetes and cancers. NCDs are more critical issues developing countries like India as NCDs impact around 60% of all deaths in India. Furthermore, NCDs kill 41 million people each year, which is equivalent to 71% of all deaths globally occurred. There are four more prominent NCDs, including cardiovascular disease, COPD, diabetes and cancer, are interconnected by few ordinary preventable risk factors associated to lifestyle which includes smoking, tobacco use, excessive alcoholism, little

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	physical activity, noticeable rise in consumption of energy-rich foods, intensified amount of psychosocial stress, etc., supporting hypertriglyceridemia and hypercholesterolemia. Traditional medicine system of India having the perception of personalized therapy (Prakriti - based medicine) in Ayurveda has the capability to provide solutions to these current challenging health issues like drug withdrawals, adverse drug reactions, economic inequalities and prolonged illness management to mention a few. The well-known three Indian systems of medicine (ISM), namely Ayurveda, Siddha and Unani, integrated with allopathic and homoeopathic systems of medicine will ensure health for all people across the India and, extended to, globe. It is now recognised that the methodology of Western medicine system, allopathic, is outstanding in management of the acute medical conditions however Ayurveda has effectively established a capability to treat chronic illnesses which are unable to cure by allopath. Management of disease by Ayurveda can establish the foundation for a new, enhanced approach to public health, comprising health advancement as well as inexpensive primary care functions, particularly for chronic and communicable. ISM is not simply a treatment however it is consider as a way of life. The ISM is implemented in ancient times. It is the conclusion of Indian thought of medicine which signifies an approach of healthy living valued with an extended and exclusive traditional antiquity. Several health situations that are prevalent and significantly on the intensification in India can be attended by the amalgamation of ISM with modern medicine. The principle aim behind such amalgamation is predominantly to fetch the attention on prevention rather than treatment. WHO in its World Health Assembly put forth an Action Plan of Global Strategy for the Prevention and Control of NCDs. As a WHO member, India similarly is dedicated to executing the same

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	and fascinating the essential actions and plan to encounter the goals. To knock the abilities of our indigenous systems of medicine and other popular systems of medicine it is essential to measure the awareness amongst society and create attempts to promote ISM concerning prevent various communicable and NCDs.

Name and Signature of Applicant:

Dr. Kevinkumar C. Garala

Name and Signature of HoD:

Mr. Falgun Dhabaliya

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IKS INTERNSHIP 2022-23

Internship Proposal

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Mentor's area of IKS for Internship	Holistic medicine & wellness
Designation	Assistant Professor
Title of the project for Internship	Evidence-based research study of Ayurvedic formulations mentioned in Indian systems of medicines
Minimum Expected background for your interns	Graduate student of program like: B.Pharm., B.Pharm. (Ayu.), BAMS
Special/preferred skills of interns for this project	Interns should able to perform project with good laboratory practice and having good analytical skill
No. of interns you would like to guide	2
Abstract/ Description of the project with clear statement of goals and outputs	According to the World Health Organization, about 80% of the world populations rely on traditional medicines mainly of herbal origin for healthcare. Complementary and alternative medicine is more popular in community due to many reasons such as side effects associated with use of synthetic drugs, lack of curative treatment for several chronic diseases, microbial resistance and emerging diseases. Ayurveda is one of the oldest medical systems, which comprises thousands of medical concepts and hypothesis. Ayurveda has ability to treat many chronic diseases such as cancer, diabetes, arthritis, and asthma, which are un-treatable in modern medicine. The Ayurvedic system of medicine is very safe that can help in reducing the enormous burden of mortality and morbidity caused by the various side effects of conventional prescribed drugs. Ayurvedic system is also found effective against

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	various diseases where pathogens developed antibiotic resistance. There are many evidences, which supported Ayurveda performances better than Western medicine, mainly in case of chronic diseases, but it needs to validate with advanced scientific procedures. Moreover, the comprehensive knowledge of the basic ideologies of Ayurveda is poorly acceptable scientifically due to lack of evidence. Hence, evidence-based research is highly needed for global recognition and acceptance of Ayurveda. The aim of this study is to disclose some Ayurvedic formulations with their in-vitro pharmacological studies to give some inputs in acceptance of Ayurvedic formulation in the global market.

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Development Of Herbal Formulation Using *Celastrus Paniculatus* and *Brassica Nigra* For Muscular Pain Relief

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1

Content

Introduction

- Aim of work
- Plan of work
- Budget of work
- Possible outcome

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Introduction

- Herbal medicine phytomedicine or herbalism is a type of alternative and complementary medicine that uses plants or their crud products for the treatment of disease. Herbal medicine is the use of plants or plant extracts for medicinal purposes.
- Although, from ancient times herbal medicines have been used effectively in treating various disorders or diseases all over the world and generally considered to be less toxic and free of side effects as compared to synthetic allopathic drugs.
- Herbal formulation means a dosage form consisting of one or more herbs or processed herbs in specified quantities to provide specific nutritional, cosmetics benefits meant for use to diagnose, treat, migrate disease of humans begins or animals, alter the structure or physiology of humans or animals

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1.Brassica nigra:

It belongs to the family ***cruciferae*** *(brassicaceae)* commonly known as black mustard. It originated from Asia Minor Iran area, but at present it occurs wild in the Mediterranean region, throughout central Europe, in the Middle East and in the Middle East and in the Ethiopian highlands.

Chemical compositions : They are rich in oil (46 – 48 %) and protein (43.6%). Phytochemical constituents like phenolic, polyphenolic, phenolic acids, flavonoids, alkaloids, terpenoids and glycosides.

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2.Celastrus Paniculatus:

It belongs to ***Celastraceae.*** It is commonly known as Black oil plant. It originated throughout India.

Chemical compositions : It contains mahogany, abortifacient. alkaloids, brain tonic, acid(20.0%),linoleic alkaloids are acid(15.51%),and stearic acid(4.18%).the sesquiterpene esterified by derived from a new sesquiterpene(celapanol) which is alternately acetic,benzoic,nicotinic, and beta-furoic acid.

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Aim Of Work :

- The aim of the presence study is to prepare pain relief Herbal formulations containing essential oils of ***Brassica Nigra*** and ***Celastrus Paniculatus***.
- Topical formulation in the concentration of oil of ***Brassica Nigra*** and ***Celastrus Paniculatus*** evaluated for pain relief study.
- Evaluation of more effective pain relief formulation.

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Plan of work:

Collection and procurement of plant material.

↓

Authentication and identification of plant material.

↓

Collection and identification of essential oils from seeds of ***Celastrus Paniculatus*** and ***Brassica Nigra.***

↓

Formulation development.

↓

Evaluation of herbal formulation using parameters such as physical appearance, pH, spread ability, viscosity, homogeneity, grittiness etc.

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Budget of Work:

Sr. No.	Requirements	Approx. Cost (Rs.)
1	Raw Plant material	3000
2	Chemicals	10000
3	Equipments (grinder, zone reader, etc.)	15,000
4	Miscellaneous	2000
	Total	**30,000**

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Possible Outcome:

- The new effective herbal formulation may prepare for better treatment of joint and other muscular pains with minimum of side-effects.
- The Formulation would may cure the muscles related problem from the root.
- As the formulation development process is aimed by keeping holistic approach as a base for the work, it may contribute in minimizing the environmental disturbance happened by formulation development.

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Formulation and Evaluation of Wound healing Property of Herbal Formulation in Diabetes

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Prepared by:

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CONTENT

- INTRODUCTION
- AIM OF WORK
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- COSTING OF THE WORK
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Introduction Of Syzygium Cumini

- *Syzygium cumini*, commonly known as Malabar plum, Java plum, black plum, jamun or jambolan, is an evergreen tropical tree in the flowering plant family Myrtaceae, and favored for its fruit, timber, and ornamental value.It is native to the Indian Subcontinent, adjoining regions of Southeast Asia, including Myanmar, Sri Lanka, and the Andaman Islands. It can reach heights of up to 30 metres (98 ft) and can live more than 100 years. A rapidly growing plant, it is considered an invasive species in many world regions.

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Pharmacological activity: [7]

- Antidiabetic,
- Antioxidant,
- Anti inflammatory,
- Neuropsycho-pharmacological,
- Antimicrobial, antibacterial,
- Anti-HIV, antifungal,
- Antiulcrogenic, gastro protective,
- Antidiarrheal, antifertility,
- Anorexigenic,
- Hypercholesterolemia, hyperlipidemia,
- Turbidity in urine, urethrorrhea,

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Introduction Of Tinospora Cordifolia

- *Tinospora cordifolia* (common names gurjo, heart-leaved moonseed, guduchi or giloy) is a herbaceous vine of the family Menispermaceae indigenous to tropical regions of the Indian subcontinent. It has been in use for centuries in traditional medicine to treat various disorders.
- Habit: Stem

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Aim Of Work

- There are so many allopathic drugs are available for diabetes and wound healing and various side effect of this treatment. But herbal formulation are very less in numbers for diabetic treatment.

- From this work can get cost effective plus reduce side effects containing the formulation which has same efficacy as available formulations are present in market.

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Pharmacological Activity: [8]

- Anti-inflammatory,
- Antidiabetic,
- Antituber,
- Anticancer,
- Antitoxin,
- Anti-HIV,
- Antioxidant,
- Antimicrobial,
- Antiosteoporotic,
- Immunomodulatory.

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Plan Of Work

- **Plant Material:**
  - Collect the raw plant material: Seeds of Syzygium Cumini
    Stems of Tinospora Cordifolia
  - Wash and dried the all plant material.

- **Preparation of plant extract:**
  - **Syzygium Cumini : [1]**
    - The syzygium cumini fruits will first wash well and pulp was removed from the seeds.
    - Seeds will wash several times with distilled water to remove the traces of pulp from the seeds.
    - The seeds will dry at room temperature and coarsely powdered. The powder was extracted with hexane to remove lipids. It will then filtered and the filtrate was discarded.
    - The residue will successively extracted with ethyl acetate and methanol using cold percolation method. The percentage yields will 1.81% in ethyl acetate and 10.36% in methanol.

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➢**Tinospora Cordifolia :[4]**

The plant material was washed with water in order to make it free of dirt and other impurities and was shade dried. The whole plant material was grind with mortar and pastel into the fine powder; alcoholic and aqueous extract of Tinospora cordifolia was prepared.

•Preparation of formulation:

➢Prepare 2 combination using different concentration of both plant extracts.

➢Preparation different herbal formulation using difference concentration of methanolic extract of Syzygium cumini and alcoholic and aqueous extract of Tinospora cordifolia.

•Evaluation of wound healing on diabetic rats of this herbal formulation. [2]

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Costing of the Work

Sr.No.	Requirements	Approx.Cost (Rs.)
1.	Plant Material	2500
2.	Chemical and Equipments	45000
3.	Laboratory test	20500
4.	Others	7000
	Total	75000

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Possible outcome

- The new effective herbal formulation may prepare for better effect of anti diabetic and wound healing property.

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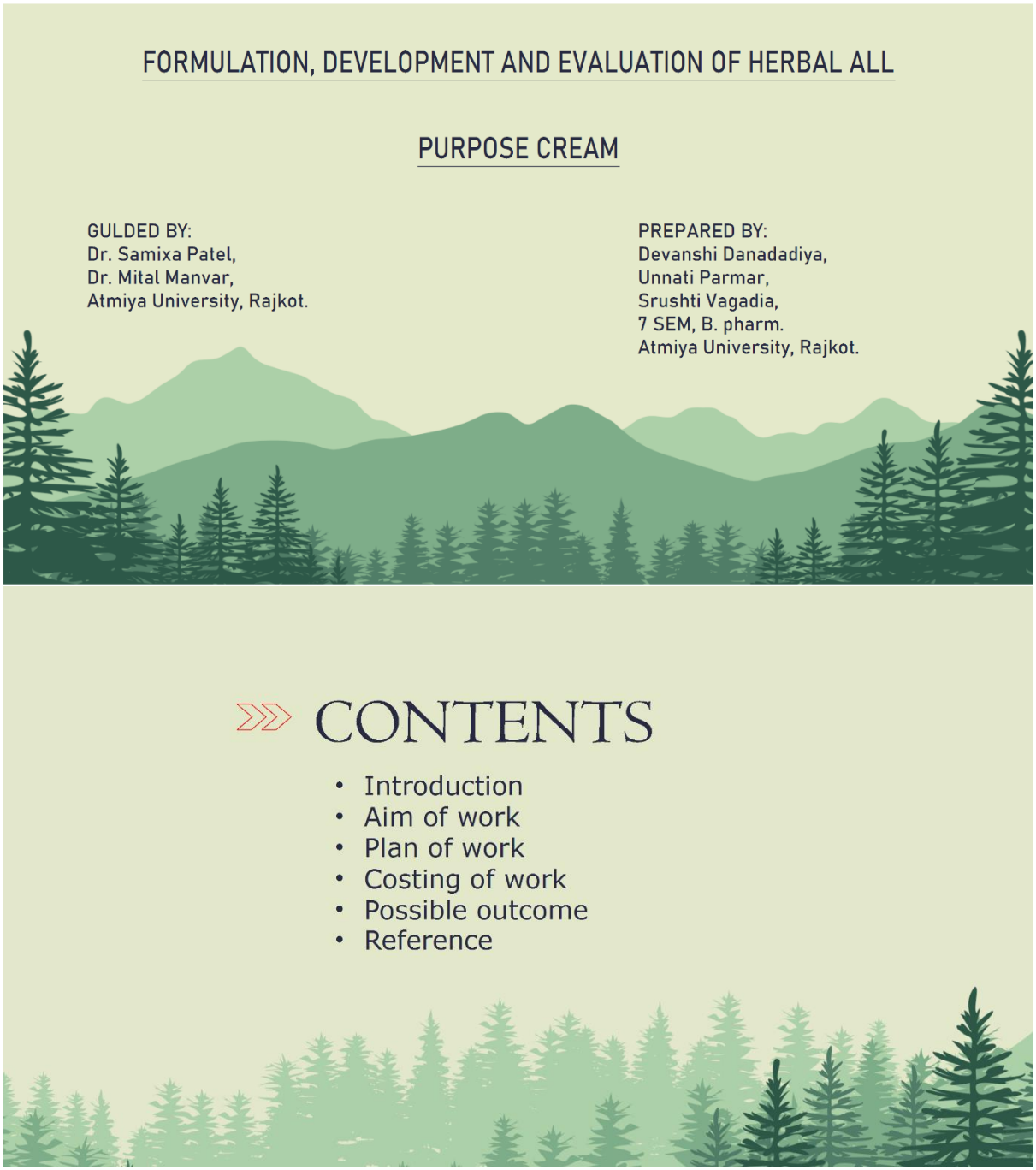

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INTRODUCTION

- In old time consumers were not as concerned about the chemicals used to make their cosmetics. They wanted cosmetic products that gave them the benefits they were looking for and they didn't think much about the ingredients used.
- But a lot has changed since those days. The rise of environmentally conscious movement, consumer activists groups and internet have all combined to create ingredient sensitive consumers who still want effective cosmetics but are looking for ones that contain ingredients that are more sustainable and feel more safe. A large majority of consumers won't buy cosmetics that contain scary sounding ingredients.

1. LEMON PEEL

- Biological name- CITRUS LIMON
- Geography- it is indigenous to north India but cultivated on large scale in countries like Spain, Italy, Sicily.
- Synonyms- Orange cortex, Seville orange.
- Uses- Preventing & fighting skin problems such wrinkles, acne, pigmentation and dark spots. Antioxidant, vit-c, Antibacterial.

2. COFFEE

- Biological name- COFFEA ARABICA
- Geography- Primary in the tropical belt, sub-sahara Africa.
- Synonyms- Caffeine, Cappuccino, Espresso, Juva.
- Uses- De-tan and Fragrance.

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3. NUTMEG

- Biological name- MYRISTICA FRAGRANS
- It is obtained from the seed.
- Synonyms- Jaifal, Cantaloupe.
- Uses- Exfoliates, Treats oily skin, Reduces pigmentation, treats acne and pimples.

2.MULBERRY POWDER

- Biological name- MORUS ALBQ
- It is obtained from the leaves of the plant.
- Synonyms- Plam , Violet, Meave .
- Uses- reduces dark pigment on the skin, Brighten the skin.

5. GINGER

- Biological name- ZINGIBER OFFICINALE
- Geography- mainly cultivated in West indies, Nigeria, Jamaica, India, Japan, Africa.
- Synonyms- Rhizoma zingiberis, Zingibere.
- Uses-Anti- aging, helps to fade scars, even skin tones & improve elasticity.

6. ROSS WATER

- Biological name- ROSA
- Geography- Native Asia, Native Europe, Africa, North America.
- Synonyms-
- Uses- Vitamin-C , Shining & smoothing skin, Antibacterial, Anti-inflammatory, reduce puffiness & redness, also use for acne.

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7. EMULSIFIERS

- Beeswax+borax
- Methylcellulose
- Lecithin
- Acacia Gum
- Woolfat(lanolin)

8. OILS

- Coconut oil
- Olive oil
- Jojoba oil

9. Preservatives

•Sorbic acid
•Benzyl alcohol

10. Buffer

•Sodium bicarbonate
•Citric acid

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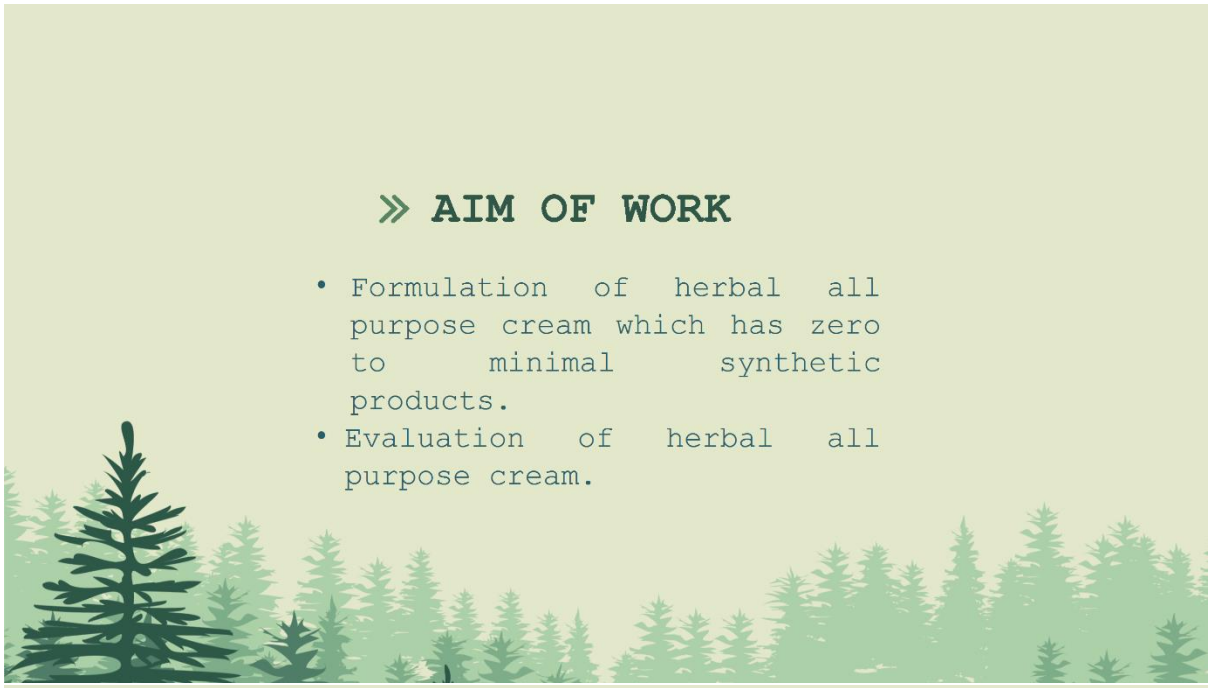

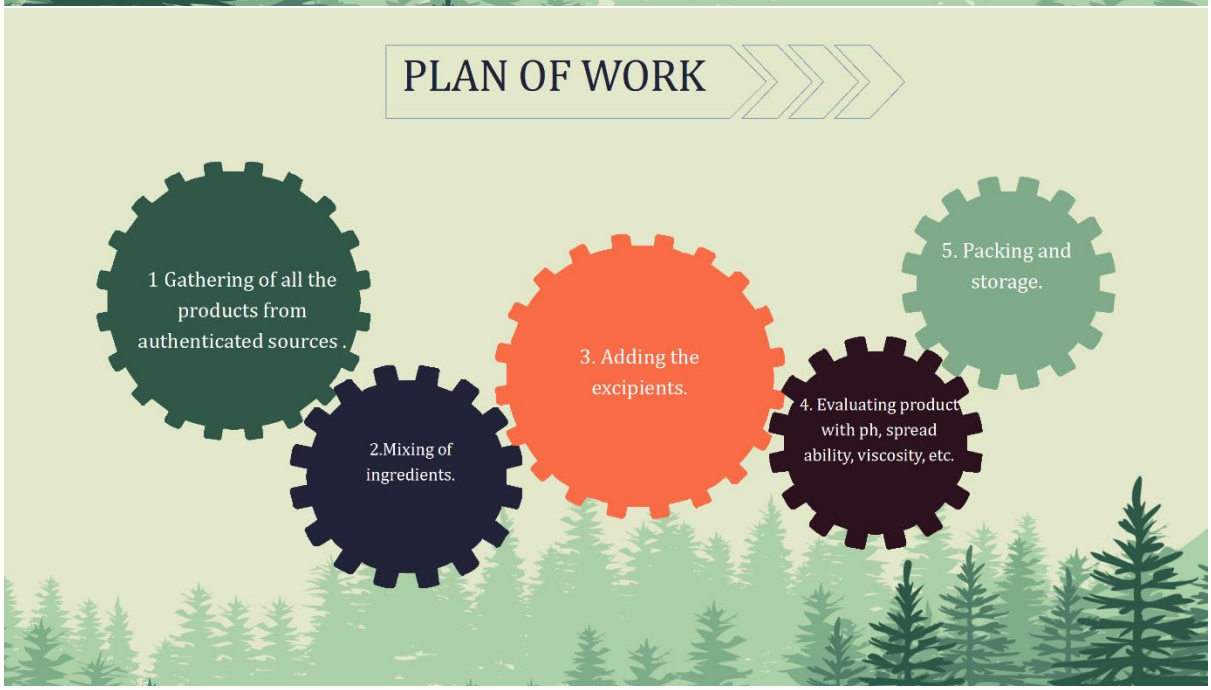

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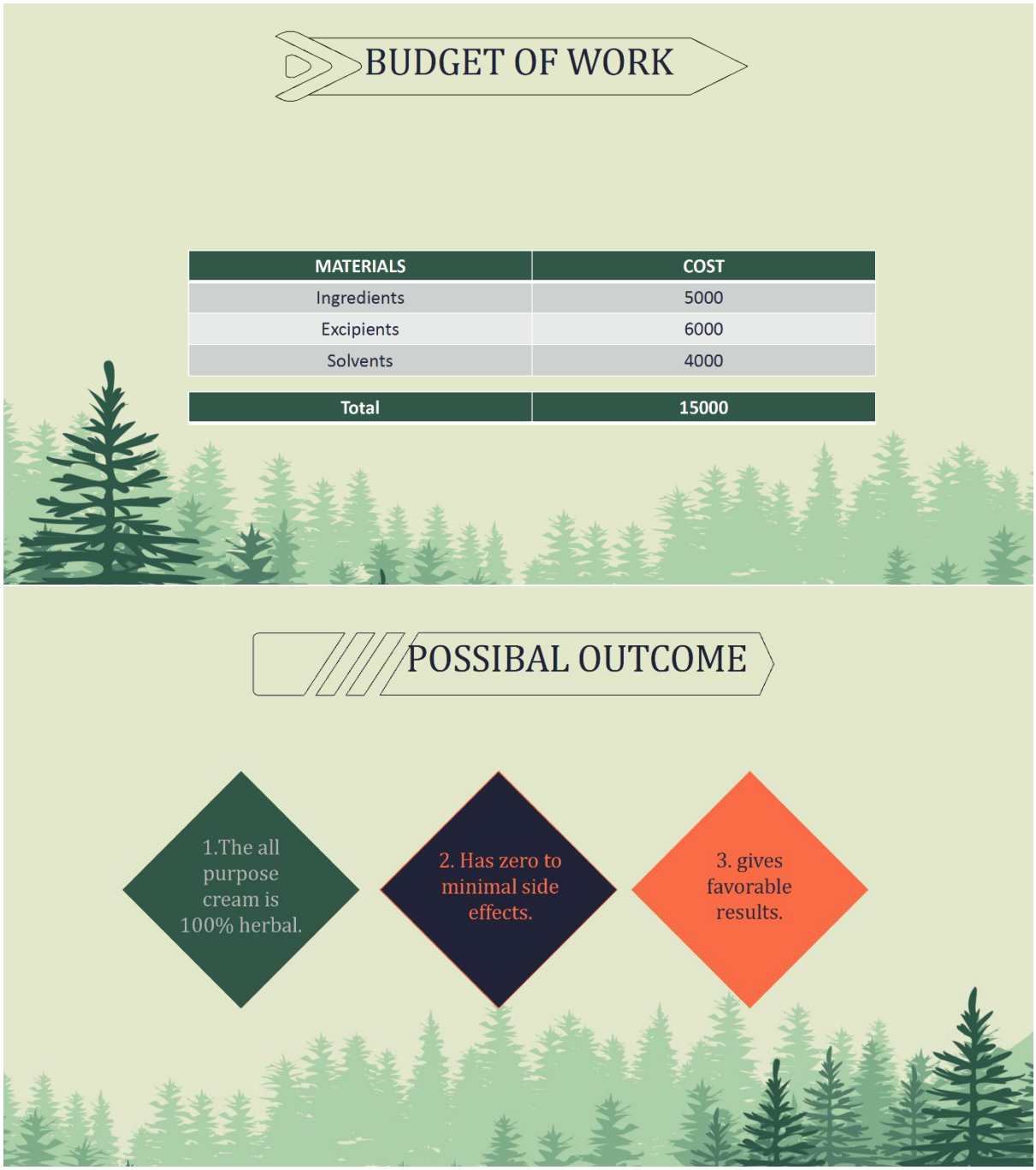

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THANK YOU

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SSIP

Herbal Formulation For Foot Corn

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Introduction for Calotropis gigantea[1]

Botanical Name : *Calotropis gigantea*

Plant Family : Apocynaceae

Common Name : Giant Milkweed, Crown Flower, Giant Calotrope, Swallow-wort

Plant Form : Herb

Habit : A large shrub, much branched, young branches covered with white cottony hairs, contains milky latex.

Leaves : 4-8 inches long, decussate, obovate

Flowers : milky sap, pale purple or white crown-like flow

Fruit : Green in colour.

Geographical sources: Road sides, waste lands. It is a fast growing perennial plant and distributed in tropical and subtropical area of the world and throughout India. [1]

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Traditional Uses:

- ***C. gigantea*** has been extensively used in Indian traditional medicine. Leaf latex is used to treat infectious skin diseases in folk medicines. It is also used in foot corn, snakebites, inflammation (swelling)[(2)] .
- The leaves of ***C. gigantea*** are used in the treatment of paralysis, swellings and intermittent fevers[(2)].
- According to Siddha systems of medicine, the leaves of *C. gigantea* are used for the treatment of poisonous snake bites, periodic fever, vatha diseases, intestinal worms and ulcers [(2)]. Latex of this plant is used to cure dental problems, rat bite, swellings, gonococcal arthritis and other rheumatic complaints [(2)].

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Pharmacological activities[(2)]:

Latex of the plant is reported to contain purgative properties, procoagulant activity, wound healing activity and antimicrobial activity.

1. Anti bacterial activity
2. Anti oxidant activity
3. Anti inflammatory activity
4. Analgesic activity
5. Antidiarrhoeal activity
6. Antipyretic activity

5

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Aim of Work:

- To prepare effective Herbal formulation of *Calotropis gigantea* for relieving foot corn.
- Evaluation of prepare herbal formulation of *Calotropis gigantea*.

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Plan of Work:

- **Authentication and collection of Plant material:**
  - Authentication of *Calotropis gigantea* plant by Faculty of Botany Department.
  - Latex of *Calotropis gigantea* will be collected from widely grown plants or may purchase from market.

- **Preparation of herbal formulations for relieving foot corn using different gelling agents.**

- **Evaluation to find more active herbal formulation for relieving foot corn .**

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Costing of the Work:

Sr. No.	Requirements	Approx. Cost (Rs.)
1	Plant material	1000
2	Chemicals	20,000
3	Hired Services	15,000
4	Other	1000
	Total	**37000**

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Possible outcome:

- The new effective herbal formulation may prepare for better treatment of foot corn.

9

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References:

1. Singh N, Gupta P, Patel AV and Pathak AK. Calotropis gigantea: a review article on its phytochemical & pharmacological profile. Int J Pharmacognosy 2014, page no: 1-2.
2. G Kumar, L Karthik and K Venkat, B Rao. A Review on Pharmacological and Phytochemical Profile of Calotropis Gigantea Linn on January 20011, page no:1-5.

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Studies on pharmacognositic parameters and evaluation of in vitro anti-diabetic effect of *Oroxylum indicum* stem extract

Guided by:

Mr. Falgun Dhabaliya,
Assistant Professor,
School of Pharmaceutical sciences,
Atmiya University, Rajkot.
Email id :- falgun.dhabaliya@atmiyauni.ac.in

Prepared by

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2.Timbadiya Arth
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Mr. Vijay Chauhan,
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Atmiya University, Rajkot.

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Content:

- Introduction
- Aim of Work
- Plane of Work
- Budget of the Work
- Possible outcome

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Introduction:

- The trumpet tree Oroxylum indicum (O. indicum) is found in the tropical region of South East Asian counties like India, Japan, China, Sri Lanka, Malaysia, and Bangladesh. This magnifcent plant has many names like Broken Bones, Midnight Horror, Sonapatha, Dashmula, and Shyonaka. This tree is immensely valued in India for its various ayurvedic preparations. [1]

3

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Plant profile: [2]

Kingdom	Plantae
Family	Bignoniaceae
Genus	Oroxylum
Species	Indicum

4

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Introduction:-

- Diabetes mellitus is a metabolic disorder characterized by impaired glucose homeostasis with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action or both. [3]

5

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Aim of Work:

- The aim of present study is to investigation of pharmacognotic and phytochemistry parameter evaluation of in vitro anti-diabetic effect of oroxylum indicum stem extract.

6

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Plan of work:

- **Collection and procurement of plant material.**
  - fresh stem and powder of dry strem.
- **Authentication and identification of plant material.**
  - stem microscopy : - transverse section
  - powder microscopy
  - TLC
- **Extraction of stem of *orxylum indicum.***
  - extraction of stem by successive solvent method. [3]
  - photochemical screening of extract. [4]

7

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standardized And evaluation parameter :-

- Total flavonoid contain
- Total phenolic contain
- Total carbohydrate contain
- TLC
- In vitro anti-antidiabetic effect
  - α-amylase Inhibitory Activity
  - α-glucosidase Inhibitory Activity

8

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Budget of the Work:

Sr. No.	Requirements	Approx. Cost (Rs.)
1	Plant material	1000
2	Chemicals and equipments	24000
3	Solvents	16,000
	Total	**41,000**

9

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Possible Outcome :

- To estimate quality control and standardization of plant oroxylum indicum.
- To prepare monograph of oroxylum indicum plant.
- Evaluation of in vitro anti-diabetic of stem extract by oroxylum indicum.

10

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References:

1. Azharul Islam, Rayhana Begum ET.AL, **"Ethnopharmacological Inspections of Organic Extract of *Oroxylum indicum*"** Volume 2019, Received 27 October 2018; Revised 14 February 2019; Accepted 21 February 2019; Published 3 April 2019.
2. D C Deka, Vimal Kumar ET.AL, **"Oroxylum indicum– a medicinal plant of North East India: An overview of its nutritional, remedial, and prophylactic properties"** Journal of Applied Pharmaceutical Science Vol. 3, Received on: 04/10/2012 Revised on: 19/11/2012 Accepted on: 02/01/2013

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3. Ramana Murty Kadali SLDV, Mangala Charan Das ET.AL "In vitro evaluation of antidiabetic activity of aqueous and ethanolic leaves extracts of Chloroxylon swietenia" Vol 7 , Received: December 18, 2016; Accepted: January 04, 2017

4. Shanti bhushan mishra, mamta simon ET.AL "phytochemical investigation and antidiabetic activity of oroxylum indicum" Received: 14 January 2019

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SSIP

Development and Evaluation of Toothpaste containing Herbs

- **Guided by:**
  Ms. Rachna Joshi, School of Pharmaceutical Sciences, Atmiya University, Rajkot

- **Prepared by:**
  Keyur Mendpara,
  7th sem, B.Pharm, School of Pharmaceutical Sciences, Atmiya University, Rajkot

  Mihir Rabadiya,
  7th sem, B.Pharm, School of Pharmaceutical Sciences, Atmiya University, Rajkot

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Content:

- Introduction
- Aim Of Work
- Plan Of Work
- Costing Of The work
- Possible Outcome
- Reference

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Introduction for Achyranthes aspera [1]

Achyranthes aspera grow as weed.

Scientific name: Achyranthes aspera
Family: Amaranthaceae
Kingdom: Plantae
Common name: Aghedo, Apamarga, Nayurivi
Geographical source: India, Pakistan, Iran.
Fruits : Oblong utricle
Seeds : Endospermic with curved embryo, 2 mm long, oblong black
Flowering and Fruiting time : September to April

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Aim Of Work:

- Formulation of anti-microbial paste using extract of Achyranthes aspera.
- To get better activity of anti-microbial paste .
- Evaluation of anti-microbial activity of herbal paste.

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Plan of Work:

- **Plant Material:**
  - Collect the raw plant material and wash and dried it.
  - Grind in powder form and store in air tight container.

- **Preparation of plant extract**:
  - The dried plant material are separately extracted with hydro alcoholic solvent using soxhelet apparatus.

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- **Preparation of formulation[4]:**
- Prepare 3 sample by mixing different concentration of extract in base having excipient and flavoring agent.
- Anti-microbial study of prepared herbal paste.
- Evaluation of more active herbal paste.

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Costing of the Work:

Sr. No.	Requirements	Approx. Cost
1	Plant material	5000
2	Chemical and Equipment	20,000
3	Solvents	7000
4	Other	3000
	Total	35,000

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Possible outcome:

- The new effective herbal formulation may Prepare for better treatment of microbial activity.

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Reference:

1. Pharmacognostical study on flowers and fruits of Apamarga (Achyranthes aspera Linn.) Hasmukh R. Jadav, Galib Ruknuddin, P. K. Prajapati, C. R. Harisha1 Department of Rasashastra and Bhasihajya Kalpana, 1 Pharmacognosy Laboratory, Institute for Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University, Jamnagar, Gujarat, India
2. Roma Yadav, Radhika Rai,[1] Abhishek Yadav, Meetika Pahuja,[2] Savita Solanki,[3] and Himani Yadav Evaluation of antibacterial activity of *Achyranthes aspera* extract against *Streptococcus mutans*: An *in vitro* study J Adv Pharm Technol Res. 2016 Oct-Dec; 7(4): 149–152. doi: 10.4103/2231-4040.191426

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Refrence

3. Kapil Kumar Verma, Akanksha Sharma, Hans Raj, Bhopesh Kumar. comprehensive review on traditional uses, chemical compositions and pharmacology properties of Achyranthes aspera (Amaranthaceae) VOL 11 NO 2-S (2021): VOLUME 11, ISSUE 2-S, MARCH-APRIL 2021

4. Pavan Deshmukh, Roshan Telrandhe, Mahendra Gunde. Formulation and Evaluation of Herbal Toothpaste: Com-pared With Marketed Preparation VOLUME-5, ISSUE-10, OCTOBER-2017

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Formulation, development, and evaluation of herbal face pack

Guided by,
Dr. Samixa Patel
Dr. Mital Manvar
Atmiya University, Rajkot

Prepared by,
Srushti Vagadia
Devanshi Danadadiya
Unnati Parmar,
Atmiya University, Rajkot.

1

Contents

- ❑ Introduction
- ❑ Aim of work
- ❑ Plan of work
- ❑ Budget of work
- ❑ Possible outcome
- ❑ References

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Introduction

- The definition of the word natural from the Merriam Webster dictionary is, "existing in nature and not made or caused by people: coming from nature: not having any extra substances or chemicals added.
- Natural cosmetics are made from raw materials sourced from nature. The raw materials go through the least amount of processing and cause the least impact to humans, animals and the earth. Natural cosmetics assist to beautify and promote radiant body, skin and hair.
- The present study has been undertaken with the aim to formulate and evaluate the natural face pack containing main ingridients like Tea tree oil, Rosehip oil, orange peel, Honey, Turmeric, Potato starch, Clay, Clove, and Eucalyptus oil.
- The formulation has is predicted to overcome 16 skin problems like acne, aging, moisturizing, whitening, brightening, scars, clean pores, bacterial and fungal outgrowths, de-tan, smoothening, softening, de-pigmentation, blackheads, sunburns and rejuvenation.

3

1.ROSEHIP OIL- It goes by the name briar rose, sweet briar, and wild rose. Its botanical name is ROSA RUBIGINOSA. It is extracted from the fruits and seeds of the plant. It moisturizes, reduces and reverses sun damage, anti aging, and boosts collagen formation.

2.HONEY- Botanical name is APIS MELIFERA and common name is Madhu. It is very popular in the cosmetic industry as it has numerous benefits such as moisurizing, pore cleaning, lightening scars, etc.

3.CLOVE OIL- Clove is also known as long or lavong in India and botanically is known as SYZYGIUM AROMATICUM. They are the flower buds of the clove tree. It has anti bacterial property and also acts as a preservative.
4. GARLIC

4. GARLIC- It is ALLIUM SATIVUM and common names are Chive and Ail.The cloves are used. It is anti bacteria and fungal, and improves blood circulation.

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5. CLAY- It is the BENTONITE CLAY and is popularly known as Multani mitti. It is anti septic, cleans pores, prevents breakouts, whitens and brightens the skin.

6.TURMERIC- The botanical name is CURCURA LONGA and commonly known as haldi, curcuma, and saffron India. It is a root. It has many uses like anti septic, de-tans, healing effect, improves skin health, and whitens the skin.

7.POTATO STARCH- Goes by the name SOLLANUM TUBEROSUM and the common names are Yam, Murphy, and Spud. It is a tuber and helps whitening and brightening the skin.

8.EUCALYPTUS OIL- It is derived from the leaves of EUCALYPTUS GLOBULUS. It is an essential oil which has anti fungal properties, anti-inflammatory, soothes sunburns.

5

9. TEA TREE OIL- Biological name- MELALEUCA ALTERNIFOLIA. It is also known as Melaleuca oil. Its uses are Anti-inflammatory, Antibacterial, and treats acne.

10. ORANGE PEEL- Biological name- CITRUS SINENSIS. Its common name is Tangerine. It is a citrus fruit and is a rich source of vit C. Its uses are Skin rejuvenation, and Anti aging.

11.PRESERVATIVES- Garlic, Benzyl alcohol, Sorbic acid, and phenol.

12. FRAGRANCE- Lavender oil, Vanillin essence, Chocolate essence.

13.COLOR- Beetroot powder and COFFEA ARABICA can be used as a natural colorant.

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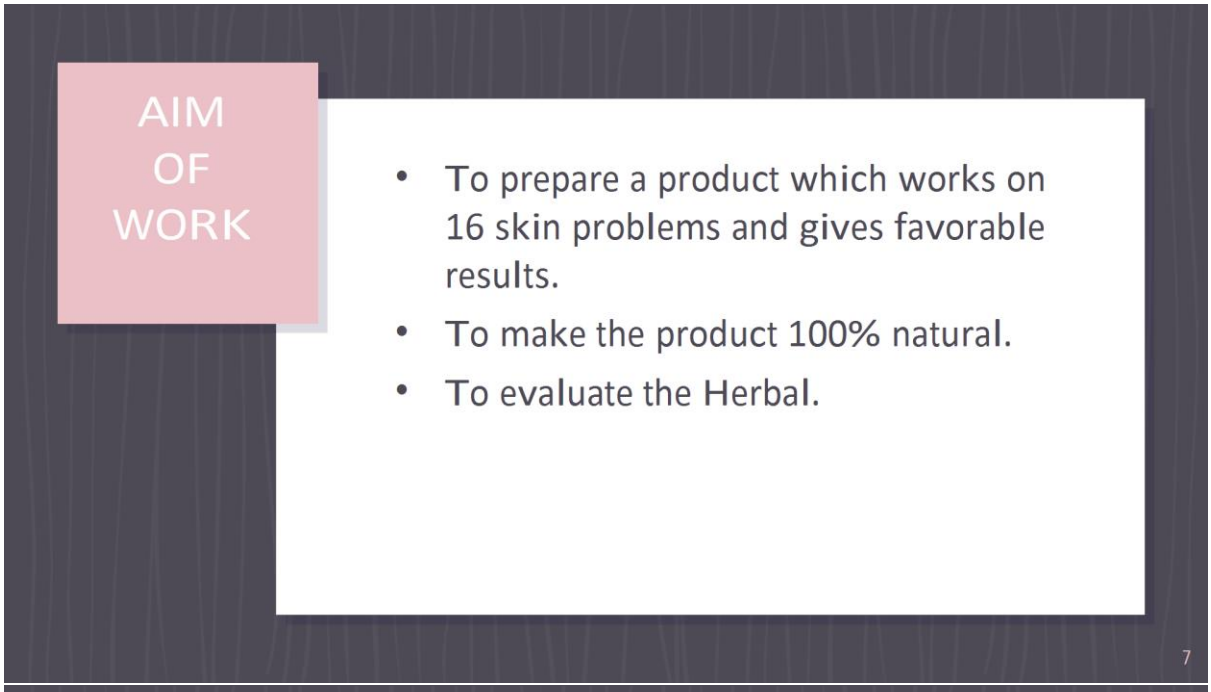

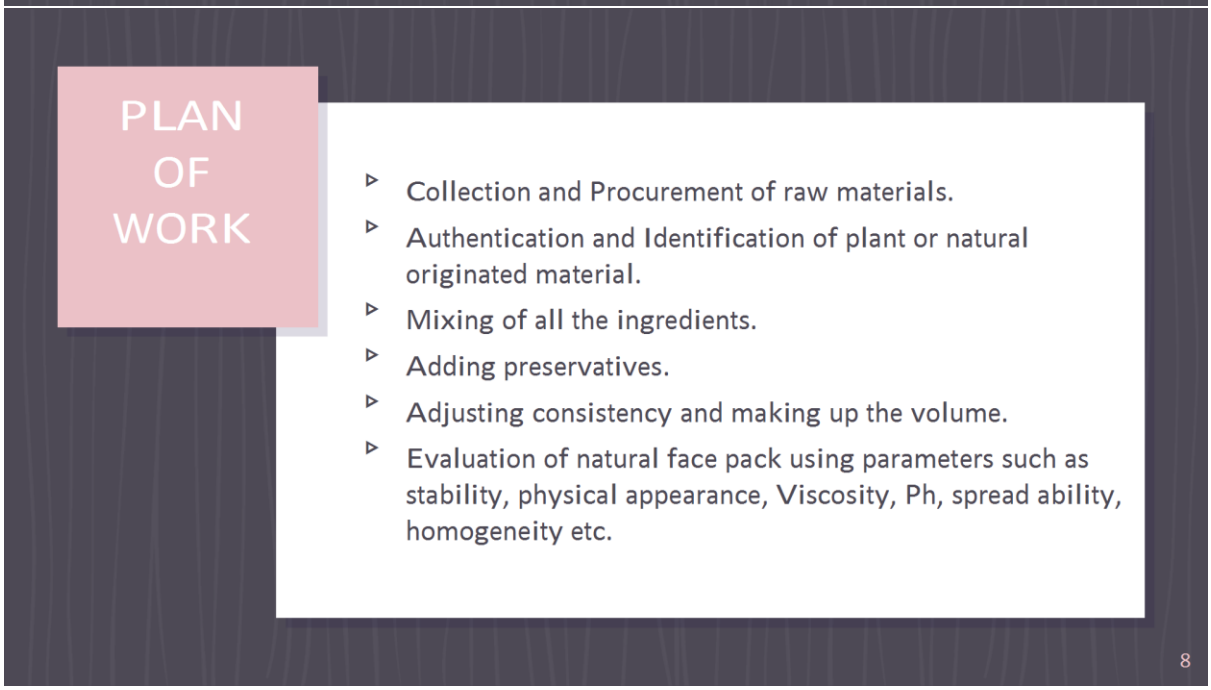

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BUDGET OF WORK

Materials	cost
Ingredients	21,000
Excipients	4000
Total	25000

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POSSIBLE OUTCOMES

- The face pack is 100% natural.
- It has zero to minimal side effects.
- Gives favorable results.

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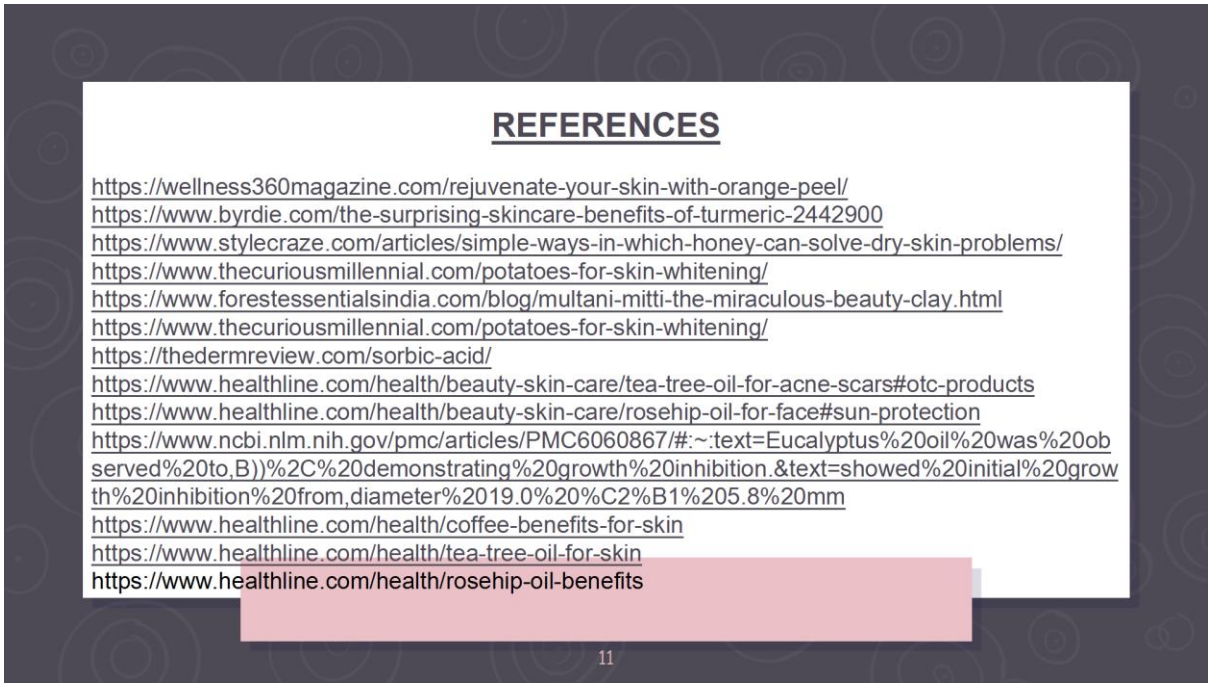

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Studies on pharmacognositic parameters and evaluation of in vitro anti-diabetic effect of *Oroxylum indicum* stem extract

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Content:

- Introduction
- Aim of Work
- Plane of Work
- Budget of the Work
- Possible outcome

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Introduction:

- The trumpet tree Oroxylum indicum (O. indicum) is found in the tropical region of South East Asian counties like India, Japan, China, Sri Lanka, Malaysia, and Bangladesh. This magnifcent plant has many names like Broken Bones, Midnight Horror, Sonapatha, Dashmula, and Shyonaka. This tree is immensely valued in India for its various ayurvedic preparations. [1]

3

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Plant profile: [2]

Kingdom	Plantae
Family	Bignoniaceae
Genus	Oroxylum
Species	Indicum

4

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Introduction:-

- Diabetes mellitus is a metabolic disorder characterized by impaired glucose homeostasis with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action or both. [3]

5

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Aim of Work:

- The aim of present study is to investigation of pharmacognotic and phytochemistry parameter evaluation of in vitro anti-diabetic effect of oroxylum indicum stem extract.

6

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Plan of work:

- **Collection and procurement of plant material.**
  - fresh stem and powder of dry strem.
- **Authentication and identification of plant material.**
  - stem microscopy : - transverse section
  - powder microscopy
  - TLC
- **Extraction of stem of *orxylum indicum.***
  - extraction of stem by successive solvent method. [3]
  - photochemical screening of extract. [4]

7

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standardized And evaluation parameter :-

- Total flavonoid contain
- Total phenolic contain
- Total carbohydrate contain
- TLC
- In vitro anti-antidiabetic effect
  - α-amylase Inhibitory Activity
  - α-glucosidase Inhibitory Activity

8

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Budget of the Work:

Sr. No.	Requirements	Approx. Cost (Rs.)
1	Plant material	5000
2	Chemicals and equipments	29000
3	Solvents	16,000
	Total	**50,000**

9

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Possible Outcome :

- To estimate quality control and standardization of plant oroxylum indicum.
- To prepare monograph of oroxylum indicum plant.
- Evaluation of in vitro anti-diabetic of stem extract by oroxylum indicum.

10

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References:

1. Azharul Islam, Rayhana Begum ET.AL, **"Ethnopharmacological Inspections of Organic Extract of *Oroxylum indicum*"** Volume 2019, Received 27 October 2018; Revised 14 February 2019; Accepted 21 February 2019; Published 3 April 2019.
2. D C Deka, Vimal Kumar ET.AL, **"Oroxylum indicum– a medicinal plant of North East India: An overview of its nutritional, remedial, and prophylactic properties"** Journal of Applied Pharmaceutical Science Vol. 3, Received on: 04/10/2012 Revised on: 19/11/2012 Accepted on: 02/01/2013

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3. Ramana Murty Kadali SLDV, Mangala Charan Das ET.AL "In vitro evaluation of antidiabetic activity of aqueous and ethanolic leaves extracts of Chloroxylon swietenia" Vol 7 , Received: December 18, 2016; Accepted: January 04, 2017

4. Shanti bhushan mishra, mamta simon ET.AL "phytochemical investigation and antidiabetic activity of oroxylum indicum" Received: 14 January 2019

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PROPOSAL REFERENCE NO. : BT/IF0073/02/22

FACE SHEET

Applicant Type
Individual
Name of Applicant
Tulshi Shiyani
How do you want to apply?
Innovation Fellows
Title of Proposal
Generation of green hydrogen using biohybrid materials
Category
Industrial Biotechnology (Industrial Products and Process)
Preferred EYCs, in the order of preferences
1'st Preference
Atmiya University Rajkot
2'nd Preference
Panjab University, Sector 14, Chandigarh
3'rd Preference
Anna University, Chennai

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APPLICANT DETAILS

First Name	Tulshi
Last Name	Shiyani
Gender	Male
Indian Citizen	Yes
Upload ID proof (Adhaar/any other)	View File
Details of last degree pursued	
Select Degree	Ph.D
Specialization	Nanosciences
Name of Institute/College	Central University of Gujarat
Institute Address	Sector 30, Gandhinagar-382030
Degree Completed	Yes
Date of Completion	2022-04-08
Email	sh.ts@protonmail.com
Personal Address	Anandpar, Society street no. 3, Kuwadava road, Rajkot-360003, Gujarat
District	Rajkot
Aspirational district	Yes
Mobile Number	7990561767
Upload Resume	View File

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PROPOSAL DETAILS

Aim/Objective of the proposal
â€¢ To develop nature inspired photoelectrochemical energy conversion devices â€¢ To demonstrate water splitting for solar fuel generation â€¢ To generate green hydrogen from water using biohybrid electrodes â€¢ To store solar fuel for future applications
Unmet Need/Problem statement
Global warming is serious problem on earth. The usage of fossil fuel has damaged the earthâ€™s atmosphere. Fossil fuel based vehicles, and energy generation system have produced pollutions that has been spread in water, air and soil. Therefore, there is a need to develop alternative fuel and energy resources for various applications.
Proposed solution
I have demonstrated the biohybrid photoelectrodes made up from natural dye and semiconducting materials for photoelectrochemical energy conversion applications. These biohybrid electrodes can mimic the photosynthesis process to generate solar fuel such as hydrogen and oxygen using solar energy via water splitting process.
Hypothesis (Why do you think the solution will work)
The biohybrid solar cells works on the principle of photoelectric effect. The photovoltaic cell is already in the market at commercial scale and generates electricity using sunlight. In nature, trees are already converting solar energy into chemical energy using sunlight through photosynthesis process. Therefore combining these two phenomena, we can develop technology to convert solar energy into solar fuel for various applications.
Any prelim work done (in house/lit)
We have fabricated and demonstrated the biohybrid photoelectrodes for photoelectrochemical energy conversion with generation of hydrogen and oxygen and also demonstrated photoswitching applications.
Upload Any prelim work done (in house/lit)
View File
References/citation
1. Biohybrid photoelectrodes for solar photovoltaic applications, Bul. Mat. Sci., 2022. DOI: https://doi.org/10.1007/s12034-021-02598-w 2. Flexible zinc oxide photoelectrode for photo electrochemical energy conversion, J. Mat. Sci. & Mat. Ele., 32, pp. 15386â€“15392, 2021. 3. Studies on optical and
Commercialization Potential and business plan
The proposed work can be useful to generate gaseous and liquid solar fuels. The biohybrid electrodes can be used to prepare electrolyzer system that can generate continuously solar fuel hydrogen. This hydrogen can be stored and used in various applications.
Work plan (Please upload flow chart or infographics in PDF format)
View File

Provide measurable objectives of the proposed program along with their timeline

S.No	Milestones	Activities	Timeline
1	To prepare biohybrid photoelectrodes	Fabrication of biohybrid photoelectrodes	1-3 months
2	To measure properties of biohybrid photoelectrodes and testing them for water splitting process	Measurement and testing of biohybrid photoelectrodes for photoelectrochemical energy conversion	3-5 months

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3	To apply for patent Indian	Preparing documentation and application of proposed work for patent	5-7 months
4	To prepare prototype model of proposed technology	Preparation of prototype of technology to generate solar fuel	7-9 months

Final deliverable at the end of 18 months
â€¢ The biohybrid photoelectrodes will be prepared using organic and inorganic materials. â€¢ The biohybrid photoelectrodes will be tested for photoelectrochemical energy conversion applications. â€¢ Generation of solar fuel hydrogen and oxygen using water splitting process. â€¢ Patent on green hydrogen generation using biohybrid photoelectrodes â€¢ Industrial scale testing of hydrogen production and storage â€¢ Commercialization of technology for hydrogen applications.
Anticipated probability of setting up of a start up towards end of the project (on a scale of 0-100%)
90-100%
Within the project duration
Yes
Any specialized infrastructure/ equipment required to run the project
â€¢ Laboratory to do experiments. â€¢ Office sitting to do documentation, analysis of data and publishing work.
Details of funding received for same/similar activities as proposed here from any other source?
I have not received any fund from this or any other sources for proposed work.
Any additional information that would facilitate better review of the proposal
I have experience in the fabrication testing of about 8 years. I will get my provisional Ph.D. degree in January month. My detail profile can seen at www.sites.google.com/view/thetulshi

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PROPOSAL REFERENCE NO. : BT/IF0005/01/22

FACE SHEET

Applicant Type
Individual
Name of Applicant
Mintu Nimavat
How do you want to apply?
Innovation Fellows
Title of Proposal
Fungal Application for Mycobricks and other commercial products by using agricultural waste to reduce pollution.
Category
Agriculture and allied areas
Preferred EYCs, in the order of preferences
1'st Preference
Atmiya University Rajkot
2'nd Preference
University of Rajasthan,Jawahar Lal Nehru Marg, Rajasthan University Campus, Talvandi
3'rd Preference
Panjab University, Sector 14, Chandigarh

1/4

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APPLICANT DETAILS

First Name	Mintu
Last Name	Nimavat
Gender	Female
Indian Citizen	Yes
Upload ID proof (Adhaar/any other)	View File
Details of last degree pursued	
Select Degree	PG
Specialization	Microbiology
Name of Institute/College	Christ Collage
Institute Address	Christ Campus, Vidya Niketan, Saurashtra University, Rajkot, Gujarat 360005
Degree Completed	Yes
Date of Completion	2020-12-19
Email	mintunimavat@gmail.com
Personal Address	To. Champabeda, Tal. Kotda Sangani, Dist. Rajkot, Gujarat 360070
District	Rajkot
Aspirational district	Yes
Mobile Number	6353450567
Upload Resume	View File

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PROPOSAL DETAILS

Aim/Objective of the proposal
Fungal application for mycobricks and other commercial products to reduce pollution.
Unmet Need/Problem statement
Air and land pollution is considered as the global problem. Multiple health related issues as well as adverse effect on environment is directly concerned with pollution.it can be dedicated by application of microorganism upto certain extend.
Proposed solution
The present study is an effort towards application of fungi to manufacture mycobricks as well as other commercial product without any deleterious effect on environment.
Hypothesis (Why do you think the solution will work)
It has been reported that fungi have been used earlier in mycobricks formation, but have not be implemented yet. We hypothesize that our product will not only work with the mycobricks but also used in the other aspects.
Any prelim work done (in house/lit)
yes
Upload Any prelim work done (in house/lit)
View File
References/citation
Shrivastava, M. 1998 . Studies on mushroom dehydration Pleurotus florida . PhD. Thesis submitted to IIT, KGP, W.B., India Chang, S. T. and J. A. Buswell. 1996. Mushroom nutriceuticals. World J. Microbiology Biotech,12:473-4 https://www.instructables.com/Grow-Architectural-Models-with-Mushrooms/
Commercialization Potential and business plan
Mycobricks will be our first product that will be used in the laboratory scale then it will be applied in pilot scale. It is cost effective and usage agri waste to reduce concrete. After successful application it can commercialized by local level advertisement such as newspaper, radio as well as social media.
Work plan (Please upload flow chart or infographics in PDF format)
View File

Provide measurable objectives of the proposed program along with their timeline

S.No	Milestones	Activities	Timeline
1	Sample Collection & Isolation of basidiospore	Collection of coconut husk, shells, groundnut shells, cotton plant etc.	3 - 4 months
2	Basidiospore Harvesting	Identification and spawn culture preparation	3 months
3	Mycobricks	Formation of mycobricks	6 months
4	Furniture Manufacture	Using different shaped molds to manufacture furniture.	4 months

Final deliverable at the end of 18 months
Formation of mycobricks or portable furniture
Anticipated probability of setting up of a start up towards end of the project (on a scale of 0-100%)
60-70%
Within the project duration

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Yes
Any specialized infrastructure/ equipment required to run the project
Mushroom cultivation room and different shaped molds.
Details of funding received for same/similar activities as proposed here from any other source?
NA
Any additional information that would facilitate better review of the proposal
Here, the substrate will be cheaper and waste. Hence, with lower value substrate, higher value product will be obtained.

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Application form for Research Proposal

Part -A
(General Information)

1.	**Title of the proposal**	Study of immune modulation by *Pongemia pinnata* alcohol extract	
2.	**Broad area of proposal**	Life Science	
3.	**Sub Area of proposal**	Microbiology	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Abhishikta Basu	Assistant Professor, Department of Microbiology	E-mail abhishikta.basu@atmiyauni.ac.in Moble: +919886784174
5.	**Details of Co-investigators**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	NA	NA	NA
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**		
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	August 2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of University**	NA	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	**Educational Qualification**				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	Ph. D.	Medicine	University of Miyazaki	2020	NA
ii.	Post-Graduation	Microbiology	Indian Academy Centre for Research and PG Studies, Bangalore University	2005	First Class
iii.	Under Graduation	Microbiology, Zoology and Chemistry	Garden City College, Bangalore University	2003	First Class
iv.	CSIR/UGG-NET/ SLET/GATE	Life Science	CSIR-UGC	2005	NA
2.	**Have you previously received any Fellowship from any funding agency?**		√**YES**	☐~~**NO**~~	
3.	**If yes, please indicate whether it was a (✓ tick appropriate)**		√Short-term fellowship (*viz* Project fellow, Project assistant, etc.) √ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other) Yes ☐ ~~post-doctoral fellowship (*viz* D S Kothari PDF, or any other)~~		
4.	**If yes, mention the details of fellowship and tenure**		**Short-Term fellowship** Project Trainee National Centre for Biological Sciences Sep 2008 - Sep 2009 1 year 1 month Bangalore, India **Pre-Doctoral Fellowship** 1. Junior Research Fellow Institute for Stem Cell Biology and Regenerative Medicine (inStem) Oct 2009 - Jan 2011 1 year 4 months Bangalore, India 2. Junior Research Fellow Nitte University Feb 2015 - Aug 2015 7 months Mangalore, India		
5.	**Details of on-going and completed research funded projects (if any)**				
	S.N.	**Title**	**Project Cost**	**Sponsoring**	**Duration**

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				Agency	**(Start – End – MM/YYYY)**
	NA	**NA**	**NA**	**NA**	**NA**
6.	**Total Experience**		Post-Graduation: 12 Years Post-Doctoral: 02 Years		
7.	**No. of Publication (Research articles - UGC Approved only)**		01		
8.	**No. of Publication (Book Chapters)**		01		
	Books Published				

Research Article:

1. **Basu, A.,** Yoshihama, M., Uechi, T., & Kenmochi, N. (2020). Prokaryotic ribosomal RNA stimulates zebrafish embryonic innate immune system. *BMC Research Notes*, *13*, 1-6.

Book Chapter:

1. Balasubramaniyam, T., **Basu, A.,** Nathan, V. K., & Lee, J. H. (2022). Therapeutic Potentials of Superoxide Dismutase: Current Status and Future Prospects.

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Study of immune modulation by *Pongemia pinnata* alcohol extract

2. Abstract (Provide a summary of your research proposal in 300 words)

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The human immune system is a dynamic network responsible for defending the body against a diverse array of threats, including pathogens, toxins, and environmental insults (Janeway et al., 2001). Its intricate orchestration of innate and adaptive responses is crucial for maintaining health and preventing disease (Abbas et al., 2017). However, various factors, including aging, chronic stress, and certain lifestyle choices, can compromise immune function, rendering individuals more susceptible to infections and chronic illnesses (Chandra, 2000).

Exploring natural compounds with immunomodulatory properties has gained significant traction in recent years. These compounds, derived from plants, animals, and microorganisms, can exert profound effects on various aspects of the immune system, including cell proliferation, cytokine production, and phagocytosis (O'Brien et al., 2000).

Pongamia pinnata, a fast-growing leguminous tree, has been traditionally utilized in Ayurvedic medicine for its diverse therapeutic properties (Kirtikar & Basu, 1935). Previous studies have demonstrated that various parts of this plant, including seeds, leaves, and bark, possess a range of pharmacological activities, such as antioxidant, anti-inflammatory, and antimicrobial effects (Sultana et al., 2009; Jayaprakasha et al., 2001). These activities are often attributed to the presence of a rich array of bioactive compounds, including flavonoids, terpenoids, and saponins (Veena et al., 2008).

While the potential of *P. pinnata* in various pharmacological contexts has been explored, its impact on the immune system remains relatively understudied. This project aims to

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systematically investigate the immunomodulatory effects of an alcohol extract of *P. pinnata* on key components of the immune system.

Specific research activities to be pursued during the project period include:

1. **In vitro studies:**
    - **Assessment of the effects of the extract on immune cell proliferation and differentiation:** This will involve evaluating the impact of the extract on the proliferation of lymphocytes (T cells and B cells), macrophages, and dendritic cells, as well as their differentiation into effector cells (Paul, 2008).
    - **Analysis of cytokine production:** The study will investigate the effect of the extract on the production of key cytokines, including interleukins (IL-1, IL-2, IL-4, IL-10, IL-17), interferon-gamma (IFN-γ), and tumor necrosis factor-alpha (TNF-α), by immune cells (Akira, 2000).
    - **Evaluation of phagocytic activity:** This study will assess the impact of the extract on the phagocytic activity of macrophages, a crucial process for pathogen clearance (Sbarra & Karnovsky, 1959).
    - **Investigation of the effect on oxidative burst:** The study will evaluate the effect of the extract on the production of reactive oxygen species (ROS) by immune cells, an essential component of the oxidative burst (Babior, 1978).
2. **In vivo studies:**
    - **Evaluation of the effect of the extract on immune responses in animal models:** The study will utilize appropriate animal models to investigate the in vivo effects of the extract on various aspects of the immune response, such as antibody production, delayed-type hypersensitivity reactions, and resistance to infections (Kuby, 2007).
3. **Mechanistic studies:**
    - **Investigation of the underlying mechanisms of action:** The study will aim to elucidate the molecular mechanisms by which the *P. pinnata* extract exerts its immunomodulatory effects. This may involve investigating the interaction of the extract with specific receptors on immune cells and identifying the key signaling

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pathways involved (Turner, 2006).

This research has significant implications for both human and animal health. If the *P. pinnata* extract is found to possess potent immunomodulatory properties, it could potentially be developed into a novel therapeutic agent for a range of immune-related disorders, including immunodeficiency disorders (Janeway et al., 2001), autoimmune diseases (Abbas et al., 2017), infectious diseases (Kuby, 2007), and potentially even cancer (Coussens & Werb, 2002).

Furthermore, the findings of this study could contribute to the development of novel immunotherapeutic strategies and provide valuable insights into the potential of natural products in modulating immune function.

This research will provide valuable scientific data on the immunomodulatory properties of *P. pinnata* and contribute to the development of novel natural therapies for a range of immune-related disorders.

References

- Abbas, A. K., Lichtman, A. H., & Pillai, S. (2017). Basic immunology:
- Akira, S. (2000). Cytokine signaling in innate immune response.
- Babior, B. M. (1978). Oxygen-dependent microbial killing by

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The immunomodulatory potential of **Pongamia pinnata** has received limited but significant attention in recent years. While the plant is widely recognized for its pharmacological activities, including antioxidant, anti-inflammatory, and antimicrobial properties, its specific effects on immune modulation remain inadequately explored. Phytochemical studies have identified bioactive compounds such as flavonoids, saponins, and terpenoids, which are known to influence immune cell behavior (Sultana et al., 2009; Jayaprakasha et al., 2001).

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Initial research indicates that Pongamia pinnata extracts may modulate immune functions by enhancing cytokine production, promoting lymphocyte proliferation, and regulating oxidative stress (Veena et al., 2008; Akira, 2000). However, most of these findings are based on in vitro experiments, with limited in vivo studies to corroborate their therapeutic relevance. Furthermore, the molecular mechanisms underlying these effects, including their interactions with immune cell receptors and signaling pathways, remain largely unknown (Turner, 2006).

This project seeks to systematically investigate the immunomodulatory effects of Pongamia pinnata alcohol extracts. By exploring its influence on immune cell proliferation, cytokine dynamics, and oxidative burst mechanisms, this research aims to fill critical knowledge gaps and establish the plant's potential as a therapeutic agent for managing immune-related disorders.

1. Akira, S. (2000). Cytokine signaling in innate immune response. *Nature Immunology*, 2(8), 675–681.
2. Jayaprakasha, G. K., Rao, L. J., & Sakariah, K. K. (2001). Antioxidant activities of flavidin in Pongamia pinnata. *Journal of Agricultural and Food Chemistry*, 49(8), 4087–4092.
3. Sultana, N., Saify, Z. S., & Ahmad, A. (2009). Phytochemical studies on Pongamia pinnata. *Journal of the Chemical Society of Pakistan*, 31(3), 492–497.
4. Turner, M. D., Nedjai, B., Hurst, T., & Pennington, D. J. (2006). Cytokines and chemokines: At the crossroads of cell signaling and inflammatory disease. *Biochimica et Biophysica Acta (BBA) - Molecular Cell Research*, 1773(4), 322–335.
5. Veena, S. M., Prakash, H. S., & Niranjana, S. R. (2008). Biochemical characterization and antioxidant properties of Pongamia pinnata. *Indian Journal of Biotechnology*, 7(1), 125–128.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

- **To Evaluate the Immunomodulatory Effects of Pongamia pinnata Alcohol Extract in vitro**

  This involves assessing the impact of the extract on immune cell proliferation, cytokine

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production, phagocytic activity, and oxidative burst in immune cells.

- **To Investigate the Immunomodulatory Potential of Pongamia pinnata Alcohol Extract in vivo**
  This includes evaluating the effects of the extract on immune responses, such as antibody production, delayed-type hypersensitivity reactions, and resistance to infections in appropriate animal models.
- **To Elucidate the Molecular Mechanisms Underlying the Immunomodulatory Activity of Pongamia pinnata Alcohol Extract**
  This entails exploring the interaction of the extract with immune cell receptors and identifying key signaling pathways involved in mediating its effects.

6. Significance of the proposed study: (300 words)

The proposed study, "Study of immune modulation by Pongamia pinnata alcohol extract," holds substantial significance in the current scientific and healthcare landscape. The immune system is critical for protecting the body from pathogens, toxins, and environmental stressors, but it is often compromised by factors such as aging, chronic stress, and lifestyle-related conditions. Identifying natural compounds with immunomodulatory properties can provide novel approaches to enhancing immune function and addressing immune-related disorders.

Pongamia pinnata, a leguminous tree widely used in traditional medicine, is recognized for its pharmacological properties, including antioxidant, anti-inflammatory, and antimicrobial effects. However, its specific role in modulating the immune system remains largely unexplored. This study aims to fill this critical gap by systematically investigating the immunomodulatory potential of alcohol extracts of **P. pinnata**.

The findings of this research could have far-reaching implications. If the extract demonstrates significant immunomodulatory activity, it could be developed into a cost-effective, plant-based therapeutic agent for managing a range of immune-related disorders, including autoimmune diseases, immunodeficiency conditions, chronic infections, and possibly even cancer. Additionally, the study could uncover novel bioactive compounds that may serve as leads for

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drug development, contributing to the growing field of natural product-based therapeutics.

This research also aligns with the increasing global emphasis on integrating traditional knowledge with modern medicine. It highlights the value of biodiversity and underscores the need for sustainable utilization of plant resources. By bridging traditional medicinal practices and cutting-edge immunological research, the study could pave the way for innovative treatments that are both scientifically validated and culturally relevant.

In summary, the proposed study is not only poised to contribute significantly to scientific knowledge but also to address pressing healthcare needs, potentially improving outcomes for individuals with compromised immune function.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study, "Study of immune modulation by Pongamia pinnata alcohol extract," holds particular relevance to Gujarat, a state known for its rich biodiversity and extensive use of traditional medicinal practices. **Pongamia pinnata**, commonly known as Karanj, is a native species widely found in Gujarat, where it thrives in the semi-arid and coastal regions. The tree is traditionally valued for its medicinal properties, and its various parts are used in Ayurvedic formulations for treating ailments such as skin disorders, inflammation, and infections.

With Gujarat's increasing focus on promoting herbal and natural products, this study aligns with regional priorities for harnessing local resources for healthcare innovation. By investigating the immunomodulatory potential of **P. pinnata**, the research could offer a scientifically validated use of this indigenous plant, contributing to the development of cost-effective, plant-based therapeutics. This is particularly relevant in Gujarat's rural areas, where access to conventional healthcare can be limited, and reliance on traditional medicine remains high.

Moreover, the study supports the state's initiatives in biotechnology and pharmaceutical industries by identifying novel bioactive compounds that could be developed into therapeutic products. By integrating traditional knowledge with modern scientific methods, the research aligns with Gujarat's vision for sustainable development and innovation in healthcare solutions.

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8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research on the immunomodulatory properties of **Pongamia pinnata** alcohol extract has the potential to generate significant societal benefits, particularly for the state of Gujarat.

1. **Enhanced Healthcare Access**:
   Gujarat has a substantial rural population, many of whom rely on traditional medicine due to limited access to modern healthcare. The findings from this study could validate the use of **P. pinnata** as a natural immunomodulator, offering a cost-effective therapeutic option for managing immune-related disorders such as infections, autoimmune diseases, and chronic inflammatory conditions. This could bridge gaps in healthcare delivery in underserved areas.
2. **Boost to Traditional Medicine and Biodiversity Conservation**:
   Gujarat's rich biodiversity includes a wide distribution of **P. pinnata**, especially in coastal and semi-arid regions. By scientifically validating its immunomodulatory properties, the research will highlight the importance of preserving this species and encourage sustainable harvesting practices. This aligns with the state's efforts to promote and conserve its natural resources and traditional knowledge systems.
3. **Promotion of Herbal Medicine Industry**:
   Gujarat is a hub for the pharmaceutical and herbal product industries. The discovery of novel bioactive compounds from **P. pinnata** could boost the herbal medicine sector, fostering economic growth and creating employment opportunities, particularly in rural areas where the tree is cultivated.
4. **Public Health Improvement**:
   By offering a natural means to strengthen the immune system, the findings could contribute to reducing the prevalence of immune-related disorders in the population. This would improve public health outcomes and reduce the burden on healthcare systems in Gujarat.
5. **Scientific Advancement and Education**:
   The project would inspire further research in the field of immunomodulation and plant-

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based therapeutics. It could also enhance local educational programs by providing a successful model of integrating traditional knowledge with modern scientific approaches.

In summary, the proposed research promises to deliver health, economic, and environmental benefits, fostering sustainable development in Gujarat.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	□
2.	Agriculture	□
3.	Health and wellness	√
4.	Nutrition	□
5.	Development of Industrial Problem Solutions	□
6.	Resources management and sustainable development	□
7.	High Impact Teaching	□
8.	Imparting corporate responsibility, ethics, accountability and values in society	□
9.	Social entrepreneurship	□
10.	Others (Veterinary)	□

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, and data analysis. (300- 400 words)

The proposed research on **Pongamia pinnata** alcohol extract will be divided into three main phases: in vitro studies, in vivo studies, and mechanistic studies. The specific research activities will include:

1. **In Vitro Studies**

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- **Cell Proliferation and Differentiation**: Evaluate the effect of the **P. pinnata** alcohol extract on immune cell proliferation (T cells, B cells, macrophages, dendritic cells) using MTT assay and flow cytometry.
- **Cytokine Production**: Measure the levels of cytokines (IL-1, IL-2, IL-4, IL-10, IL-17, TNF-α, IFN-γ) in immune cell cultures treated with the extract using ELISA and qPCR.
- **Phagocytic Activity**: Assess the impact of the extract on macrophage phagocytic activity using flow cytometry and fluorescent bacterial assays.
- **Oxidative Burst**: Investigate the production of reactive oxygen species (ROS) in immune cells using DCFH-DA assay and fluorescence microscopy.

2. **In Vivo Studies**
   - **Immune Response Evaluation**: Using animal models (mice/rats), evaluate the effect of the extract on antibody production, delayed-type hypersensitivity (DTH) reactions, and resistance to infections (bacterial or viral).
   - **Survival Analysis**: Perform survival analysis post-infection to assess the impact of the extract on immune response in vivo.
3. **Mechanistic Studies**
   - **Receptor Binding and Signaling Pathways**: Investigate the interaction of the extract with specific immune cell receptors using receptor-ligand binding assays and western blotting for signaling pathways (e.g., NF-κB, MAPK)

Start → In Vitro Studies → In Vivo Studies → Mechanistic Studies → Data Analysis → Conclusion

↓ ↓ ↓

Cell Proliferation → Immune Response Evaluation → Receptor Binding

& Differentiation ↓ → Pathway Analysis

↓ ↓

Cytokine Production Survival Analysis

↓ ↓

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Phagocytic Activity Histopathological Analysis

↓

Oxidative Burst

- Sharma, S., et al. (2020). "Immunomodulatory effects of plant-derived bioactive compounds." *Journal of Immunological Research*.
- Bandyopadhyay, U., et al. (2018). "Antioxidant and immunomodulatory properties of plant extracts." *Phytotherapy Research*.
- Zhai, X., et al. (2019). "Mechanisms of action of natural immunomodulators." *Journal of Experimental Medicine*.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The research will be carried out in a phased approach over a period of 3 years, focusing on **Pongamia pinnata** alcohol extract's immunomodulatory effects. The first phase (Year 1) will involve **in vitro studies** to assess the extract's impact on immune cell proliferation, cytokine production, phagocytic activity, and oxidative burst. Immune cells will be isolated from healthy human blood and treated with varying concentrations of the extract. The effects will be quantified using assays like ELISA, flow cytometry, and fluorescence microscopy.

The second phase (Year 2) will expand to **in vivo studies**, using animal models (mice) to evaluate the extract's effect on immune responses, including antibody production, delayed-type hypersensitivity (DTH), and pathogen resistance. This phase will also assess histopathological changes to confirm immune system alterations.

The final phase (Year 3) will focus on **mechanistic studies**, investigating the molecular pathways by which the extract exerts immunomodulatory effects. This will include receptor binding assays and Western blotting to explore signaling pathways involved in immune modulation.

Data collected from both in vitro and in vivo studies will be analyzed using appropriate statistical methods (ANOVA, t-tests) to determine the significance of the results. The findings will be

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compared to current literature, contributing to the understanding of natural immunomodulators for potential therapeutic applications.

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	**In Vitro Studies**	1	1st Year	12	1st Year
2.	**Cell Proliferation & Differentiation Studies**	1	1st Year	6	2nd Year
3.	**Cytokine Production Assessment**	3	1st Year	9	2nd Year
4.	**In Vivo Studies**	13	2nd Year	24	2nd Year
5.	**Immune Response Evaluation in Animal Models**	14	2nd Year	18	2nd Year
6.	**Final Report Preparation and Dissemination**	34	3rd Year	36	3rd Year

13. Budget Requirements

Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount (Rs.)
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	NA	NA	93500
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	NA	NA	10000
3.	Contingency (Upto maximum for Rs. 3000/-)	NA	NA	3000
4.	Stationery and Printing (With justification)	NA	NA	1500
5.	Any other special requirement (analysis service)	NA	NA	230000
6.	Overhead (10% of recurring)	NA	NA	15000
	TOTAL	**NA**	**NA**	**353000**

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Application form

Part -A

(General Information)

1.	Title of the proposal	Decoupled Generalized Integrator Phase Locked Loop Performance: Balanced and Unbalanced Operation	
2.	Broad area of proposal	Electrical Engineering	
3.	Sub Area of proposal	Power Quality	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Dhaval Yogeshbhai Raval	Assistant Professor	7383261271 dhaval.raval@atmiyauni.ac.in Ext. No:1051
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Ankit B. Lehru	Assistant Professor	9601626303 Ankit.lehru@atmiyauni.ac.in Ext. No:1051
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	07/12/1991	
8.	Date of joining the Department of PI (DD/MM/YYYY)	11/01/2016	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	-	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D. (Pursuing)	Electrical Engineering	G.T.U	-	-
ii.	Post Graduation	Electrical Engineering	G.T.U	2016	8.87
iii.	Under Graduation	Electrical Engineering	G.T.U	2013	6.45
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-
2.	Have you previously received any Fellowship from any funding agency?		☐ YES	☐ NO	
3.	If yes, please indicate whether it was a (✓tick appropriate)		☐ Short-term fellowship (viz Project fellow, Project assistant, etc.)		
			☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)		
			☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)		
4.	If yes, mention the details of fellowship and tenure				
5.	Details of on-going and completed research funded projects (if any)				

S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (8 Year + 6 Months)
		Research Experience: 0
7.	No. of Publication (Research articles	National: 0

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	- UGC Approved only)	International: 01
8.	No. of Publication (Book Chapters)	05
	Books Published	0
(Please enclose the list of papers and books published and/or accepted during last five years)		

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Decoupled Generalized Integrator Phase Locked Loop Performance: Balanced and Unbalanced Operation

2. Abstract (Provide a summary of your research proposal in 300 words)

This research investigates the performance of a Decoupled Generalized Integrator Phase Locked Loop (GIPLL) under balanced and unbalanced operating conditions. We analyze its key performance metrics, including closed-loop transfer function, steady-state error, and transient response, through a combination of analytical derivations and simulations. The analysis focuses on the impact of loop parameters, signal imbalances, and noise on the overall system behavior. Our findings provide valuable insights into the strengths and limitations of the decoupled GIPLL architecture in various applications, particularly those involving unbalanced signals or challenging operating environments, aiding in the optimal design and implementation of these critical components.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Phase-Locked Loops (PLLs) have been a cornerstone of modern signal processing, widely used in telecommunications, power systems, and control applications for tasks such as frequency synthesis, signal synchronization, and phase alignment. One of the key challenges in PLL design is the ability to maintain stable phase-locking performance in the presence of noise, signal imbalances, and varying operating conditions. Traditional PLL architectures, though robust in many scenarios, often face limitations when subjected to unbalanced signals or complex system dynamics, necessitating the development of more advanced and adaptable PLL structures. This paper introduces the Decoupled Generalized Integrator Phase Locked Loop (GIPLL), a novel PLL design that improves upon traditional PLLs by addressing some of these inherent challenges, particularly in systems with unbalanced signals or those exposed to noisy environments.

The Decoupled GIPLL is an enhanced version of the Generalized Integrator PLL (GIPLL), which itself has gained popularity due to its ability to provide superior noise suppression and transient response, as well as its versatility in handling both phase and frequency estimation tasks. However, traditional GIPLLs can struggle with unbalanced signal conditions, such as when the reference and input signals differ in amplitude, phase, or noise characteristics. The decoupling strategy incorporated into the GIPLL aims to address these imbalances by isolating the effects of various components within the loop, thereby improving overall system performance. By separating the processing of different components of the error signal, the decoupled GIPLL enhances the loop's ability to track and phase-align signals that are subject to imbalance, noise, or other disturbances.

This study focuses on investigating the performance of the Decoupled GIPLL under both

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balanced and unbalanced operating conditions, providing a thorough analysis of the system's key performance metrics. A primary objective of this research is to examine the loop's closed-loop transfer function, which characterizes the system's response to input disturbances, as well as the steady-state error and transient response, which are crucial for assessing the accuracy and stability of the PLL under various conditions. By deriving analytical expressions for these metrics, and validating them through simulations, we aim to develop a deeper understanding of the strengths and limitations of the decoupled GIPLL architecture.

One of the main contributions of this paper is the exploration of how loop parameters, signal imbalances, and noise impact the system's behavior. Traditional PLL designs may struggle in scenarios where the input signal exhibits asymmetries, whether due to noise, phase shifts, or amplitude discrepancies. For example, in communication systems where the reference signal is subjected to fading or distortion, or in power electronics where unbalanced voltages might arise due to asymmetrical loads, these imbalances can lead to degraded performance, instability, or even failure of the PLL to lock correctly. The Decoupled GIPLL, with its ability to separate the effects of various components, provides a more resilient approach to maintaining phase-locking in these environments.

Through detailed simulations and analytical derivations, this paper offers insights into how the performance of the Decoupled GIPLL varies with changes in loop parameters, including the choice of integrators, gain values, and damping factors. Additionally, we explore how different types of signal imbalances—such as amplitude variations, phase distortions, or noise-induced interference—affect the PLL's ability to maintain stable phase locking. The interaction between these factors and the system's transient and steady-state behaviors is also examined, providing a comprehensive view of the Decoupled GIPLL's response to both ideal and challenging operating conditions.

The findings of this research have significant implications for the design and implementation of PLL-based systems in real-world applications. As systems increasingly operate in dynamic and unpredictable environments, particularly in fields like wireless communications, power systems, and automation, the ability to adapt to signal imbalances and noise is of paramount importance. The insights gained from this study will help guide engineers in optimizing Decoupled GIPLL architectures, enabling more robust, efficient, and reliable PLL designs. Furthermore, this paper lays the groundwork for further research into advanced PLL structures that can more effectively address the challenges posed by unbalanced and noisy signal conditions.

In summary, this research contributes to the body of knowledge in PLL design by providing a detailed analysis of the Decoupled GIPLL under a variety of conditions. By investigating its key performance metrics, including its closed-loop transfer function, steady-state error, and transient response, we aim to offer a better understanding of how the Decoupled GIPLL architecture can be leveraged in practical applications, particularly in scenarios where signal imbalances and noise pose significant challenges to traditional PLL designs.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

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Current research on Phase-Locked Loops (PLLs) has largely focused on improving the stability, accuracy, and adaptability of these systems across a range of applications, particularly in communications, power systems, and control. Traditional PLL designs have been extensively studied and optimized for balanced, ideal conditions. However, as real-world systems increasingly operate under unbalanced conditions—such as amplitude variations, phase distortions, and noise—these conventional PLLs exhibit limitations in performance and robustness. This has led to the development of more advanced PLL architectures like the Generalized Integrator PLL (GIPLL), which offers improved noise rejection and dynamic response.

Despite the progress made with GIPLLs, research on their adaptation to unbalanced signal conditions remains limited. Most studies have focused on the basic principles of GIPLL operation under ideal, balanced conditions or in the presence of small disturbances. The integration of decoupling techniques within GIPLLs to enhance performance under unbalanced and noisy environments is an emerging area of interest. However, few works have comprehensively explored the impact of signal imbalances on the transient and steady-state behavior of decoupled GIPLLs, especially in practical, real-world scenarios. While simulations have demonstrated the potential benefits of these designs, analytical frameworks that fully characterize the behavior of decoupled GIPLLs in various conditions are still underdeveloped. Therefore, there is a critical need for deeper exploration into these architectures to optimize their design and improve their robustness in challenging operating environments.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Analyze the Closed-Loop Transfer Function of the Decoupled GIPLL: To derive and evaluate the closed-loop transfer function of the Decoupled Generalized Integrator Phase-Locked Loop (GIPLL) under both balanced and unbalanced operating conditions, highlighting how the decoupling strategy affects the system's stability and response to input disturbances.
2. Investigate Steady-State Error Performance: To assess the steady-state error in the Decoupled GIPLL, examining how various loop parameters and signal imbalances influence the accuracy of phase-locking and the long-term performance of the PLL.
3. Evaluate Transient Response: To study the transient response of the Decoupled GIPLL in scenarios involving both ideal and non-ideal conditions, with a particular focus on the system's ability to lock to phase changes quickly and effectively under different noise and imbalance scenarios.
4. Examine the Impact of Signal Imbalances: To analyze the effect of various signal imbalances (e.g., amplitude variations, phase distortions, and noise) on the performance of the Decoupled GIPLL, and identify the conditions under which the system maintains optimal performance.
5. Optimize Loop Parameters for Robust Performance: To explore the role of different loop parameters (such as integrator gains, damping factors, and loop bandwidth) in enhancing the robustness of the Decoupled GIPLL against noise, signal distortion, and operating environment variations.

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6. Provide Design Guidelines for Real-World Applications: To develop practical design guidelines and recommendations for the implementation of Decoupled GIPLLs in real-world systems, particularly in environments subject to unbalanced signals or noise, ensuring better system stability, accuracy, and performance.

6. Significance of the proposed study: (300 words)

The proposed study on the Decoupled Generalized Integrator Phase-Locked Loop (GIPLL) holds significant value in advancing the field of signal processing, particularly in applications where traditional PLL designs encounter limitations due to signal imbalances and environmental noise. As the demand for more robust and adaptable systems increases in fields such as telecommunications, power systems, and control engineering, the ability to maintain stable phase-locking performance under non-ideal conditions becomes crucial. The study aims to address this need by exploring the decoupled GIPLL architecture, which offers enhanced resilience against disturbances like amplitude variations, phase shifts, and noise, thereby improving the overall system performance in real-world scenarios.

A key contribution of this research is the comprehensive evaluation of the Decoupled GIPLL's performance metrics, such as closed-loop transfer function, steady-state error, and transient response, in both balanced and unbalanced conditions. These insights are essential for understanding how the decoupling mechanism improves the loop's ability to track phase changes accurately in the presence of signal imbalances, which is particularly critical in modern communication systems exposed to fading and distortion, or power systems affected by unbalanced loads.

Moreover, the study aims to establish guidelines for the optimal selection of loop parameters, such as integrator gains and damping factors, in order to maximize the robustness of the Decoupled GIPLL under a variety of operating conditions. The findings of this research will not only enhance the theoretical understanding of advanced PLL architectures but also provide practical design recommendations that can be applied to a wide range of applications.

In summary, the proposed study is significant as it contributes to the development of more reliable and efficient PLL systems, particularly for challenging environments where signal imbalances and noise are prevalent. The outcomes of this research will aid in the design of next-generation PLL-based systems, improving their stability, accuracy, and overall performance in critical applications.

7. Relevance of the proposed study to Gujarat: (200 words)

In particular, Gujarat's power grid is subject to challenges related to unbalanced voltages and fluctuating loads, especially with the increasing integration of renewable energy sources. Traditional PLL systems may struggle to maintain synchronization in such conditions. The development of the Decoupled GIPLL, which is designed to handle unbalanced and noisy environments, could enhance the reliability and efficiency of power systems by providing stable phase synchronization, ensuring continuous and efficient energy distribution.

Additionally, Gujarat's growing telecom infrastructure and high-tech industries would benefit from improved PLL performance in communication systems. In areas like wireless communication and data transmission, the ability to maintain precise signal synchronization amidst noise or signal distortion is critical. Therefore, the insights gained from this research can

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directly contribute to optimizing PLL-based systems in various Gujarat-based industries, advancing both technological innovation and economic growth in the state.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

1. Enhanced Power Systems Stability: Gujarat's power grid, with increasing contributions from renewable energy sources like wind and solar, faces challenges related to voltage imbalances, fluctuating loads, and grid synchronization. The proposed research's focus on improving PLL performance in unbalanced and noisy environments can lead to more stable power systems. This would directly benefit the public by ensuring reliable electricity distribution, minimizing power outages, and enhancing the integration of renewable energy, contributing to Gujarat's sustainability goals and reducing dependence on fossil fuels.
2. Advancements in Telecommunications: With Gujarat emerging as a key player in the telecom sector, particularly with the expansion of 5G networks and digital infrastructure, the ability to maintain precise signal synchronization in the presence of noise or signal distortion is critical. The Decoupled GIPLL can improve the reliability and efficiency of communication systems, resulting in faster and more stable internet services for residents, businesses, and industries. This directly supports digital inclusion and economic growth, improving access to information and technology across the state.
3. Boosting Industrial Automation: Gujarat has a thriving manufacturing sector, including automotive, textiles, and electronics. The proposed study's findings can improve the performance of automation systems that rely on accurate synchronization and control, leading to more efficient production lines, reduced downtime, and better quality control. These improvements can result in cost savings for industries and contribute to the state's economic growth and job creation.
4. Supporting Smart Cities and Infrastructure: The insights from the proposed research can enhance technologies used in smart cities, which are being developed across Gujarat. PLL-based systems are integral to technologies such as traffic management, real-time monitoring, and communication networks. By optimizing PLL performance in challenging environments, the research can contribute to smarter, more resilient infrastructure, improving the quality of life for urban residents by reducing congestion, enhancing safety, and ensuring better resource management.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐

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6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The methodology for this research project on the Decoupled Generalized Integrator Phase-Locked Loop (GIPLL) will be structured into specific phases that include theoretical analysis, simulation, and validation. These activities will be aimed at analyzing the performance of the Decoupled GIPLL under balanced and unbalanced operating conditions, with a focus on key metrics such as closed-loop transfer function, steady-state error, and transient response. The following outlines the specific research activities, hypothesis, sampling plan, data collection, and data analysis:

Research Activities:

1. Theoretical Analysis:
   - Derive the closed-loop transfer function for the Decoupled GIPLL under ideal conditions (balanced signals) and with signal imbalances (e.g., amplitude variations, phase shifts, and noise).
   - Develop expressions for steady-state error and transient response based on the proposed architecture and key loop parameters.
2. Simulation Setup:
   - Implement the Decoupled GIPLL model in simulation software (e.g., MATLAB/Simulink) to evaluate system performance. Simulations will be conducted under varying conditions, including different levels of signal imbalance and noise, to assess how these factors influence key performance metrics.
3. Parameter Variation and Sensitivity Analysis:
   - Systematically vary key parameters such as integrator gains, damping factors, loop bandwidth, and phase noise, and analyze their impact on the system's stability, error, and transient response.
   - Examine the performance of the Decoupled GIPLL in the presence of both balanced and unbalanced signal inputs.
4. Performance Evaluation:
   - Analyze the system's steady-state error and transient behavior under various conditions using time-domain and frequency-domain analysis methods.
   - Compare the results of the Decoupled GIPLL with a standard PLL to assess the improvements made by the decoupling technique.

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Hypothesis:

The primary hypothesis of this research is that the Decoupled GIPLL will exhibit superior performance, particularly in unbalanced and noisy environments, compared to traditional PLL designs. It is expected that the decoupling technique will significantly reduce the impact of signal imbalances, resulting in improved phase-locking stability, lower steady-state error, and faster transient response under non-ideal conditions.

Sampling Plan:

Data will be collected from simulations conducted over a range of signal conditions, including:

- Balanced conditions: Ideal signal input with minimal noise or imbalance.
- Unbalanced conditions: Varying levels of amplitude imbalance, phase distortion, and added noise.
- Loop parameter variations: A range of values for integrator gains, loop bandwidth, and damping factors.

Each simulation run will represent a "sample" of system behavior under specific conditions, and the data will be collected over several iterations for robustness.

Data Collection:

Data will be collected from the simulations based on the following performance metrics:

- Steady-state error: The difference between the desired and actual phase at steady-state.
- Transient response: The system's ability to achieve phase lock within a specified time after a disturbance.
- Closed-loop transfer function: The system's response to a given input disturbance.

Data Analysis:

The collected data will be analyzed using:

- Time-domain analysis: To study transient behavior and time-to-lock performance.
- Frequency-domain analysis: To evaluate system stability and phase noise suppression.
- Statistical analysis: To quantify the performance improvements across different scenarios (balanced vs. unbalanced) and loop parameter variations.
- Comparison with traditional PLLs: To assess the relative improvements in performance offered by the Decoupled GIPLL architecture.

By systematically varying input conditions and loop parameters, the study will provide insights into how the decoupling technique influences PLL performance in both ideal and challenging environments.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

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Year 1: Literature Review and Theoretical Foundation

- Conduct a thorough review of existing literature on Phase-Locked Loops (PLLs), Generalized Integrator PLLs (GIPLLs), and their applications in balanced and unbalanced signal environments.
- Develop the theoretical framework for the Decoupled GIPLL, focusing on the derivation of the closed-loop transfer function, steady-state error, and transient response under various conditions.
- Define the research hypothesis and objectives clearly.

Year 2: Simulation Model Development and Preliminary Tests

- Develop a simulation model of the Decoupled GIPLL in MATLAB/Simulink, implementing basic PLL architecture and control mechanisms.
- Run preliminary simulations under ideal conditions to verify model accuracy and identify any initial challenges.
- Begin sensitivity analysis by varying key parameters (loop gain, damping factors) under balanced signal conditions.

Year 3: Performance Evaluation in Unbalanced Conditions

- Conduct detailed simulations of the Decoupled GIPLL under unbalanced signal conditions (amplitude imbalances, phase shifts, and noise).
- Analyze the system's steady-state error and transient response in the presence of signal disturbances.
- Compare the performance of the Decoupled GIPLL with traditional PLL architectures.

Year 4: Parameter Optimization and Advanced Analysis

- Perform extensive parameter variation studies to identify the optimal loop parameters for robust performance in noisy and unbalanced environments.
- Conduct statistical analysis of results to quantify performance improvements.
- Begin writing research papers based on key findings for publication.

Year 5: Validation, Documentation, and Dissemination

- Finalize validation through additional simulations and experimental setups if applicable.
- Prepare final research documentation and publish results in peer-reviewed journals.
- Present findings at conferences, workshops, and industry forums to disseminate research outcomes to the broader academic and industrial communities.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review and Theoretical Foundation	June	2022	May	2023
2.	Simulation Model	June	2023	May	2024

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	Development and Preliminary Tests				
3.	Performance Evaluation in Unbalanced Conditions	June	2024	May	2025
4.	Hardware Development	June	2025	May	2026
5.	Validation, Documentation, and Dissemination	June	2026	May	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	MATLAB/Simulink License	3,00,000	1	3,00,000
2.	Conference Fees & Travelling	1,00,000	-	1,00,000
3.	Contingency	50,000	-	50,000
4.	Oscilloscope and Signal Generators	2,50,000	1	2,50,000
5.	MityDSP-Pro Dev. Kit Motherboard	2,50,000	1	2,50,000
6.	Prototyping Kits and Components (e.g., resistors, capacitors)	1,00,000		1,00,000
	TOTAL			10,50,000/-

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	MATLAB/Simulink License	3,00,000	June 2024	To perform simulation study
2	Conference Fees & Travelling	1,00,000	During entire project	For equipment purchase and attending conferences
3	Contingency	50,000	During entire project	-

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4	Prototyping Kits and Components (e.g., resistors, capacitors) MityDSP-Pro Dev. Kit Motherboard Oscilloscope and Signal Generators	6.00,000	June 2025-May 2026	For hardware development
	Grand Total	10,50,000/-		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Modification of Electrical , Mechanical , Optical and Thermal properties of crystal with metal ion	
2.	**Broad area of proposal**	Physical science	
3.	**Sub Area of proposal**	Material Science	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Dipak J Dave	Associate Professor and Head Department of physics	djdave@vsc.edu.in 9472769434 Ext No. 2056
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	22/07/1974	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01/01/2019	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**		

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***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Physics	Shaurashtra University - Rajkot	2011	NA
ii.	Post Graduation	Physics	M.S. Uni. - Vadodara	1996	57
iii.	Under Graduation	Physics	North Guj. Uni. - Patan	1994	61
iv.	CSIR/UGG-NET/ SLET/GATE	Physics	M.S. Uni. - Vadodara	2020	NA

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☐✓ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

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6.	Total Experience	Teaching Experience: (20. Year + 8 Months)
		Research Experience: (12Year + 6 Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 02
		International: 11
8.	No. of Publication (Book Chapters)	
	Books Published	05
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Modification of Electrical , Mechanical , Optical and Thermal properties of crystal with metal ion

2. Abstract (Provide a summary of your research proposal in 300 words)

Crystal growth is a crucial process in materials science, as it enables the production of high-quality crystals with specific properties. These crystals have numerous applications in fields like electronics, optics, and medicine. With advancement of Morden electronics and metallurgy , metallic crystals with modification in properties like anti corrosion properties , electrical conductivity , thermal stability and mechanical strength are always in need.

This research proposal aims to investigate the growth and characterization of high-quality crystals with suitable dopping using advanced techniques.

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Define Research Objectives

- Understanding crystal growth mechanisms.
- Optimizing growth conditions for high-quality crystals.
- Analyzing structural, optical, and electrical properties.
- Investigating applications in electronics, catalysis, or materials science.

Literature Review

Conduct a thorough review of existing research to understand:

- Types of metals and alloys studied for crystal growth.
- Techniques used (e.g., chemical vapor deposition, Bridgman method).
- Known properties of metal crystals.
- Challenges in synthesis and characterization.

Sources include academic journals, books, and patents.

Selection of Materials

Choose the specific metal(s) for crystal growth based on:

- Desired properties (e.g., conductivity, magnetic behavior).
- Availability and cost of raw materials.
- Safety and environmental considerations.

elect Growth Techniques

Choose an appropriate crystal growth technique based on the material properties:

- **Physical Methods**:
  - **Czochralski Method**: Ideal for large, single crystals (e.g., silicon, gallium arsenide).
  - **Bridgman-Stockbarger Technique**: Suitable for metals with well-defined melting points.
- **Chemical Methods**:

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- **Chemical Vapor Deposition (CVD)**: For thin films and nanocrystals.
- **Electrochemical Deposition**: Cost-effective for small-scale crystals.

- **Solution Growth**:
  - **Hydrothermal Growth**: Effective for specific metals under high pressure.
  - **Solvent-Based Techniques**: Ideal for materials soluble in specific solvents.

Factors to Optimize:

- Temperature gradients and rates of cooling.
- Purity of starting materials.
- Gas flow rates and pressure (for vapor-phase techniques).

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6. Prepare Experimental Setup

- Design a controlled environment to minimize contamination.
- Calibrate instruments for temperature, pressure, and deposition rates.
- Use crucibles and growth chambers made of inert materials to avoid reactions with the growing crystal.

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7. Grow Crystals

- Monitor and control parameters during growth.
- Use real-time imaging or sensors to track crystal morphology.
- Document observations for each experimental run.

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8. Post-Growth Processing

- Cool crystals gradually to avoid thermal stress.
- Cut or polish crystals for uniformity if needed.
- Clean the crystals using solvents or etching solutions to remove surface impurities.

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Part B: Characterization of Metal Crystals

9. Structural Analysis

Characterize the crystal's structural properties using:

- **X-Ray Diffraction (XRD)**: Determines crystal structure and orientation.
- **Scanning Electron Microscopy (SEM)**: Studies surface morphology.
- **Transmission Electron Microscopy (TEM)**: Analyzes lattice defects and grain boundaries.

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10. Chemical Composition Analysis

Ensure material purity and composition using:

- **Energy-Dispersive X-Ray Spectroscopy (EDX)**: For elemental analysis.
- **Inductively Coupled Plasma Mass Spectrometry (ICP-MS)**: Detects trace impurities.

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11. Optical Properties

For applications in photonics or optoelectronics, study:

- **UV-Vis Spectroscopy**: Measures absorbance and reflectance.
- **Photoluminescence (PL) Spectroscopy**: Analyzes defect levels and recombination processes.

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12. Mechanical and Electrical Characterization

Assess mechanical and electrical properties relevant to applications:

- **Nano-indentation**: For hardness and elastic modulus.
- **Four-Point Probe Measurement**: To determine electrical resistivity and conductivity.
- **Hall Effect Measurement**: For carrier concentration and mobility.

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13. Thermal Properties

Measure the crystal's response to heat using:

- **Differential Scanning Calorimetry (DSC)**: Determines melting and phase transition points.

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- **Thermal Conductivity Measurements**: Essential for heat management in devices.

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14. Data Analysis and Modeling

Analyze experimental data using software tools for:

- Crystallographic analysis (e.g., CrystalMaker, VESTA).
- Statistical modeling to correlate growth conditions with properties.
- Simulation tools (e.g., COMSOL Multiphysics) to model growth dynamics.

Documentation and Reporting

15. Results and Interpretation

- Compile data into graphs, tables, and images.
- Compare experimental results with theoretical models and literature.

16. Write Research Papers

Prepare manuscripts detailing:

- Growth conditions.
- Characterization techniques and findings.
- Potential applications of the metal crystals.

Submit to peer-reviewed journals and present findings at conferences.

Iterative Improvements

17. Troubleshooting and Optimization

Based on the results:

- Refine growth parameters for better crystal quality.
- Investigate anomalies or unexpected results.

18. Scalability and Reproducibility

Evaluate the feasibility of scaling up the process for industrial applications.

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4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research on metal crystals continues to advance, driven by their critical role in modern technology. Metal crystals, characterized by their highly ordered atomic structures, are studied to enhance their mechanical, electrical, thermal, and optical properties. Recent breakthroughs have focused on understanding and manipulating defects, grain boundaries, and the microstructure of metal crystals to improve their performance.

Single-crystal metals, which lack grain boundaries, are extensively investigated for their exceptional strength and conductivity. These materials are crucial in applications like turbine blades and microelectronics. Scientists are exploring novel methods to grow large, high-quality single crystals through advanced techniques like chemical vapor deposition (CVD) and additive manufacturing.

Nanocrystalline metals, featuring grain sizes in the nanometer range, are also a key area of research. They exhibit remarkable hardness and strength due to their unique grain-boundary-dominated behavior. However, challenges such as thermal stability and ductility remain.

Emerging fields include two-dimensional metal crystals and metallic glasses, which offer exciting potential for next-generation materials. Additionally, the use of computational models and machine learning to predict crystal behavior is accelerating material discovery.

The intersection of metal crystallography with quantum mechanics and nanotechnology continues to open new frontiers, aiming to design customized materials for energy, aerospace, and medical applications.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. **Understanding Atomic Structure**: Investigate the arrangement and behavior of atoms in metal crystals to understand their microstructural properties, such as grain boundaries, lattice defects, and crystallographic orientations.

2 **Optimizing Material Properties**: Develop insights into how metal crystal structures influence mechanical, electrical, thermal, and magnetic properties to enhance performance in specific applications.

3 **Tailoring Alloys and Composites**: Design advanced alloys and materials by controlling crystal growth, phase transitions, and impurity incorporation for improved durability, strength, and corrosion resistance.

4 **Improving Manufacturing Processes**: Innovate fabrication techniques such as additive manufacturing, forging, or annealing by understanding crystal growth dynamics and

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minimizing defects.

5 **Advancing Fundamental Science**: Contribute to theoretical and experimental knowledge of crystallography and metallurgy, enabling the discovery of novel materials with groundbreaking applications in technology, energy, and healthcare.

6. Significance of the proposed study: (300 words)

Research on metal crystals is highly significant due to their critical role in advancing materials science and technology. Metal crystals are the building blocks of many engineered materials, with their structure and properties determining mechanical strength, electrical conductivity, and thermal performance. By studying their atomic arrangement and growth patterns, researchers can design materials with tailored properties for diverse applications, from aerospace to electronics.

One key area of focus is improving the understanding of crystal defects, such as dislocations and grain boundaries, which directly impact a material's durability and performance under stress. Additionally, the exploration of nanocrystalline metals opens avenues for creating lightweight, high-strength materials, vital for energy-efficient transportation and sustainable infrastructure.

Metal crystal research also supports the development of advanced manufacturing techniques, such as additive manufacturing and crystal engineering, enabling precise control over material properties. Moreover, understanding the crystallization process informs the development of corrosion-resistant alloys and materials for extreme environments.

These advancements not only enhance industrial capabilities but also address global challenges like energy efficiency and resource sustainability. By pushing the boundaries of materials design, research on metal crystals lays the foundation for innovative technologies that drive progress in science, engineering, and society.

7. Relevance of the proposed study to Gujarat: (200 words)

Metal crystal industries play a significant role in Gujarat's economic and industrial landscape, reflecting the state's robust metallurgical and manufacturing capabilities. Gujarat, known for its entrepreneurial spirit, houses several industrial clusters engaged in metal processing and crystal production, serving sectors such as jewelry, electronics, construction, and renewable energy.

The importance of metal crystals lies in their exceptional structural and electrical properties, making them integral to advanced applications like semiconductors, precision instruments, and optical components. Gujarat's industrial hubs, such as Ahmedabad, Vadodara, and Surat, are home to companies specializing in metal refining and crystal fabrication, leveraging the state's well-developed infrastructure and business-friendly policies.

The presence of key ports like Kandla and Mundra facilitates the export of metal crystals to

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global markets, enhancing Gujarat's position in the international trade network. Additionally, the industry contributes to employment generation and technological innovation, driving research collaborations with institutions and fostering skill development.

Gujarat's strategic focus on green energy and sustainability has also spurred demand for metal crystals in solar panels and wind turbines, aligning with India's renewable energy goals. Thus, metal crystal industries in Gujarat are crucial not only for economic growth but also for advancing high-tech and sustainable development.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

Research on metal crystals holds immense significance across various scientific and industrial domains. Metal crystals, characterized by their organized atomic structure, offer exceptional mechanical, electrical, and thermal properties, making them crucial for advancing materials science and engineering.

One of the primary benefits of studying metal crystals is the development of stronger, lighter, and more durable materials. By understanding the crystallographic structures and defects, researchers can manipulate metals at the atomic level to enhance their properties. This can lead to the creation of advanced alloys for applications in aerospace, automotive, and construction industries, where materials need to withstand extreme conditions while maintaining performance.

Metal crystals also play a critical role in electronics and energy technologies. Their conductivity and magnetic properties can be optimized for use in semiconductors, sensors, and renewable energy devices. For instance, high-purity crystalline metals are essential in solar cells and batteries, improving energy efficiency and storage capacity, which are vital for sustainable energy solutions.

Furthermore, research into metal crystals contributes to advancements in nanotechnology. Metallic nanocrystals have unique properties, such as catalytic activity, that are beneficial in chemical processes, environmental remediation, and medical applications like targeted drug delivery.

On a broader scale, studying metal crystals fosters innovation in manufacturing processes. Techniques like additive manufacturing and crystal growth methods become more refined, leading to cost-effective production with minimal waste.

In conclusion, research on metal crystals not only pushes the boundaries of material capabilities but also drives progress in energy, electronics, healthcare, and environmental sustainability. It bridges the gap between fundamental science and practical applications, ensuring a brighter, more efficient future.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

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Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	√
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The research methodology for a project on metal crystal growth involves a systematic approach encompassing experimental design, characterization, and analysis. Key steps include:

1. **Literature Review**: Analyze existing studies on metal crystal growth mechanisms, influencing factors, and growth models. This helps in identifying knowledge gaps and defining objectives.
2. **Material Selection**: Choose metals based on desired properties and applications, considering factors like purity, melting points, and crystallographic characteristics.
3. **Experimental Setup**: Design experiments to grow crystals using methods like Bridgman, Czochralski, or vapor-phase techniques. Carefully control parameters such as temperature, pressure, and cooling rates to achieve desired growth conditions.
4. **Simulation and Modeling**: Use computational tools to predict crystal growth dynamics

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and validate experimental results. Finite element analysis or molecular dynamics simulations can aid in optimizing growth conditions.

5. **Characterization**: Employ techniques like X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDX) to analyze the crystallographic structure, morphology, and composition of grown crystals.
6. **Data Analysis**: Interpret experimental and simulation data to understand growth mechanisms, defect formation, and influence of external factors.
7. **Iterative Refinement**: Based on findings, refine experimental conditions to improve crystal quality, ensuring reproducibility and scalability.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

 Define Objectives: Clearly articulate the research goals, such as understanding crystal growth mechanisms, analyzing mechanical properties, or exploring applications like superconductors or catalysts.

 Literature Review: Conduct an extensive review of existing studies on metal crystal structures, growth processes, and relevant characterization techniques to identify knowledge gaps and refine the project scope.

 Experimental Design: Develop a detailed methodology. This may involve:

- **Material Selection**: Choose metals (e.g., copper, aluminum) or alloys based on the research focus.
- **Crystal Growth Techniques**: Opt for methods like Bridgman, Czochralski, or vapor deposition, depending on size and purity requirements.
- **Parameter Variation**: Plan experiments to vary conditions like temperature, pressure, and cooling rates to study their effects on crystal structure.

 Characterization and Analysis: Use tools such as X-ray diffraction (XRD), scanning electron microscopy (SEM), or transmission electron microscopy (TEM) to evaluate crystal orientation, defects, and morphology.

 Data Interpretation and Modeling: Analyze experimental results and compare with theoretical predictions or simulations to draw insights into growth dynamics and material behavior.

 Documentation and Reporting: Present findings in reports or scientific papers, highlighting advancements and potential applications.

 Future Work: Identify areas for continued exploration, such as optimizing synthesis techniques or exploring new alloys.

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	**Literature Review**	July	2022	October	2022
2.	**Material Selection**	November	2022	February	2023
3.	**Experimental Setup**	March	2023	October	2023
4.	**Simulation and Modeling**	November	2023	On going	
5.	**Characterization, Data analysis and Iterative Refinement**				

13. Budget Requirements

a. Consolidated budget:

S. N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	1) 15000	15	225000
		2) 25000	10	250000
		3) 30000	4	120000
		4) 50000	3	150000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	2000	6	92000
3.	Contingency (Upto maximum for Rs. 3000/-)	1500	20	30000

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4.	Stationery and Printing (With justification)	400	200	8000
5.	Any other special requirement	Printer , system and scanner 25000	3	75000
6.	Overhead (10% of recurring)	30000	5	150000
	TOTAL			**1100000**

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**	225000		
	a) Metal Flux	100000	For entire project	As project is based on modification of different properties of metallic crystals
	b) High Cost Metal Flux	125000	For entire project	As project is based on modification of different properties of metallic crystals
	c)			
2.	**B. Glassware/ Metal Container**	250000		
	a) Quartz Tubes and container	75000	For entire project	As project is based on modification of different properties of metallic crystals
	b) Metal Container	75000	For entire project	As project is based on modification of different properties of metallic crystals

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	c) Any other as per requirement	100000	For entire project	As project is based on modification of different properties of metallic crystals
3.	**C. Any other consumable items (like wires/ electric items etc)**	270000		
	a) Electrical furnace	150000	2023-2024	Required for experimental set up
	b) Temperature controller , MCB , Electrical motors	170000	2023-2024	Required for experimental set up
4.	**Travel**	92000	2023-2027	Different industries and research centers of metallurgy has to be frequently visited for technical know how
	a) For study of flux growth technique	50000	2022-2024	
	b) For different characterization	42000	2024-2027	
5.	**Contingency**	30000	For entire duration	To cop up with unplanned requirement
6.	**Stationery and printing**	8000	For entire duration	
	a) Literature review		2022-223	To have hard copies of some reference and set-up drawing
	b) Documentation		For entire project	To maintain detailed of different stages of project and to publish out come
7.	**Any other special requirement**	75000	For entire project	
8.	**Overhead (10% of recurring)**	150000	For entire project	
	Grand Total	1100000		

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Application form

Part -A
(General Information)

1.	**Title of the proposal**	Synthesis, Characterization and Antimicrobial Screening of Some New Imidazolines	
2.	**Broad area of proposal**	Medicinal Chemistry	
3.	**Sub Area of proposal**	Organic Synthesis	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Govind Vagadiya	Assistant Professor	9924876888 govind.vagadiya@atmiyauni.ac.in
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	14/11/1989	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	18/06/2012	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B
(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Chemistry	RK University	2020	Pass
ii.	Post Graduation	M.Sc. Industrial Chemistry	Saurashtra University	2012	76.00
iii.	Under Graduation	B.Sc. Industrial Chemistry	Saurashtra University	2010	71.00
iv.	CSIR/UGG-NET/ SLET/GATE	NA	NA	NA	NA

2.	Have you previously received any Fellowship from any funding agency?	☐ ~~YES~~	☐✓ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ Short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ Pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ Post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	NA	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	1	Studies on N/O heterocycle fused Chromenones as Potential Bioactive	1 Lac	UGC	2013-2015

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		Compounds			
6.	Total Experience		Teaching Experience: (10Year + 0 Months)		
			Research Experience: (10 Year + 0 Months)		
7.	No. of Publication (Research articles - UGC Approved only)		National:- 00		
			International:- 05		
8.	No. of Publication (Book Chapters)		- 00		
	Books Published		02		
(Please enclose the list of papers and books published and/or accepted during last five years)					

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Synthesis, Characterization and Antimicrobial Screening of Some New Imidazolines

2. Abstract (Provide a summary of your research proposal in 300 words)

Imidazolines are a class of heterocyclic compounds with a wide range of biological activities, including antimicrobial properties. This research aims to synthesize novel imidazoline derivatives through efficient and eco-friendly methodologies. The synthesized compounds will be thoroughly characterized using spectroscopic techniques (NMR, IR, and Mass spectrometry) and elemental analysis. Furthermore, their antimicrobial activities against a panel of Gram-positive and Gram-negative bacteria, as well as fungi, will be evaluated. The study seeks to identify promising imidazoline candidates with potent antimicrobial activity and explore their potential as novel therapeutic agents to combat drug-resistant microorganisms.

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Imidazolines, a class of five-membered heterocyclic compounds containing two nitrogen atoms, have gained significant attention in medicinal chemistry due to their diverse biological activities. These compounds exhibit a wide spectrum of pharmacological properties, including antimicrobial, antihypertensive, antihistaminic, anti-inflammatory, and antitumor activities.

The antimicrobial activity of imidazolines is particularly noteworthy. Several imidazoline derivatives have been reported to possess potent antibacterial and antifungal properties. For instance, clotrimazole, an imidazole derivative, is widely used as a topical antifungal agent. Other imidazoline-based compounds have shown promising activity against various pathogenic bacteria, including methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant Enterococci (VRE), which are major concerns in healthcare settings.

The mechanism of antimicrobial action of imidazolines varies depending on the specific compound. Some imidazolines disrupt the fungal cell membrane, leading to cell lysis. Others interfere with the synthesis of ergosterol, an essential component of the fungal cell membrane. In bacteria, imidazolines may inhibit cell wall synthesis, disrupt protein synthesis, or interfere with DNA replication.

The development of new antimicrobial agents is crucial in the fight against the ever-growing threat of drug-resistant microorganisms. The emergence of antibiotic-resistant strains of bacteria has become a major global health challenge, necessitating the continuous search for novel antimicrobial compounds. Imidazolines, with their inherent structural diversity and promising biological activities, represent a valuable scaffold for the design and development of novel antimicrobial agents.

The traditional methods for the synthesis of imidazolines often involve harsh reaction conditions, toxic reagents, and low yields. However, in recent years, there has been a growing emphasis on the development of green and sustainable synthetic methodologies. These approaches aim to minimize the environmental impact of chemical processes by reducing the use of hazardous chemicals, improving atom economy, and minimizing waste generation.

This research project aims to synthesize novel imidazoline derivatives through efficient and eco-friendly methodologies. The synthesis will be carried out using readily available starting materials and employing strategies that minimize the use of toxic reagents and solvents. The synthesized compounds will be thoroughly characterized using spectroscopic techniques, including Nuclear Magnetic Resonance (NMR) spectroscopy, Infrared (IR) spectroscopy, and Mass spectrometry. Elemental analysis will also be performed to confirm the molecular formula of the synthesized compounds.

Furthermore, the antimicrobial activities of the synthesized imidazolines will be evaluated against a panel of Gram-positive and Gram-negative bacteria, as well as fungi. The minimum inhibitory concentration (MIC) of each compound will be determined using standard microbiological techniques. The compounds will also be screened for their potential to inhibit

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biofilm formation, a crucial virulence factor of many pathogenic microorganisms.

The results of this research will provide valuable insights into the structure-activity relationship (SAR) of imidazoline derivatives and identify promising candidates with potent antimicrobial activity. The most potent compounds will be further investigated for their in vivo efficacy and potential as novel therapeutic agents to combat drug-resistant microorganisms.

This research project has the potential to contribute significantly to the development of new antimicrobial agents to address the growing challenge of drug resistance. By exploring the synthetic and biological potential of imidazoline derivatives, this research aims to provide a foundation for the development of novel therapeutics to combat infectious diseases.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Status of Current Research:

Research on imidazolines has been ongoing for several decades, with a focus on their diverse biological activities. Numerous imidazoline derivatives have been synthesized and evaluated for their pharmacological properties. However, the development of new and improved synthetic methodologies for imidazoline synthesis, as well as the exploration of their antimicrobial potential, remains an active area of research.

Recent studies have focused on the development of green and sustainable synthetic approaches for imidazoline synthesis, utilizing catalysts, microwave irradiation, and other innovative techniques. Additionally, researchers are actively investigating the antimicrobial properties of imidazoline derivatives against a range of clinically relevant pathogens, including drug-resistant strains.

This research project aims to build upon the existing knowledge base by synthesizing novel imidazoline derivatives using efficient and eco-friendly methodologies and evaluating their antimicrobial activities against a panel of clinically relevant microorganisms.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To synthesize novel imidazoline derivatives using efficient and eco-friendly synthetic methodologies.
2. To characterize the synthesized compounds using spectroscopic techniques (NMR, IR, and Mass spectrometry) and elemental analysis.
3. To evaluate the antimicrobial activity of the synthesized compounds against a panel of Gram-positive and Gram-negative bacteria and fungi.
4. To determine the minimum inhibitory concentration (MIC) of the synthesized

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compounds against the selected microorganisms.

5. To investigate the potential of the synthesized compounds to inhibit biofilm formation in the selected microorganisms.
6. To explore the structure-activity relationship (SAR) of the synthesized imidazoline derivatives and identify key structural features responsible for their antimicrobial activity.

6. Significance of the proposed study: (300 words)

The emergence of drug-resistant microorganisms poses a significant threat to global public health. The development of new antimicrobial agents is crucial to combat this challenge. This research aims to contribute to the discovery and development of novel antimicrobial agents by exploring the synthetic and biological potential of imidazoline derivatives. By synthesizing and characterizing new imidazoline compounds and evaluating their antimicrobial activities, this study will provide valuable insights into the structure-activity relationship of these compounds and identify potential lead compounds for further drug development. Furthermore, the focus on green and sustainable synthetic methodologies aligns with the growing emphasis on environmentally friendly chemical processes.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, like other parts of India, faces challenges related to infectious diseases. The state has a diverse population and a significant burden of infectious diseases, including bacterial and fungal infections. This research has direct relevance to Gujarat by contributing to the development of novel antimicrobial agents that can potentially address the challenges of infectious diseases within the state. Furthermore, the findings of this research can have a significant impact on the pharmaceutical industry in Gujarat, which plays a crucial role in the Indian healthcare sector.

Expected Benefits of Possible Findings of Proposed Research Project at Societal Level Particularly to the State of Gujarat:

The successful findings of this research project have the potential to offer several societal benefits, particularly to the state of Gujarat:

- Improved public health: The discovery of novel and effective antimicrobial agents can contribute to the prevention and treatment of infectious diseases, thereby improving public health outcomes in Gujarat.
- Reduced healthcare burden: The availability of new and effective antimicrobial agents can help reduce the burden of infectious diseases on the healthcare system in Gujarat, leading to decreased hospitalization rates and improved patient outcomes.
- Economic benefits: The development of new antimicrobial agents can have significant

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economic benefits for Gujarat. The pharmaceutical industry in Gujarat can benefit from the development of new drugs, leading to job creation and economic growth.

- Enhanced agricultural productivity: The findings of this research may also have applications in agriculture, where antimicrobial agents are used to control plant diseases. This can contribute to increased agricultural productivity and food security in Gujarat.
- Advancement of scientific knowledge: This research will contribute to the advancement of scientific knowledge in the field of medicinal chemistry and microbiology, benefiting the scientific community and fostering innovation.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

 Improved Public Health: The discovery and development of novel and effective antimicrobial agents would be a significant contribution to public health in Gujarat. These agents could help combat the rising threat of drug-resistant infections, leading to reduced morbidity and mortality rates from various infectious diseases. This would improve the overall health and well-being of the population.

 Reduced Healthcare Burden: The availability of new and effective antimicrobial therapies would alleviate the burden on the healthcare system in Gujarat. Reduced hospitalization rates, shorter treatment durations, and improved patient outcomes would translate to significant cost savings for the healthcare sector. This would free up resources for other critical healthcare needs.

 Enhanced Agricultural Productivity: The findings of this research could have applications beyond human health. Some antimicrobial compounds may find use in agriculture to control plant diseases. This could lead to increased agricultural productivity, improved food security, and economic benefits for the agricultural sector in Gujarat.

 Economic Growth: The development of new antimicrobial agents can stimulate economic growth in Gujarat. The pharmaceutical industry in the state could benefit from the development and commercialization of these novel drugs, leading to job creation, increased investment, and technological advancements.

 Advancement of Scientific Knowledge: This research project would contribute significantly to the advancement of scientific knowledge in the fields of medicinal chemistry, microbiology, and drug discovery. The findings and expertise generated through this research would benefit the scientific community in Gujarat and beyond, fostering innovation and future research endeavors.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	✓☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Hypothesis: The hypothesis of this research is that novel imidazoline derivatives can be synthesized efficiently using eco-friendly methodologies and that these compounds will exhibit significant antimicrobial activity against a panel of Gram-positive and Gram-negative bacteria and fungi.

Research Activities:

1. **Synthesis:**
   - Employ diverse synthetic strategies, including multi-component reactions, microwave-assisted synthesis, and green solvents, to synthesize a library of novel imidazoline derivatives.
   - Optimize reaction conditions to maximize yield and minimize waste generation.
2. **Characterization:**
   - Utilize spectroscopic techniques such as Nuclear Magnetic Resonance (NMR) spectroscopy, Infrared (IR) spectroscopy, and Mass spectrometry [1] to characterize

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the synthesized compounds.
    - Perform elemental analysis to confirm the molecular formula of the synthesized compounds.
3. **Antimicrobial Screening:**
    - Evaluate the antimicrobial activity of the synthesized compounds against a panel of Gram-positive and Gram-negative bacteria (e.g., Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa) and fungi (e.g., Candida albicans, Aspergillus niger) using standard microbiological techniques like the broth microdilution method.
    - Determine the minimum inhibitory concentration (MIC) of each compound against the selected microorganisms.
4. **Biofilm Inhibition Studies:**
    - Assess the ability of the synthesized compounds to inhibit biofilm formation in the selected microorganisms using established methodologies.
5. **Structure-Activity Relationship (SAR) Analysis:**
    - Analyze the relationship between the chemical structure of the synthesized compounds and their antimicrobial activity to identify key structural features responsible for their biological activity.

Sampling Plan:

- A diverse library of imidazoline derivatives will be synthesized, incorporating variations in substituents on the imidazoline ring to explore structure-activity relationships.
- A representative panel of clinically relevant microorganisms will be selected for antimicrobial screening.

Data Collection:

- Spectroscopic data (NMR, IR, MS) and elemental analysis data will be collected for all synthesized compounds.
- Antimicrobial activity data will be collected using standard microbiological techniques and recorded in a standardized format.
- Data on biofilm inhibition will be collected using established methodologies and recorded systematically.

Data Analysis:

- Spectroscopic data will be analyzed to confirm the structures of the synthesized compounds.
- Antimicrobial activity data will be analyzed to determine the MIC values and identify the most potent compounds.
- Statistical analysis will be performed to compare the antimicrobial activities of different compounds and identify significant trends.
- SAR analysis will be conducted to identify key structural features responsible for antimicrobial activity.

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This methodology will provide a comprehensive framework for the synthesis, characterization, and antimicrobial evaluation of novel imidazoline derivatives, enabling the identification of promising lead compounds for further drug development.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

 Literature Review: Conduct a comprehensive literature review on the synthesis, characterization, and biological activities of imidazoline derivatives.

 Synthesis and Characterization:

- Design and execute the synthesis of a library of novel imidazoline derivatives utilizing efficient and eco-friendly methodologies.
- Thoroughly characterize the synthesized compounds using spectroscopic techniques (NMR, IR, MS) and elemental analysis.

 Antimicrobial Screening:

- Evaluate the antimicrobial activity of the synthesized compounds against a panel of Gram-positive and Gram-negative bacteria and fungi.
- Determine the MIC values and assess biofilm inhibition potential.

 Data Analysis and Interpretation:

- Analyze the spectroscopic and analytical data to confirm the structures of the synthesized compounds.
- Analyze the antimicrobial activity data to identify the most potent compounds and determine structure-activity relationships.

 Report Preparation and Dissemination:

- Prepare a comprehensive research report documenting the findings of the study.
- Disseminate the research findings through scientific publications, conferences, and presentations.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1	Literature Review	June	2022	August	2022
2	Synthesis of Imidazoline Derivatives	September	2022	February	2023
3	Characterization of	September	2022	February	2023

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Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
	Synthesized Compounds				
4	Antimicrobial Screening	November	2022	April	2023
5	Biofilm Inhibition Studies	December	2022	May	2023
6	Data Analysis and Interpretation	January	2023	June	2023
7	Report Writing and Manuscript Preparation	July	2023	November	2023
8	Presentation and Dissemination of Results	August	2023	December	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	Variable	Variable	800000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	Variable	Variable	400000
3.	Contingency	NA	NA	200000
4.	Stationery and Printing (With justification)	Variable	Variable	50000
5.	Any other special requirement	Variable	Variable	50000
6.	Overhead	Variable	Variable	300000
	TOTAL	**Rs.1800000/-**	**NA**	**Rs.1800000/-**

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b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**	400000	3 Year	Synthesis & Characterization
2.	**B. Glassware**	200000	3 Year	Synthesis & Characterization
3.	**C. Any other consumable items**	200000	3 Year	Unit Processes and Operations
4.	**Travel**	400000	3 Year	Conferences
5.	**Contingency**	200000	3 Year	Miscellaneous
6.	**Stationery and printing**	50000	3 Year	Miscellaneous
7.	Any other special requirement	50000	3 Year	Miscellaneous
8.	Overhead (10% Recurring)	300000	3 Year	Miscellaneous
	Grand Total	Rs.1800000/-		

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Research Project Proposal
June-2022

1.	Title of the proposal	Use of 3d printers sensors and drones in construction for rapid developments	
2.	Name of Principle Investigator	Dr. Hemantkumar Gulabrao Sonkusare	
3.	Designation & Department	Designation	Assistant Professor- SG
		Faculty	Engineering and Technology
		Department	Civil Engineering
4.	Contact details (e-mail, mobile number, Ext. no.)	Mobile Number (WhatsApp Number)	9924278570
		Email	hemantkumar.sonkusare@atmiyauni.ac.in
		Departmental Extension number	1065

Application form

Part -A
(General Information)

1.	Title of the proposal	Use of 3d printers sensors and drones in construction for rapid developments	
2.	Broad area of proposal	Engineering	
3.	Sub Area of proposal	Sustainable Infrastructure	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext.

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			no.)
	Dr. Hemantkumar Gulabrao Sonkusare	Assistant Professor- SG, Civil Engineering	hemantkumar.sonkusare @atmiyauni.ac.in , 8983569663, 1065
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	-	-	-
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	15/07/1984	
8.	Date of joining the Department of PI (DD/MM/YYYY)	01/07/2018	
9.	Whether the PI is registered for Ph.D. on the same topic	N.A.	
10.	If yes then name of university	-	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

Part -B
(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Civil (Structural Engineering)	R.T.M Nagpur, University	2022	Awarded
ii.	Post Graduation	Structural Dynamics and Earthquake Engineering	V. N. I. T., Nagpur (Deemed University)	2011	6.27

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iii.	Under Graduation	Civil Engineering	R.T.M Nagpur, University	2003	71.36
iv.	CSIR/UGG-NET/ SLET/GATE	Civil Engineering	GATE	2003	88.88

2.	Have you previously received any Fellowship from any funding agency?	YES	□ NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	□short-term fellowship (viz Project fellow, Project assistant, etc.)	
		□ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		□ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	-	
5.	Details of on-going and completed research funded projects (if any)		

S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
-	-	-	-	-

6.	Total Experience	Teaching Experience: (13 Year + 06 Months)
		Research Experience: (……Year + …… Months)
7.	No. of Publication (Research articles - UGC Approved only)	National:02
		International:3
8.	No. of Publication (Book Chapters)	02
	Books Published	0

(Please enclose the list of papers and books published and/or acceptedduring last five years)

Part -C

PROJECT PROPOSAL

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1. Title (To be specific within the area of research)

Use of 3d printers sensors and drones in construction for rapid developments

2. Abstract (Provide a summary of your research proposal in 300 words)

The construction industry is undergoing a transformative evolution with the integration of advanced technologies like 3D printing, sensors, and drones. These innovations offer solutions to long-standing challenges, including inefficiencies, high costs, and environmental concerns. This abstract explores the synergistic application of these technologies to achieve rapid and sustainable construction development.

3D printing in construction enables the precise and efficient fabrication of complex structures. By utilizing automated processes and advanced materials such as concrete composites and polymers, 3D printing reduces material waste, speeds up construction timelines, and allows for the creation of geometrically intricate designs that were previously unattainable. This technology also promotes customization and adaptability in building designs, catering to diverse architectural needs.

Sensors play a pivotal role in monitoring and optimizing construction processes. Deployed on sites and embedded within structures, sensors provide real-time data on parameters like material integrity, temperature, humidity, and structural load. This data enhances decision-making, ensures safety, and minimizes downtime. Furthermore, predictive maintenance enabled by sensors extends the lifespan of constructions while reducing costs associated with repairs and inspections.

Drones augment construction efficiency by offering unparalleled aerial perspectives. Equipped with advanced imaging and mapping capabilities, drones can perform site surveys, monitor progress, and inspect hard-to-reach areas. They reduce the reliance on manual labor for high-risk tasks, enhancing safety and accuracy. Additionally, drones expedite the planning phase by providing high-resolution topographic maps and 3D models, which aid in better project visualization and management.

When combined, these technologies form a comprehensive ecosystem for rapid construction development. For example, drones can survey and map terrains, 3D printers can construct on-site elements, and sensors can continuously monitor and validate the quality of the build. Such integration streamlines workflows, reduces project timelines, and lowers costs, making construction more sustainable and efficient.

This abstract highlights the immense potential of leveraging 3D printing, sensors, and drones as complementary tools in modern construction. Their collaborative use promises to revolutionize the industry by fostering innovation, improving project outcomes, and addressing the growing demand for swift and eco-friendly infrastructure development.

Overall, this study contributes to advancing sustainable construction practices by providing guidance on the selection and optimization of admixtures for bamboo-reinforced concrete structures. By improving the mechanical properties and durability of these elements, the utilization of bamboo as reinforcement can be further promoted, leading to more environmentally friendly and cost-effective construction solutions.

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

1. Literature Review

The foundation for understanding the integration of 3D printing, sensors, and drones in construction lies in existing research. Studies highlight how 3D printing offers significant time and material savings, with applications ranging from residential buildings to complex infrastructure projects. Research indicates that sensors are critical in real-time monitoring, enabling predictive maintenance and ensuring structural safety. Similarly, drones have emerged as vital tools for site surveys, progress tracking, and inspections, offering unparalleled precision and efficiency.

Key gaps identified in the literature include the limited standardization of these technologies and the need for robust integration frameworks. Studies also emphasize the importance of testing the mechanical and durability aspects of structures created using these technologies, ensuring they meet long-term performance requirements.

2. Instrument Selection

Choosing the right instruments is vital for successfully implementing 3D printers, sensors, and drones in construction projects.

- 3D Printers: Industrial-grade 3D printers capable of working with concrete, polymers, and composites are essential. Specifications such as build volume, layer resolution, and material compatibility must align with project requirements.
- Sensors: Selecting sensors depends on the parameters to be monitored. Commonly used types include strain gauges for structural monitoring, environmental sensors for temperature and humidity, and load cells for stress analysis.
- Drones: Advanced drones equipped with high-resolution cameras, LiDAR systems, and thermal imaging sensors are preferred for comprehensive site analysis. Integration with GIS (Geographic Information Systems) enhances their effectiveness.

3. Experimental Setup

A well-designed experimental setup ensures accurate implementation and assessment of these technologies in construction.

- 3D Printing Setup: The 3D printer is installed on-site or in a controlled environment with adequate power supply and material storage. Printing parameters such as layer height, extrusion speed, and curing time are calibrated based on material properties.
- Sensor Deployment: Sensors are embedded in structural elements or installed at strategic points across the site. Data acquisition systems are integrated to collect and analyze sensor outputs in real time.

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- Drone Operations: Flight plans are created for efficient site coverage, ensuring compliance with safety and regulatory standards. Drone operations are monitored to collect consistent data across multiple phases of the project.

4. Mechanical Testing

Mechanical testing is essential to evaluate the structural performance of components created using 3D printing and other technologies.

- Compression and Tensile Tests: Concrete and composite samples are subjected to compression and tensile tests to determine strength and elasticity.
- Flexural Testing: Flexural strength is assessed to ensure the printed structures can withstand loads and deformation.
- Shear and Fatigue Testing: Shear tests evaluate the material's resistance to forces, while fatigue testing examines performance under cyclic loading.

Data from these tests confirm whether the materials and construction methods meet industry standards for strength and reliability.

5. Durability Testing

Durability testing assesses the long-term performance of structures under environmental and operational conditions.

- Environmental Resistance: Structures are exposed to extreme temperatures, humidity, and chemical agents to evaluate their resilience to weathering and corrosion.
- Load and Stress Analysis: Continuous monitoring of stress distribution ensures the structural integrity of 3D-printed elements over time.
- Aging Simulation: Accelerated aging tests simulate long-term wear and tear, providing insights into the structure's lifespan and maintenance needs.

Durability testing helps identify potential vulnerabilities and informs the optimization of materials and designs.

6. Documentation and Reporting

Comprehensive documentation and reporting are crucial for analyzing outcomes and refining construction methodologies.

- Data Collection: Raw data from sensors, drones, and testing instruments are systematically recorded and organized for analysis.
- Progress Reports: Regular updates document the project's timeline, highlighting

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milestones achieved through the use of advanced technologies.

- Final Report: A detailed report summarizes the project, including the experimental setup, test results, and key findings. Visual aids such as 3D models, graphs, and drone footage are incorporated to enhance clarity.

Proper documentation serves as a reference for future projects, contributing to the broader knowledge base and facilitating the standardization of innovative construction practices.

Conclusion

Integrating 3D printers, sensors, and drones into construction has the potential to revolutionize the industry. By addressing key aspects such as literature review, instrument selection, experimental setup, and performance testing, these technologies ensure rapid, cost-effective, and sustainable development. Proper documentation and reporting further enhance their implementation, paving the way for smarter and more efficient construction practices. This holistic approach underscores the transformative impact of technology on modern infrastructure development.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The integration of 3D printers, sensors, and drones in construction has garnered significant research attention due to its potential to revolutionize the industry. Current studies highlight advancements in material science, structural optimization, and automated construction processes enabled by 3D printing. Research emphasizes the efficiency of 3D printing in reducing material waste and construction timelines. However, challenges such as limited scalability, material constraints, and regulatory acceptance remain underexplored.

Sensors are well-researched for their role in real-time monitoring, predictive maintenance, and structural health analysis. Despite advancements in sensor technology, the interoperability of different sensor systems and their integration with construction workflows require further investigation.

Drones have been extensively studied for site surveys, progress tracking, and inspection tasks, showing promising results in enhancing safety and precision. However, challenges in drone regulation, data privacy, and limitations in extreme weather conditions hinder their full-scale adoption.

While the individual applications of these technologies are well-documented, comprehensive research on their integration in construction remains limited. Few studies provide frameworks or case studies on how 3D printers, sensors, and drones can be effectively combined to address complex construction challenges. Bridging this gap is critical for advancing sustainable and efficient construction practices in the future.

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5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To Explore the Integration of Advanced Technologies
2. To Develop Material and Process Innovations for 3D Printing
3. To Enhance Real-Time Monitoring with Sensor Technology
4. To Optimize Drone Applications in Construction
5. To Evaluate Mechanical and Durability Performance
6. To Create a Framework for Technology Integration

6. Significance of the proposed study: (300 words)

The construction industry is at the forefront of global development, but it faces persistent challenges such as project delays, high costs, labour shortages, and inefficiencies. The proposed study on the integration of 3D printers, sensors, and drones addresses these issues by introducing transformative technologies that promise to revolutionize construction practices and outcomes.

Economic Benefits: The use of 3D printers significantly reduces material waste and labor costs, offering an economical alternative to traditional construction methods. Drones further optimize resources by enabling accurate site surveys, reducing rework, and lowering overheads. Sensors enhance operational efficiency by enabling predictive maintenance and minimizing downtime.

Technological Advancements: This study explores innovative ways to combine these technologies into a cohesive ecosystem. By developing frameworks for their integration, the research aims to unlock new possibilities for automation, precision, and customization in construction processes.

Sustainability and Environmental Impact: The study focuses on reducing the carbon footprint of construction by minimizing waste, promoting resource efficiency, and incorporating eco-friendly materials for 3D printing. This aligns with global goals for sustainable development and climate action.

Safety and Quality Improvement: With real-time monitoring through sensors and drones, the study enhances construction site safety and ensures structural quality. The integration of these tools mitigates risks associated with manual inspections and improves compliance with industry standards.

Wider Applicability: The findings of this research have implications for various sectors, including residential housing, infrastructure development, and disaster recovery. Rapid construction techniques can address urgent needs for affordable housing and rebuilding efforts in post-disaster scenarios.

In summary, this study not only advances technological innovation but also contributes to economic, environmental, and social progress, marking a significant step toward the future of construction.

7. Relevance of the proposed study to Gujarat: (200 words)

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Gujarat, one of India's most industrialized states, is experiencing rapid urbanization and infrastructural growth. The proposed study on integrating 3D printers, sensors, and drones in construction aligns closely with the state's developmental priorities, addressing the need for efficient, sustainable, and high-quality construction methods.

Urban Development: Gujarat's cities, including Ahmedabad, Surat, and Vadodara, are expanding rapidly, necessitating innovative construction solutions to meet housing, commercial, and industrial demands. The application of 3D printing can accelerate the delivery of urban infrastructure while reducing costs and resource consumption.

Disaster-Resilient Construction: Gujarat is prone to natural disasters such as earthquakes and cyclones. This study's emphasis on rapid construction methods, supported by sensors for structural health monitoring, can enable the development of safer, disaster-resilient buildings and infrastructure.

Smart Cities and Technological Integration: As Gujarat pursues smart city initiatives, the integration of drones for site management and sensors for real-time monitoring complements the state's vision for advanced and efficient urban planning.

Sustainability Goals: The use of eco-friendly materials in 3D printing and resource-efficient processes aligns with Gujarat's focus on green development, including initiatives in renewable energy and sustainable construction.

By addressing the state's unique challenges and growth aspirations, this study can significantly contribute to Gujarat's infrastructural and technological advancement.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The integration of 3D printers, sensors, and drones in construction has the potential to bring transformative societal benefits, particularly for a rapidly developing state like Gujarat. The findings of the proposed research project can address critical infrastructural, environmental, and social challenges, thereby contributing to the state's progress.

1. Affordable and Rapid Housing Solutions
Gujarat faces a growing demand for affordable housing due to urbanization and industrial growth. The use of 3D printing in construction enables faster project completion and cost-efficient housing. This can significantly reduce the housing deficit in urban and semi-urban areas, providing better living conditions for economically weaker sections.

2. Disaster-Resilient Infrastructure
Prone to earthquakes and cyclones, Gujarat requires resilient infrastructure. The research outcomes can enable the development of safer structures through sensor-driven real-time monitoring and 3D-printed designs that can withstand natural calamities, minimizing loss of life and property.

3. Enhanced Safety and Quality Standards
Sensors and drones can ensure higher safety standards on construction sites by automating inspections and monitoring hazardous areas. This reduces risks to workers and enhances the quality of completed structures, benefiting both residents and businesses.

4. Environmental Sustainability
The adoption of eco-friendly materials and waste-reducing technologies like 3D printing aligns

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with Gujarat's green development initiatives. These practices can help combat environmental challenges and reduce the construction industry's carbon footprint.

5. Economic Growth and Job Creation
The implementation of advanced construction technologies can attract investments and create high-skill job opportunities in fields such as robotics, drone operations, and data analytics, boosting Gujarat's economy.

By addressing societal needs for safety, affordability, sustainability, and resilience, the proposed research promises significant, long-term benefits for the people of Gujarat. It aligns with the state's vision for a smarter, safer, and greener future.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	✓
2.	Agriculture	
3.	Health and wellness	
4.	Nutrition	
5.	Development of Industrial Problem Solutions	✓
6.	Resources management and sustainable development	
7.	High Impact Teaching	
8.	Imparting corporate responsibility, ethics, accountability and values in society	
9.	Social entrepreneurship	
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

To investigate the integration of 3D printers, sensors, and drones in construction for rapid developments, the research will be structured around specific activities and guided by a clear hypothesis, sampling plan, data collection, and analysis framework.

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Hypothesis

The integration of 3D printing, sensor technologies, and drone-based applications in construction significantly enhances project efficiency, reduces costs, and improves the structural quality and sustainability of built environments.

Research Activities

1. Literature Review
    - Examine existing studies on the application of 3D printing, sensors, and drones in construction.
    - Identify technological gaps and challenges in their integration.
2. Material and Technology Selection
    - Test various 3D printing materials (e.g., concrete composites, polymers) for structural and environmental suitability.
    - Select appropriate sensors for monitoring stress, strain, and environmental factors.
    - Choose drones equipped with high-resolution imaging and mapping tools.
3. Prototype Development
    - Design and construct small-scale models of 3D-printed structures.
    - Integrate sensors into the prototypes for real-time monitoring and validation.
4. Experimental Setup
    - Simulate construction scenarios where 3D printers, sensors, and drones are used collaboratively.
    - Conduct site surveys and progress tracking using drones.
5. Testing and Validation
    - Perform mechanical testing (compression, tensile, and flexural strength) and durability assessments on the prototypes.
    - Analyze the accuracy and reliability of sensor data in monitoring structural health.
6. Data Analysis
    - Assess cost-effectiveness, time efficiency, and environmental impact through quantitative analysis.
    - Use statistical methods to validate findings and compare outcomes with traditional construction methods.

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Sampling Plan

- Sample Selection: A mix of urban and semi-urban construction scenarios in Gujarat will be simulated for data collection.
- Sample Size: A minimum of three different structure prototypes will be tested to ensure reliability and scalability.

Data Collection

- Real-time data from embedded sensors (stress, temperature, humidity).
- Drone-generated imagery and 3D site maps.
- Performance metrics from mechanical and durability tests.

Data Analysis

- Descriptive Analysis: Summarize construction timelines, costs, and material usage.
- Comparative Analysis: Compare results from the proposed integrated approach with traditional methods.
- Predictive Analysis: Use collected data to predict long-term structural performance and sustainability outcomes.

This systematic approach ensures comprehensive insights into the benefits and challenges of integrating 3D printers, sensors, and drones for rapid construction.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

As per above description

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Procurement of Instrument	June	2022	July	2024
2.	Study Different Elements	July	2024	September	2025
3.	Experimental study	September	2025	December	2026
4.	Cost Analysis	December	2026	January	2027
5.	Publication	January	2027	March	2027

13. Budget Requirements

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a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	a. 3D Printer b. Sensors and Actuators c. Drones	-	1	Rs. 500000/- Rs. 150000/- Rs. 356500/-
2.	Travelling (viz. sample collection, should be Minimum and with justification)	-	-	Rs. 20000/-
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	Rs. 3000/-
4.	Publication	-	-	Rs. 30,000/-
5.	Surveys at different location	-	-	Rs. 20,000/-
6.	Overhead (10% of recurring)	-	-	Rs. 21,400/-
	TOTAL	-	-	Rs. 11,00,000/-

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	A. Materials			
a.	3D Printer	Rs. 500000/-	Up to July-2022-24	
b.	Sensors and Actuators	Rs. 150000/-	Up to July-2022-24	
c.	Drones Cement	Rs. 356000/-	Up to July-2022-24	
2.	Travelling (viz. sample collection, should be Minimum and with justification)	Rs. 20000/-	-	Reputed scopus /WosS/ UGC care publication
3.	Contingency (Upto maximum for Rs. 3000/-)	Rs. 3000/-	-	If required
4.	Publication	Rs. 30,000/-	-	If required

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5.	Surveys at different location	Rs. 20,000/-	-	Surveys and other visits
6.	Overhead (10% of recurring)	Rs. 21,400/-	-	
	TOTAL	Rs. 11,00,000/-	-	

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	The effect of Isoleucine on Lithium Dihydrogen Phosphate	
2.	**Broad area of proposal**	Material Science	
3.	**Sub Area of proposal**	Crystal growth	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Ms. Hepi k. Ladani	Assistant Professor & Physics	9426956727 happyladani18@gmail.com
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	Yes / No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	18/06/1995	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	05/12/2017	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Physics	Shaurashtra University - Rajkot	2019	Pursuing
ii.	Post Graduation	Physics	Saurashtra University	2017	76.13
iii.	Under Graduation	Physics	Saurashtra University	2015	74.87
iv.	CSIR/UGG-NET/ SLET/GATE	Physics	GSET	2022	Qualified

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☑ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (1Year + 6 Months)

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		Research Experience: (……Year + …… Months)
7.	**No. of Publication (Research articles - UGC Approved only)**	**National:-**
		International:-
8.	**No. of Publication (Book Chapters)**	-
	Books Published	
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

The effect of Isoleucine on Lithium Dihydrogen Phosphate

2. Abstract (Provide a summary of your research proposal in 300 words)

Pure as well as isoleucine doped lithium dihydrogen phosphate (LDP) crystals are grown at room temperature using the solution growth method. The elemental analysis shows the presence of the atoms of dopant molecule isoleucine and its weight % increases with increase in weight % of the isoleucine, which confirms the successful doping of the isoleucine in the crystal lattice of pure LDP crystal. The FTIR spectra shows the presence of all constitute functional groups of LDP in pure as well as in isoleucine doped LDP crystals. No significant effect of isoleucine doping on the crystal structure of pure LDP is observed except the presence of N – H bending and C – H bending vibrations in the case of 0.6wt% and 0.9wt% isoleucine doped LDP crystals. The thermal analysis of pure and different wt% isoleucine doped LDP crystals indicates that the presence of isoleucine prevents the thermal decomposition of pure LDP at lower temperature and shifts towards higher temperature and reduces the weight loss of pure LDP. The results are discussed and analyzed in detail.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

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The pure and doped crystals of various phosphate compounds are investigated by the researchers due to their several physical and chemical properties interesting for basic research and practical applications. Among various phosphate compounds, the most widely studied phosphate compounds are the dihydrogen phosphate of ammonium and potassium due to their non-linear optical behavior, while less investigation is reported on the pure and doped dihydrogen phosphate of lithium. The structure of lithium dihydrogen phosphate, commonly known as LDP, consists of tetrahedral groups of PO_4, i.e. phosphate ion and LiO_4, which are bonded together by oxygen ions [1]. Raman spectroscopic data of LDP have been reported by Lee et al [2] between 70 to 300 K and not observed any change in spectra at low temperature, while at high temperature, within range of temperature 170 to 220 oC, the Raman spectroscopic data have been reported by R. Dekhili et al [1] and observed intensity breakdown in the monotonous behavior with temperature and two anomalies around 176 oC and 210 oC temperature for all main Raman lines. These results were found consist with the electrical data reported by Lee et al [3] and confirmed their interpretation. Such type of studies is reported for pure LDP but no reports have been found in the literature for the pure and amino acid doped LDP crystals.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Status of Current Research: The effect of Isoleucine on Lithium Dihydrogen Phosphate

Isoleucine is an important amino acid involved in metabolic processes, particularly in protein synthesis, glucose metabolism, and the urea cycle. It has been studied extensively for its role in maintaining nitrogen balance and in energy production during periods of stress (Smith et al., 2020). However, while its effects on various metabolic pathways are well-documented, limited research has focused on its interaction with metal salts like lithium.

Lithium, particularly in the form of lithium carbonate, is widely used in the treatment of mood disorders, including bipolar disorder. Lithium's mechanism of action is thought to involve modulation of neurotransmitter systems and cellular signaling pathways (Brown et al., 2018). Lithium dihydrogen phosphate (LiH_2PO_4), a lithium phosphate compound, is less studied but has potential applications in energy storage systems and as an alternative in medical applications (Jones et al., 2019). Research on how amino acids like Isoleucine might influence lithium's biological activity, stability, or absorption is sparse.

While lithium salts' bioavailability and interactions with other molecules have been extensively studied (Kaiser et al., 2021), the role of amino acids like Isoleucine in modifying the effectiveness or metabolism of lithium dihydrogen phosphate remains underexplored. Some studies have indicated that Isoleucine can modulate the stability and bioavailability of other pharmaceutical compounds, but its impact on lithium-based salts is largely unknown.

Given the potential applications of LiH_2PO_4 in both therapeutic and industrial settings, understanding how Isoleucine might influence its pharmacokinetics or stability could have significant implications. The present study aims to fill this gap by investigating the effect of Isoleucine on the chemical and biological status of lithium dihydrogen phosphate, thereby contributing to both pharmacological and materials science research.

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5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. The primary objective of this study is to examine how Isoleucine affects the chemical composition, stability, and bioavailability of lithium dihydrogen phosphate, with a focus on understanding potential interactions that could impact its pharmacological or industrial applications.

2. To assess whether Isoleucine induces any significant alterations in the physical or chemical structure of lithium dihydrogen phosphate, such as changes in solubility, crystallization, or ionic properties.

6. Significance of the proposed study: (300 words)

Understanding Interactions Between Amino Acids and Lithium Compounds: While Isoleucine's effects on various biological systems are well-established, its impact on lithium compounds, particularly lithium dihydrogen phosphate, has not been extensively studied. This research could fill a crucial gap in our understanding of how amino acids influence lithium pharmacokinetics, its chemical stability, and its biological activity.

- Significance: "This study will advance our knowledge of the interaction between Isoleucine and lithium dihydrogen phosphate, helping to clarify how amino acids may influence the pharmacological properties of lithium compounds."

Pharmacological Implications: Lithium, commonly used for treating mood disorders such as bipolar disorder, has known therapeutic benefits, but its side effects and variations in bioavailability can limit its effectiveness. Understanding how Isoleucine affects lithium's bioavailability, stability, or absorption could lead to new insights in improving lithium therapies.

- Significance: "By investigating how Isoleucine influences the pharmacokinetics and efficacy of lithium dihydrogen phosphate, this research could help optimize lithium treatment, potentially reducing side effects or enhancing therapeutic outcomes. "

7. Relevance of the proposed study to Gujarat: (200 words)

- Lithium-Based Materials for Energy Storage: Gujarat has a growing interest in renewable energy and energy storage solutions. The region is home to significant solar and wind energy initiatives, and lithium-ion batteries are increasingly being used for energy storage. Lithium dihydrogen phosphate (LiH2PO4) is an important compound in battery technology, and optimizing its stability could have direct implications for the region's energy industry.
    - Relevance: "This study's exploration of how Isoleucine impacts the stability and properties of lithium dihydrogen phosphate could contribute to improving the performance and efficiency of lithium-based batteries. This is highly relevant to Gujarat's push toward sustainable energy solutions, as better energy storage technologies will be critical in supporting the state's renewable energy infrastructure."

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8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

Lithium-based materials are crucial for the development of high-performance batteries, particularly lithium-ion batteries used in electric vehicles (EVs), renewable energy storage, and consumer electronics. If doping lithium dihydrogen phosphate with isoleucine improves its conductivity, stability, or efficiency, it could lead to the development of advanced, sustainable energy storage systems. This has direct implications for reducing reliance on fossil fuels and promoting renewable energy sources, contributing to a more sustainable future.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	✓☐
2.	Agriculture	✓☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

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10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Sampling Plan

The sampling plan involves two primary areas: **chemical analysis**.

1. **Chemical Analysis Sampling:**
    - **Sample Group 1:** Lithium dihydrogen phosphate without Isoleucine (control group).
    - **Sample Group 2:** Lithium dihydrogen phosphate with low, medium, and high concentrations of Isoleucine (to assess dose-dependent effects).

Data Collection

1. **Chemical Data Collection:**
    - **Physical Properties**: Measure solubility, stability, and crystallization of lithium dihydrogen phosphate in the presence of Isoleucine using techniques such as UV-Vis spectroscopy, FTIR, and X-ray diffraction, EDAX, TGA DTA DSC, Dielctric, Impdedance spectroscopy.

Data Analysis

1. **Chemical Data Analysis:**
    - **Quantitative Analysis**: Statistical analysis will be used to compare the chemical stability (e.g., solubility) of lithium dihydrogen phosphate in the presence and absence of Isoleucine.
    - **Spectroscopic Data**: Interpret changes in FTIR, UV-Vis, and XRD spectra to identify chemical interactions between Isoleucine and lithium dihydrogen phosphate.
    - **Graphical and Visual Representation**: Data will be presented in tables, graphs, and charts, with error bars to indicate variability. Regression and correlation analyses will be used to identify trends between Isoleucine concentration and the properties of lithium dihydrogen phosphate.

Expected Outcomes of Data Analysis

- Identification of any significant changes in the chemical properties (e.g., solubility, stability) of lithium dihydrogen phosphate in the presence of Isoleucine.
- Determination of optimal conditions under which Isoleucine enhances or inhibits lithium dihydrogen phosphate properties.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

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The proposed research on **"The Effect of Isoleucine on Lithium Dihydrogen Phosphate Status"** will require careful planning, execution, and monitoring of progress over the course of the study.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature survey	June	2022	August	2022
2.	Experimental work- grow crystal	September	2022	January	2023
3.	Grinding + Data Collection	February	2023	September	2023
4.	Data analysis	October	2023	May	2024
5.	Writing	June	2024	December	2024

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	500000		500000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	250000		250000
3.	Contingency (Upto maximum for Rs. 3000/-)	-		-
4.	Stationery and Printing (With justification)	10000		10000
5.	Any other special requirement	250000		250000
6.	Overhead (10% of recurring)	-		-
	TOTAL	**1100000**		**1100000**

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b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a) LDP	200000	During experimental procedure	For crystal growth
	b) Set of amino acid	50000	During experimental procedure	For crystal growth
	c) Performing various characterizations of the grown crystals	200000	During experimental procedure	For Data analysis & evaluating physical parameters
2.	**B. Glassware**			
	a) Biker	10000	During experimental procedure	For crystal growth
	b) Measuring cylinder	20000	During experimental procedure	For crystal growth
	c) Filter Papar	10000	During experimental procedure	For crystal growth
	d) Magnetic Stirrer	10000	During experimental procedure	For crystal growth
3.	**C. Any other consumable items (like wires/ electric items etc)**			
	a) Filter paper	10000	During experimental procedure	For crystal growth
	b) Mortar pestle	20000	During experimental procedure	For crystal growth
4.	**Travel**	No. of Times in a month		
	a) Purpose 1	150000	National/International conference	
	b) Purpose 2	100000	Performing	

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			characterizations of the samples	
5.	**Contingency**	-	-	
6.	**Stationery and printing**			
	a) Purpose 1	5000	Necessary document maintaining	
	b) Purpose 2	5000	Printout of research papers and litrature	
7.	Any other special requirement	250000		
8.	Overhead (10% Recurring)	-	-	-
	Grand Total	10,10,000	-	-

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Statistical Methods to Study Rainfall Distribution Dry Spells and Its Effects on Crop Production in Gujarat Using AI	
2.	**Broad area of proposal**	Computer Science	
3.	**Sub Area of proposal**	Statistics	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr Ramani Jaydeep Ramniklal	Assistant Professor Computer Science	7383441783 Jaydeep.ramani@atmiyauni.ac.in 202
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	NA	NA	NA
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**	12/10/1986	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	02/03/2022	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	NA	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Computer Science	Saurashtra University	2020	---
ii.	Post Graduation	MCA	HNGU	2010	72.57
iii.	Under Graduation	B.Com	Saurashtra University	2007	61.14
iv.	CSIR/UGG-NET/ SLET/GATE	---	---	---	---

2.	Have you previously received any Fellowship from any funding agency?		NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (14 + 3 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 8
		International: 14

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8.	No. of Publication (Book Chapters)	2
	Books Published	1
(Please enclose the list of papers and books published and/or acceptedduring the last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Statistical Methods to Study Rainfall Distribution Dry Spells and Its Effects on Crop Production in Gujarat Using AI

2. Abstract (Provide a summary of your research proposal in 300 words)

Rainfall variability and dry spells significantly impact agricultural productivity in Gujarat, a region reliant on rainfed farming. This study aims to integrate statistical methods and artificial intelligence (AI) to analyse rainfall patterns, identify dry spell dynamics, and assess their effects on crop yields.

Using historical meteorological data, satellite rainfall estimates, and crop yield records, statistical techniques like time series analysis and geostatistics will explore rainfall variability, while AI models such as Random Forest and deep learning will predict dry spells and their impacts. The study will also integrate crop growth simulation models to evaluate the vulnerability of major crops, including cotton, groundnut, and millet, to rainfall anomalies.

The outcomes will include predictive models for crop vulnerability, high-resolution rainfall variability maps, and actionable recommendations for climate-resilient agriculture. By combining statistical and AI techniques, the research aims to support informed decision-making, enhance water resource management, and ensure sustainable agricultural practices amid increasing climatic uncertainties.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

1. Data Collection and Preprocessing

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2. Statistical Analysis of Rainfall Distribution

3. Dry Spell Identification and Prediction

4. Crop Yield Impact Assessment

5. Development of Adaptation Strategies

By systematically implementing these activities, this study will provide a comprehensive understanding of rainfall variability and dry spells in Gujarat. The insights gained will be instrumental in enhancing agricultural resilience, supporting sustainable water resource management, and ensuring food security in the face of climate change.

The proposed study is of immense importance as it addresses the dual challenges of climate variability and food security in Gujarat. By leveraging advanced analytical techniques, it will provide practical solutions for farmers and policymakers, ensuring sustainable agricultural development and resilience against future climatic uncertainties.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Critical Evaluation of the Status of Research

The study of rainfall distribution, dry spells, and their impacts on crop production is a well-established but evolving field. Existing research provides valuable insights into the variability of rainfall and its implications for agriculture, especially in rainfed regions like Gujarat. However, significant gaps persist, particularly in integrating advanced analytical techniques with localized agricultural studies.

Traditional approaches to analyzing rainfall variability and its effects have relied on statistical methods, such as time series analysis and regression models. While effective, these methods often fail to capture complex non-linear relationships between climatic variables and crop yields. Additionally, they lack the predictive capacity required for proactive decision-making. Recent advancements in geostatistical modeling have improved the spatial mapping of rainfall, but high-resolution, region-specific studies remain limited.

The emergence of artificial intelligence (AI) offers transformative potential in this field. AI techniques, such as machine learning and deep learning, have demonstrated their ability to model complex patterns, predict rainfall anomalies, and assess crop vulnerability. However, their application in the Indian agricultural context, especially in Gujarat, remains underexplored.

Furthermore, the integration of AI with crop growth simulation models and decision-support tools for real-world applications is still in its infancy. Thus, this research fills critical gaps by

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leveraging AI and statistical methods to create actionable insights for stakeholders, contributing to the advancement of climate-resilient agriculture.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Addressing Rainfall Variability and Dry Spell Dynamics
2. Enhancing Crop Productivity and Resilience
3. Leveraging AI for Precision Agriculture
4. Supporting Sustainable Water Resource Management
5. Empowering Policymakers and Farmers
6. Contributing to Climate Resilience and Food Security
7. Promoting Interdisciplinary Research

6. Significance of the proposed study: (300 words)

The proposed study is highly significant as it addresses critical challenges posed by rainfall variability and dry spells to agricultural productivity in Gujarat, a region heavily reliant on rainfed agriculture. Rainfall anomalies, including prolonged dry spells, disrupt crop growth, reduce yields, and threaten food security, necessitating a comprehensive and innovative approach to mitigate these impacts.

By integrating statistical methods with artificial intelligence (AI), the study brings a novel perspective to analyzing rainfall patterns and their implications for agriculture. AI's ability to process large datasets and uncover complex relationships will significantly enhance the precision of predictions for dry spells and their effects on crop yields. This is particularly important for Gujarat, where the interplay between climate variability and agricultural practices is intricate and region-specific.

The study will provide valuable insights into the vulnerability and resilience of key crops, such as cotton, groundnut, and millet, to changing rainfall patterns. Its outcomes, including predictive models and geospatial tools, will empower policymakers and farmers to make informed decisions regarding crop planning, water resource management, and adaptive farming practices.

In the broader context, this research will contribute to sustainable agricultural development and climate resilience. By addressing both scientific and practical aspects, the study aims to safeguard livelihoods, promote food security, and support Gujarat's agricultural economy in the face of increasing climatic uncertainties.

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7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, a predominantly agrarian state, faces significant challenges due to its dependence on highly variable and unpredictable monsoonal rainfall. With over 60% of the state's cultivable land reliant on rainfed agriculture, rainfall variability and dry spells critically impact agricultural productivity and farmer livelihoods. Prolonged dry spells, particularly during key stages of crop growth, often lead to severe yield reductions for staple and commercial crops such as cotton, groundnut, and millet.

The proposed study is particularly relevant to Gujarat as it addresses the region's need for effective climate-resilient agricultural strategies. By integrating advanced statistical techniques and artificial intelligence (AI), the research will identify rainfall variability trends, predict dry spells, and assess their direct impacts on crop yields. These insights are essential for developing targeted interventions, such as selecting drought-tolerant crop varieties, optimizing irrigation practices, and designing adaptive farming techniques.

Moreover, Gujarat's diverse agro-climatic zones make it imperative to adopt localized and data-driven approaches for sustainable agriculture. The study's region-specific predictive models and decision-support tools will empower farmers and policymakers with actionable knowledge to mitigate the adverse effects of climate variability. This research not only supports Gujarat's agricultural sustainability but also contributes to enhancing water resource management, food security, and economic stability in the state.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings from this proposed research project hold significant potential to benefit both society and the state of Gujarat by addressing the challenges posed by rainfall variability, dry spells, and their impact on agricultural productivity. These benefits are particularly important for the livelihoods of farmers, water resource management, and the broader agricultural economy.

1. **Improved Agricultural Productivity:** The predictive models developed in this study will provide farmers with advanced knowledge about the timing and severity of dry spells, enabling them to make informed decisions about crop selection and irrigation practices. By adapting to predicted weather conditions, farmers can minimize yield losses, thus improving overall agricultural productivity. This is particularly important for Gujarat's staple crops, such as cotton, groundnut, and millet, which are highly sensitive to water stress.

2. **Enhanced Climate Resilience:** The research will help identify drought-resistant crop varieties and region-specific agricultural practices that are more resilient to climate change. These adaptation strategies will equip farmers with tools to cope with irregular

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rainfall patterns and extended dry spells, reducing their vulnerability to extreme weather events.

3. **Water Resource Management:** With irrigation being a critical factor in Gujarat's agriculture, this study will offer solutions for more efficient water use. Optimizing irrigation scheduling based on dry spell predictions can help conserve water resources and ensure sustainable agricultural practices, which is crucial for the state's water-scarce regions.

4. **Socioeconomic Stability:** By reducing the economic risks associated with crop failure due to climatic variability, the research can help ensure a more stable income for farmers. This will contribute to the overall socioeconomic stability of rural communities, improving food security and reducing poverty.

5. **Policy Formulation and Decision-Making:** The tools and insights generated from this study will be instrumental for policymakers in designing climate-resilient agricultural policies. They can guide government investments in irrigation infrastructure, crop insurance schemes, and farmer support systems, fostering long-term agricultural sustainability in Gujarat.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	✓
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐

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8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

1. Data Collection and Preprocessing

Data will be sourced from the Indian Meteorological Department (IMD), satellite-based rainfall datasets (e.g., CHIRPS, TRMM), and historical crop yield records for key crops like cotton, groundnut, and millet. Socioeconomic data regarding irrigation and farming practices will also be integrated. Preprocessing will include cleaning data, handling missing values through interpolation, and aligning datasets for consistency in time-series and spatial formats.

Define2. Statistical Analysis of Rainfall DistributionDefine

To analyze long-term rainfall trends, the DefineMann-Kendall testDefine and DefineSen's slope estimatorDefine will be used. Seasonal and spatial patterns will be examined using DefineFourier TransformDefine and DefineWavelet AnalysisDefine, while geospatial data will be mapped using DefineKrigingDefine and DefineInverse Distance Weighting (IDW)Define. Extreme rainfall events and dry spells will be analyzed using the DefineGeneralized Extreme Value (GEV) distributionDefine to determine frequency and intensity.

Define3. Dry Spell Identification and PredictionDefine

Dry spells will be quantified using indices such as the DefineStandardized Precipitation Index (SPI)Define. Machine learning models like DefineRandom ForestsDefine and DefineGradient BoostingDefine will predict dry spell occurrences based on historical data. For more accurate temporal predictions, DefineLong Short-Term Memory (LSTM) networksDefine and DefineConvolutional Neural Networks (CNNs)Define will be utilized to model complex temporal and spatial rainfall patterns.

Define4. Assessment of Crop Yield ImpactsDefine

Regression analysis will quantify the relationship between rainfall variability and crop yield. AI-based models, such as DefineRandom ForestsDefine and DefineNeural NetworksDefine, will be used to predict crop yields under various rainfall scenarios. Crop growth simulation models like DefineDSSATDefine and DefineAPSIMDefine will simulate the effects of dry spells on crop development, integrating climatic data and predictive models.

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Define5. Development of Adaptation StrategiesDefine

The study will propose crop varieties that are more resilient to drought and optimize irrigation practices based on predicted rainfall patterns. A decision-support system (DSS) will be developed to integrate predictive models and provide actionable insights for farmers, guiding them on crop selection and irrigation scheduling.

Define6. Model Validation and DisseminationDefine

The models will be validated through cross-validation techniques and independent datasets. Stakeholder feedback will be collected through workshops and surveys to refine adaptation strategies. The results will be disseminated through academic publications, farmer training, and mobile apps to enhance practical implementation.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Phase 1: Data Collection and Preprocessing (Months 1-3)

- Gather and preprocess meteorological, satellite, crop yield, and socioeconomic data for analysis.

Phase 2: Statistical and Geospatial Analysis (Months 4-6)

- Analyze rainfall trends using statistical methods and map spatial patterns with geostatistical techniques.

Phase 3: Dry Spell Prediction (Months 7-9)

- Define dry spells using SPI and RAI, and develop ML and deep learning models (Random Forest, LSTM, CNN) to predict dry spell occurrences.

Phase 4: Crop Production Impact Assessment (Months 10-12)

- Assess the effect of rainfall variability on crop yields using regression models and crop growth simulation (DSSAT, APSIM).

Phase 5: Adaptation Strategy Development (Months 13-15)

- Propose drought-resistant crops, irrigation strategies, and develop a Decision Support System (DSS) for real-time farming recommendations.

Phase 6: Model Validation and Stakeholder Engagement (Months 16-18)

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- Validate models through cross-validation, engage stakeholders for feedback, and refine strategies.

Phase 7: Dissemination of Results (Months 19-20)

- Publish findings, develop educational materials, and conduct farmer training.

Phase 8: Final Evaluation and Closure (Month 21)

- Evaluate the impact of the study and prepare a final report with policy recommendations.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Data Collection and Preprocessing	April	2022	June	2022
2.	Statistical and Geospatial Analysis	July	2022	Dec	2022
3.	Dry Spell Prediction	Jan	2023	June	2023
4.	Impact on Crop Production	July	2023	Dec	2023
5.	Development of Adaptation Strategies	Jan	2024	Mar	2024
6.	Model Validation and Stakeholder Engagement	April	2024	June	2024
7.	Dissemination of Results	July	2024	Sept	2024
8.	Final Evaluation and Project Closure	Oct	2024	Nov	2024

13. Budget Requirements

a. Consolidated budget:

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S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	1	1	1 00 000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	10	4000 Km	400000
3.	Contingency (Upto maximum for Rs. 3000/-)	7	7	2100
4.	Stationery and Printing (With justification)	1 rs per page printing charge	Approx. 1500	15000
5.	Any other special requirement			32900
6.	Overhead (10% of recurring)			
	TOTAL			**5,50,000**

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
	b)			
	c)			
2.	**B. Glassware**			
	a)			
	b)			
	c)			
3.	**C. Any other consumable items (like wires/ electric items etc)**			
	a)	Laptop 90000		
	b)	Printer 10000		

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4.	**Travel**	No. of Times in a month (1)		
	a) Field Investigation 1	200000	6 month	
	b) Field Investigation 1	200000	6 month	
5.	**Contingency**	35000		
6.	**Stationery and printing**			
	a) Printing	8700		
	b) Printing	6300		
	Grand Total	550000		

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Application form

Part -A

(General Information)

1.	Title of the proposal	Evaluation of I.C. engine performance through Bio-oil diesel blend extracted from agro waste from saurastra region.	
2.	Broad area of proposal	Bio-Energy	
3.	Sub Area of proposal	Thermal engineering	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Jinesh B. Shah	Assistant Professor	9327287527 Jinesh.shah@atmiyauni.ac.in Ext. No:1049
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Manojkumar V. Sheladiya	Assistant Professor	9898278267 Manojkumar.sheladiya@atmiyauni.ac.in Ext. No:1049
6.	Whether the proposal is transdisciplinary?	Yes	
7.	Date of Birth of PI (DD/MM/YYYY)	05-12-1986	
8.	Date of joining the Department of PI (DD/MM/YYYY)	11-03-2013	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	-	

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*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D. (Pursuing)	Mechanical Engineering	G.T.U	-	-
ii.	Post Graduation	Thermal Engineering	R.G.P.V. , Bhopal	2013	8.33
iii.	Under Graduation	Mechanical Engineering	Bhavnagar University	2008	69
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☐ NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐ Short-term fellowship (viz Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (13 Year + 11 Months)

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		Research Experience: 0
7.	No. of Publication (Research articles - UGC Approved only)	National: 0
		International: 01
8.	No. of Publication (Book Chapters)	02
	Books Published	0
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Evaluation of I.C. engine performance through Bio-oil diesel blend extracted from agro waste from saurastra region.

2. Abstract (Provide a summary of your research proposal in 300 words)

The rising demand for sustainable and eco-friendly fuels has led to the exploration of alternative energy sources, particularly biofuels derived from agro-waste. This study investigates the performance of an Internal Combustion (I.C.) engine using bio-oil diesel blends extracted from non-edible agro-waste specific to the Saurashtra region. The research focuses on evaluating the engine's efficiency, emissions, and combustion characteristics when using these bio-oil diesel blends. Bio-oil is produced through pyrolysis of agro-waste materials abundant in Saurashtra, such as cotton stalks, groundnut shells, and castor residue. The extracted bio-oil is then blended with conventional diesel in varying proportions to assess its feasibility as a sustainable alternative fuel. Key performance indicators such as brake thermal efficiency, specific fuel consumption, and exhaust gas emissions are measured and analyzed. The results indicate that the bio-oil diesel blends exhibit comparable or improved performance characteristics with reduced emissions, highlighting their potential as a cleaner fuel option for I.C. engines. This research not only promotes sustainable fuel development but also supports the valorization of agro-waste, contributing to the region's economic and environmental sustainability.

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

1. Collection of agro waste: The collection of agro-waste for the Pyrolysis process in the Saurashtra region focuses on sourcing biomass such as cotton stalks, groundnut shells, and castor residues. Collaborating with local farmers, cooperatives, and agro-industries, collection points are strategically placed near major farming hubs to reduce logistical challenges. Farmers are incentivized through buy-back schemes, encouraging sustainable disposal practices.

2. Pre-process of agro waste:

The pre-processing of agro-waste for the pyrolysis process involves several critical steps to ensure efficient conversion and quality bio-oil or bio char production:

- Size Reduction: The agro-waste is shredded or ground into smaller, uniform particles to enhance heat transfer during pyrolysis and facilitate efficient handling.
- Drying: The biomass is dried to reduce moisture content, ideally below 10-15%, using sun drying, mechanical dryers, or waste heat from the process. High moisture content can affect the Pyrolysis efficiency.
- Sorting and Cleaning: Impurities like stones, metal, or soil are removed to prevent damage to equipment and ensure consistent feedstock quality.
- Storage: The processed material is stored in dry, ventilated conditions to avoid re absorption of moisture or microbial degradation.

3. Pyrolysis process for prepared agro waste:

The pyrolysis process for prepared agro-waste involves thermal decomposition of biomass in the absence of oxygen, converting it into valuable products like bio-oil, bio char, and syngas. The process can be summarized as follows:

- Feedstock Loading: Pre-processed agro-waste is fed into the pyrolysis reactor, ensuring consistent feed rates for uniform heating.
- Heating: The reactor is heated to 300–600°C, depending on the desired product yield and type. Heat is supplied externally or via combustion of syngas produced during pyrolysis.
- Thermal Decomposition: At elevated temperatures, biomass undergoes chemical breakdown into solid (bio char), liquid (bio-oil), and gaseous (syngas) components.
- Product Separation: Bio-oil is condensed and collected using cooling systems, bio char is separated from the reactor, and syngas is either flared or utilized as a heat source for the process.
- Storage and Utilization: Bio-oil is stored for use as fuel or feedstock for chemical industries, bio char is used for soil enrichment or carbon sequestration, and syngas can power the pyrolysis system or generate electricity.

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4.Characterization of bio-oil:

The characterization of bio-oil is essential to evaluate its properties and suitability for various applications, such as fuel or chemical feedstock. Key characterization parameters include:

- Physical Properties:
  - Density: Determines the mass-to-volume ratio, typically measured using a pycnometer or densitometer.
  - Viscosity: Indicates flow behaviour, affecting pumpability and atomization.
  - Moisture Content: Measured using Karl Fischer titration, crucial for stability and calorific value.
  - Flash Point: Assessed for safety in handling and storage.
- Chemical Properties:
  - Elemental Composition: Carbon, hydrogen, oxygen, nitrogen, and sulphur content analyzed using CHNS analyzers.
  - pH Value: Determines acidity, influencing storage and handling.
  - Functional Groups: Identified via Fourier Transform Infrared Spectroscopy (FTIR).
- Thermal Properties:
  - Calorific Value: Indicates energy potential, determined by a bomb calorimeter.
  - Thermal Stability: Analyzed using thermo gravimetric analysis (TGA).
- Chemical Composition:
  - GC-MS Analysis: Identifies volatile organic compounds and chemical constituents.

5.Fuel preparation:

Fuel preparation from bio-oil involves several steps to improve its properties for efficient and safe utilization in combustion systems. The process includes:

- Filtration and Removal of Impurities:
  - Bio-oil is filtered to remove particulates and impurities such as char or ash residues that may clog nozzles or damage equipment.
- Moisture Reduction:
  - Excess water is removed using vacuum distillation or drying techniques to

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improve the calorific value and combustion characteristics.

- Blending with Conventional Fuels:
  - Bio-oil is blended with diesel or other petroleum-based fuels to enhance stability, reduce viscosity, and improve ignition properties.
- Additive Addition:
  - Additives like stabilizers or surfactants are mixed to improve bio-oil's storage stability, reduce acidity, and prevent phase separation.
- Homogenization:
  - The blended fuel is thoroughly mixed to ensure a consistent composition, crucial for uniform combustion.
- Characterization and Quality Testing:
  - The prepared fuel is tested for key parameters such as density, viscosity, flash point, and calorific value to meet industry standards.
- Storage and Handling:
  - The final fuel is stored in corrosion-resistant tanks under controlled conditions to prevent degradation.

6.Engine performance evolution:

The evaluation of engine performance using prepared bio-oil-based fuel involves assessing its impact on engine efficiency, emissions, and operational characteristics. Key parameters measured during performance evaluation include:

Performance Parameters:

- Brake Thermal Efficiency (BTE): Indicates how efficiently the engine converts fuel energy into mechanical work.
- Specific Fuel Consumption (SFC): Measures the fuel required to produce a unit of power, indicating fuel economy.
- Power Output: Determines the engine's ability to generate power using bio-oil fuel blends.

Combustion Characteristics:

- Ignition Delay: Monitors the time lag between fuel injection and combustion.

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- Cylinder Pressure: Assessed to evaluate combustion efficiency and smoothness.
- Heat Release Rate: Determines how the energy is liberated during the combustion cycle.

Emission Analysis:

- Carbon Monoxide (CO): Indicates incomplete combustion.
- Nitrogen Oxides (NOx): Assesses thermal emissions due to high-temperature combustion.
- Hydrocarbons (HC): Represents unburned fuel emissions.
- Particulate Matter (PM): Evaluates soot and particulate formation.

Operational Characteristics:

- Engine Noise and Vibration: Assessed for compatibility with bio-oil blends.
- Cold Start Behaviour: Evaluates the ease of engine start-up under low-temperature conditions.
- Long-Term Stability: Checks for deposits, corrosion, or wear on engine components.

Comparison with Conventional Fuels:

- Performance metrics are compared with those of diesel to assess viability and optimize fuel blend ratios.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

1. Bio-Oil Extraction Techniques:

- Pyrolysis: The most widely researched method for bio-oil production. Advances in reactor designs, such as fluidized bed, rotary kiln, and microwave-assisted systems, aim to enhance yield and quality.
- Catalytic Pyrolysis: Research is focused on using catalysts (zeolites, metal oxides) to improve bio-oil composition by reducing oxygenated compounds and increasing hydrocarbon content.
- Hydrothermal Liquefaction: Emerging as an effective process for wet biomass, eliminating the need for pre-drying.

2. Feedstock Diversity:

- Studies target non-edible agro-wastes like cotton stalks, rice husks, and sugarcane

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bagasse, optimizing yield based on feedstock type.

- Research also explores pre-treatment methods like torrefaction to improve feedstock properties.

3. Bio-Oil Upgrading:

- Current efforts aim to reduce bio-oil's acidity, high water content, and instability using techniques such as hydrogenation, emulsification, and blending with fossil fuels.
- Nano-catalysts and renewable solvents are being developed for efficient bio-oil refining.

4. Engine Compatibility and Testing:

- Extensive studies focus on blending bio-oil with diesel (10-30%) to evaluate its performance in internal combustion (I.C.) engines.
- Dual-fuel systems and modified engines are being tested to accommodate bio-oil's unique properties, such as high viscosity and lower calorific value.
- Improvements in injection systems, such as pre-heating bio-oil, are under study to enhance atomization and combustion.

Thus currently, many researches have been carried out on Pyrolysis process for agro waste but, utilization of bio-oil as fuel is still facing several issues.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Selection of agro waste and its pre-process.
2. Bio-oil extraction from prepared agro waste using slow Pyrolysis process.
3. Characterization of derived bio-oil.
4. Bio-oil diesel blends preparation and its characterization.
5. Engine performance and emission evaluation of proposed fuel.

6. Significance of the proposed study: (300 words)

The significance of the proposed study on bio-oil extraction from agro-waste and its use as fuel in internal combustion (I.C.) engines includes several impactful dimensions:

1. Environmental Sustainability:

- Utilizes agro-waste, reducing environmental pollution caused by open-field burning.
- Promotes renewable energy, decreasing reliance on fossil fuels and mitigating

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greenhouse gas emissions.

2. Waste Management:

- Converts agricultural residues into value-added products, addressing waste disposal challenges.
- Encourages a circular economy by integrating waste utilization into energy production.

3. Energy Security:

- Provides a sustainable alternative to conventional fuels, supporting energy diversification.
- Reduces dependence on imported fossil fuels, enhancing energy independence.

4. Economic Benefits:

- Offers rural income opportunities through waste collection, processing, and bio-oil production.
- Creates pathways for cost-effective fuel production, benefiting industrial and transport sectors.

5. Scientific Contribution:

- Advances knowledge in biomass pyrolysis, bio-oil upgrading, and fuel-engine compatibility.
- Fosters innovation in clean energy technologies, influencing policy and industrial practices.

6. Climate Change Mitigation:

- Supports carbon-neutral energy production, contributing to global climate goals.
- Enhances soil health when bio char (a by-product) is used for carbon sequestration.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on bio-oil extraction from agro-waste and its use as fuel in I.C. engines holds significant relevance to Gujarat due to the following factors:

1. Agricultural Landscape of Gujarat:

- Gujarat generates substantial agro-waste from crops like cotton, groundnut, castor, and sugarcane. Utilizing this waste for bio-oil production ensures effective waste management.

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2. Industrial Demand:

- Gujarat, a hub for industries and agriculture-based businesses, faces high energy demands. Bio-oil can serve as an alternative fuel, reducing dependency on fossil fuels.

3. Environmental Challenges:

- Open-field burning of agro-residues contributes to air pollution. This study provides a sustainable solution to manage agro-waste, improving air quality in rural and urban areas.

4. Economic Upliftment:

- Bio-oil production can generate additional income for farmers and rural communities, aligning with Gujarat's focus on rural development.

5. Renewable Energy Focus:

- Gujarat is a leader in renewable energy initiatives (solar and wind). This study complements the state's efforts by introducing bio energy, diversifying its clean energy portfolio.

6. Alignment with Government Policies:

- The study supports state and national goals, such as the "National Bio-Energy Mission," enhancing Gujarat's contribution to India's renewable energy targets.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The expected benefits of the proposed research project on bio-oil extraction from agro-waste and its use as fuel in I.C. engines, particularly for Gujarat, are substantial at the societal level:

1. Environmental Benefits:

- Reduction in Pollution: The utilization of agro-waste for bio-oil production will reduce the harmful effects of open-field burning, which is a significant contributor to air pollution, especially during harvesting seasons.
- Reduction in Carbon Emissions: Using bio-oil as a renewable fuel will help lower greenhouse gas emissions, contributing to the state's climate change mitigation efforts.

2. Economic Benefits:

- Rural Income Generation: Farmers and rural communities can earn additional income through the collection, processing, and sale of agro-waste, boosting local economies and enhancing rural livelihoods.

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- Cost-effective Energy Supply: Bio-oil can provide a locally sourced, affordable alternative fuel, reducing the state's reliance on imported fossil fuels and helping to stabilize energy prices.

3. Energy Security:

- Diversification of Energy Sources: By developing bio-oil as an alternative fuel, Gujarat can diversify its energy sources, improving its energy security and making it less dependent on conventional energy imports.
- Renewable Energy Integration: This aligns with Gujarat's growing emphasis on renewable energy and can help contribute to national energy goals.

4. Sustainable Agriculture:

- Efficient Agro-waste Management: The proposed project will provide a solution to manage large volumes of agricultural waste, promoting sustainable farming practices and reducing the environmental impact of waste disposal.
- Circular Economy: Agro-waste will be transformed into valuable bio fuel and by-products like bio char, which can be used to improve soil health, contributing to more sustainable agricultural practices.

5. Health Benefits:

- Improved Air Quality: Reducing open burning of agro-waste will improve air quality, particularly in rural areas, and reduce health issues related to smoke inhalation and respiratory diseases.

6. Technological Innovation:

- Local Technological Advancements: The development of cost-effective and efficient pyrolysis technologies will foster innovation and establish Gujarat as a leader in the emerging bio-energy sector, encouraging further research and development in sustainable technologies.
- Skill Development: The project can create new job opportunities and skill development for local communities involved in bio-oil production, engineering, and research.

7. Socio-political Impact:

- Policy Alignment: The findings of the research will align with Gujarat's policies on renewable energy, waste management, and rural development, enhancing the state's commitment to sustainability.
- Increased Public Awareness: The study can help raise awareness about the benefits of utilizing agro-waste, bio energy solutions, and the importance of transitioning to

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sustainable energy practices.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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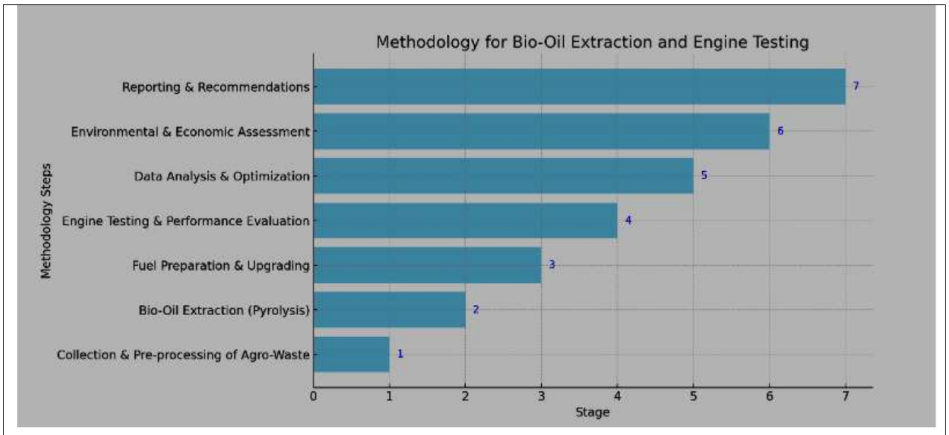

1.Collection and Pre-processing of Agro-Waste:

- Selection of Feedstock: Various agro-residues (e.g., cotton stalks, groundnut shells, sugarcane bagasse) will be sourced from farms and agro-industries in the Saurashtra region of Gujarat.
- Pre-treatment: The agro-waste will be cleaned to remove impurities (stones, soil, etc.) and reduced in size (shredded or ground). Moisture content will be reduced to below 10-15% using sun drying or mechanical dryers.

2. Bio-Oil Extraction (Pyrolysis Process):

- Pyrolysis Reactor Setup: A batch or continuous pyrolysis reactor will be used, maintaining an oxygen-free environment.
- Process Optimization: The temperature, heating rate, and residence time will be optimized for maximum bio-oil yield. Catalytic pyrolysis will be explored to enhance bio-oil quality.
- Collection of Products: Bio-oil, bio char, and syngas will be collected separately. Bio-oil will be condensed and stored for further use.

3. Fuel Preparation and Upgrading:

- Blending: Bio-oil will be blended with conventional fuels (diesel) at different ratios (e.g., 10%, 20%, and 30% bio-oil) to improve fuel properties.
- Additives: Chemical additives, such as stabilizers and surfactants, will be mixed to improve the stability, viscosity, and ignition characteristics of the fuel.
- Characterization: The prepared fuel will undergo testing for physical (density, viscosity, flash point) and chemical (elemental composition, functional groups) properties using

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standard laboratory techniques.

4. Engine Testing and Performance Evaluation:

- Engine Setup: A diesel engine will be modified (if necessary) to run on bio-oil blends. Parameters such as engine speed, load, and fuel consumption will be monitored.
- Performance Parameters: Key performance indicators like brake thermal efficiency (BTE), specific fuel consumption (SFC), and power output will be measured.
- Combustion and Emissions: Combustion characteristics (ignition delay, cylinder pressure) will be recorded using sensors. Emissions such as CO, CO_2, NOx, HC, and particulate matter will be measured using standard emission analyzers.

5. Data Analysis and Optimization:

- Comparison with Conventional Fuels: Engine performance and emissions will be compared between bio-oil blends and conventional diesel.
- Optimization: Based on the findings, optimal fuel blends will be identified, and process parameters (such as pyrolysis conditions) will be adjusted to improve fuel quality and engine performance.

6. Environmental and Economic Assessment:

- Life Cycle Analysis (LCA): The environmental impact of using bio-oil will be assessed through a life cycle analysis, considering emissions, energy consumption, and waste generation.
- Economic Feasibility: A cost-benefit analysis will be conducted to evaluate the economic viability of bio-oil production and its use as fuel in Gujarat.

7. Reporting and Recommendations:

- The findings will be compiled into a comprehensive report, detailing the feasibility, efficiency, and environmental benefits of bio-oil as an alternative fuel for I.C. engines.
- Recommendations for scaling up bio-oil production and utilization will be provided, along with potential policy suggestions for integrating bio energy into the state's energy mix.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

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Year 1: Foundation and Initial Research (Study Phase)

Activities:

- Literature Review: Focus on bio-oil extraction methods (e.g., pyrolysis, transesterification) and their application in I.C. engines.
- Identify Key Agro-Waste: Select agro waste from Saurashtra (e.g., cotton stalks, groundnut shells, mustard).
- Initial Laboratory Setup: Procure necessary laboratory equipment for bio-oil extraction and analysis (e.g., pyrolysis reactor, analytical instruments for fuel characterization).
- Define Testing Parameters: Identify engine types, test conditions, and the parameters for performance evaluation.

Year 2: Bio-Oil Extraction and Preliminary Engine Testing

Activities:

- Bio-Oil Extraction: Set up and run Pyrolysis or other suitable methods to extract bio-oil from the selected agro waste.
- Characterization of Bio-Oil: Analyze the bio-oil's chemical properties, such as calorific value, viscosity, flash point, and density.
- Blend Preparation: Prepare different bio-oil diesel blends (e.g., 5%, 10%, 15%, 20% bio-oil) and characterize the blend properties.
- Initial Engine Testing: Run engine tests to measure key parameters like power, fuel consumption, and emissions.

Year 3: Performance Optimization and Environmental Impact Assessment

Activities:

- Process Optimization: Improve bio-oil extraction and blending methods to increase yield, quality, and performance of bio-oil diesel blends.
- Advanced Engine Testing: Perform detailed engine testing (e.g., full load, partial load, varying temperatures) for each blend and compare results with conventional diesel.
- Environmental Impact Assessment: Measure emissions (CO_2, NOx, HC, etc.) and assess the environmental benefits of bio-oil diesel blends.
- Energy Efficiency Study: Compare brake thermal efficiency, specific fuel consumption, and other performance metrics with conventional diesel.

Year 4: Scaling Up and Real-World Application Testing

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Activities:

- Large-Scale Production: Scale up bio-oil extraction and blending processes for larger quantities to support real-world testing.
- Extended Engine Testing: Test bio-oil diesel blends in various I.C. engine models (e.g., agricultural, transport) under different operating conditions (e.g., load, speed, temperature).
- Performance under Field Conditions: Conduct long-duration tests to assess long-term engine performance, fuel stability, and maintenance requirements.
- Economic Feasibility Study: Analyze cost-effectiveness, including production costs, engine maintenance, and overall savings in fuel costs.

Year 5: Final Evaluation, Reporting, and Commercialization Feasibility

Activities:

- Final Data Analysis: Complete the final analysis of all engine testing, performance metrics, and environmental impact.
- Technology Transfer: Investigate opportunities for technology transfer, including potential collaborations with industries or government bodies for commercial adoption.
- Commercialization Feasibility: Explore commercial scalability of bio-oil diesel blends, including possible pilot projects and funding opportunities.
- Dissemination of Findings: Publish papers in peer-reviewed journals, present at conferences, and engage with stakeholders (e.g., local government, farmers, engine manufacturers).

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Foundation and Initial Research	June	2022	May	2023
2.	Bio-Oil Extraction and Preliminary Engine Testing	June	2023	May	2024
3.	Performance Optimization and Environmental Impact Assessment	June	2024	May	2025
4.	Scaling Up and Real-World	June	2025	May	2026

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	Application Testing				
5.	Final Evaluation, Reporting, and Commercialization Feasibility	June	2026	May	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	a. Slow Pyrolysis reactor & gas analyzer b. I.C. engine complete set up	4 ,00,000 4 ,00,000	1 1	4 ,00,000 4 ,00,000
2.	Travelling	50,000	-	50,000
3.	Contingency	50,000	-	50,000
4.	Property measurement instrument	8,15,000	-	8,15,000
	TOTAL			17,15,000

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	a. Slow Pyrolysis reactor & gas analyzer b. I.C. engine complete set up	4,00,000 4,00,000	June 2023-May 2024	For bio-oil extraction and engine performance analysis
2	Travelling	50,000	During entire project	For equipment purchase and biomass collection.
3	Contingency	50,000	During entire project	-
4	Property measurement	8,15,000	June	For property

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	instrument a. Density measurement b. Viscosity measurement c. Moisture content measurement d. Gross calorific value measurement e. Flash point measurement f. Fire point measurement		2023-May 2024	measurement
	Grand Total	17,15,000		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Analyzing the Relationship between FDI, FII, and India's GDP: An Evaluation from 1991 to 2021	
2.	**Broad area of proposal**	Commerce	
3.	**Sub Area of proposal**	Economics and Corporate Finance	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Mr. Kirtikumar R. Solanki	Assistant Professor, Commerce Department	Mo No: 88495 90361 E-mail: Kirti.solanki@atmiyauni.ac.in
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	----------	----------	----------
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	18/09/1995	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	15/03/2022	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	----------	

Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	M.Com	Accountancy	Gujarat University	2019	68.67%
ii.					
iii.					
iv.					

2.	Have you previously received any Fellowship from any funding agency?	[]YES	[ ]NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	[]short-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		[] pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		[] post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	----------	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	**Title**	**Project Cost**	**Sponsoring Agency**	**Duration (Start – End – MM/YYYY)**
		----------	----------	----------	----------
		----------	----------	----------	----------

6.	Total Experience	Teaching Experience: (3 Years +4Months)

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		Research Experience: No
7.	**No. of Publication (Research articles - UGC Approved only)**	**National:0**
		International:0
8.	**No. of Publication (Book Chapters)**	**0**
	Books Published	**0**
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Analyzing the Relationship between FDI, FII, and India's GDP: An Evaluation from 1991 to 2021

2. Abstract (Provide a summary of your research proposal in 300 words)

This research investigates the relationship between Foreign Direct Investment (FDI), Foreign Institutional Investment (FII), and India's Gross Domestic Product (GDP) from 1991 to 2021. Recognizing GDP as a critical measure of economic progress, the study highlights how FDI and FII contribute to India's economic growth by enabling capital influx, improving productivity, and fostering sectoral advancements. Using secondary data, correlation analyses, and regression models, this study quantifies the proportional impact of FDI and FII on GDP, offering insights into the stability and significance of foreign investments. The findings underscore FDI's substantial role in infrastructure and industrial growth and FII's dynamic contributions to financial markets. This research fills existing gaps by providing precise quantitative evaluations of how foreign investments influence GDP, aiding policymakers in optimizing strategies for sustained economic development.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

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Economic development is a cornerstone of improving the economic well-being and quality of life for a nation. While economic growth and development are interconnected, the latter encompasses a broader range of factors, including social and infrastructural advancements. A critical measure of economic performance is the Gross Domestic Product (GDP), which reflects the total value of goods and services produced within a country. This study aims to explore the dynamics of GDP growth, focusing on the pivotal role of foreign investments—specifically Foreign Direct Investment (FDI) and Foreign Institutional Investment (FII)—in driving economic development.

Specific Research Activities:

1. Analysis of GDP Determinants:

Evaluate the influence of domestic monetary resources on GDP growth.

Identify gaps where domestic funds fall short in sustaining growth, necessitating external financing.

2. Impact of Foreign Investments on Economic Growth:

Examine the comparative effects of FDI and FII on GDP.

Investigate sector-specific impacts of FDI, such as infrastructure, manufacturing, and technology.

Assess the volatility of FII flows and their implications for financial market stability.

3. Economic Stability and Investment Patterns:

Analyze the long-term stability provided by FDI compared to the fluidity of FII.

Explore case studies where FDI has led to significant domestic infrastructure improvement.

4. Policy Recommendations for Optimizing Foreign Investments:

Develop strategies to attract FDI in priority sectors.

Propose measures to mitigate the risks associated with volatile FII inflows.

Evaluate regulatory frameworks to ensure a balance between foreign investor interests and national economic goals.

5. Quantitative Modeling and Empirical Validation:

Use econometric modeling to measure the correlation between foreign investments and GDP growth.

Conduct regression analysis on historical data to predict the potential outcomes of varying levels of FDI and FII.

Significance of the Study:

Economic growth depends not only on the availability of resources but also on the strategic use of external funding. The proposed research will contribute significantly to understanding the nuances of how foreign investments can enhance GDP growth and, consequently, economic development.

1. Enhancing Domestic Productivity:

FDI often brings technology transfer, expertise, and improved production capacity. These investments

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have a multiplier effect, enhancing the domestic economy's ability to produce goods and services efficiently.

2. Fostering Infrastructure Development:

Investment in infrastructure—such as transportation, energy, and communication—creates a foundation for sustained economic growth and improves citizens' quality of life.

3. Mitigating Volatility:

While FII can inject much-needed liquidity into financial markets, its inherent instability necessitates robust policies to safeguard against economic disruptions.

4. Policy Implications:

The findings of this research will provide actionable insights for policymakers to design frameworks that attract stable investments, promote economic resilience, and optimize resource allocation.

By delving into the interplay between GDP growth and foreign investments, this study will highlight pathways to achieve sustainable economic development. The research outcomes aim to guide policymakers and stakeholders in fostering a robust economy, ultimately enhancing the quality of life for citizens.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The role of Foreign Direct Investment (FDI) in driving economic development has been widely studied, highlighting its importance in fostering technological advancements, infrastructure development, and employment opportunities. FDI is recognized as a stable and long-term investment mechanism that contributes significantly to GDP growth. Existing research emphasizes its ability to bring modern technologies, managerial expertise, and access to international markets, which collectively enhance a nation's production capabilities and competitiveness.

Despite its acknowledged benefits, the extent and nature of FDI's impact vary across sectors and regions. For instance, while infrastructure and manufacturing often reap substantial gains, other areas may experience limited benefits due to insufficient domestic absorptive capacity or restrictive regulatory environments. Research also suggests that the effectiveness of FDI depends on complementary factors such as a skilled workforce, sound economic policies, and a favorable investment climate.

However, there is a gap in existing literature regarding sector-specific strategies for maximizing the developmental benefits of FDI and its role in fostering inclusive growth. This study seeks to address these gaps by critically examining the mechanisms through which FDI influences GDP growth and

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proposing policy-driven solutions to optimize its impact on sustainable economic development.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To Analyze the Role of FDI in Economic Growth: Examine the contribution of Foreign Direct Investment to GDP growth and its impact on key economic sectors, such as infrastructure, manufacturing, and services.
2. To Evaluate Sector-Specific Impacts of FDI: Assess how FDI influences productivity, technological advancements, and job creation across various industries.
3. To Investigate the Stability and Long-Term Benefits of FDI: Study the stability of FDI as an investment source and its long-term implications for economic development and resilience.
4. To Identify Policy and Regulatory Factors Influencing FDI: Analyze the role of national policies, regulatory frameworks, and investment climate in attracting and retaining FDI.
5. To Propose Strategies for Optimizing FDI Utilization: Develop actionable recommendations for maximizing the developmental benefits of FDI, with a focus on sustainable and inclusive growth.
6. To Explore the Relationship Between FDI and Infrastructure Development: Investigate how FDI contributes to building critical infrastructure and its role in enhancing the overall quality of life for citizens.

6. Significance of the proposed study: (300 words)

This study is significant as it addresses the critical role of Foreign Direct Investment (FDI) in driving sustainable economic growth and improving the quality of life. FDI is not only a vital source of capital but also a channel for technology transfer, managerial expertise, and access to global markets. By exploring its impacts on Gross Domestic Product (GDP), this research will provide insights into how FDI contributes to enhanced productivity, infrastructure development, and employment generation.

The findings of this study will hold particular importance for policymakers and economic planners, as it identifies the sectors that benefit most from FDI and the conditions required to maximize its impact. Understanding the role of regulatory frameworks, national policies, and investment climates in attracting stable FDI flows will help countries formulate effective strategies to secure and utilize foreign investments.

Additionally, the study emphasizes sustainable and inclusive growth, ensuring that the benefits of FDI reach a broader population. By addressing gaps in existing research and proposing actionable

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recommendations, this work will serve as a roadmap for leveraging FDI as a tool for long-term economic resilience, enhancing living standards, and fostering innovation and competitiveness in domestic industries.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study is highly relevant to Gujarat, a state known for its industrial growth and economic dynamism. Gujarat has been a leading destination for Foreign Direct Investment (FDI) in India, attracting investments in sectors like manufacturing, renewable energy, and infrastructure. By analyzing the impact of FDI on economic growth and infrastructure development, the study will provide critical insights for optimizing investment strategies tailored to Gujarat's unique industrial strengths. It will also help policymakers identify opportunities to enhance job creation, boost technological advancements, and ensure sustainable growth, further solidifying Gujarat's position as an economic powerhouse in India.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research project holds substantial potential for societal benefits, particularly in Gujarat, by enhancing economic growth, infrastructure development, and employment opportunities. By exploring the impact of Foreign Direct Investment (FDI) on GDP growth, the study will offer valuable insights that can guide policymakers in attracting and effectively utilizing FDI. These findings will help create a more robust and diversified economy in Gujarat, especially in key sectors like manufacturing, renewable energy, and infrastructure.

At the societal level, the study's outcomes are expected to contribute to job creation, particularly in industries that receive substantial FDI, fostering a more inclusive economy. As FDI brings technological advancements and improves productivity, it will also enhance the skills of the local workforce, promoting long-term human capital development.

Additionally, the research will support the development of critical infrastructure, which will improve the quality of life for citizens through better transportation, healthcare, and energy facilities. The focus on sustainable economic practices will ensure that growth is both inclusive and environmentally responsible, addressing the needs of marginalized communities.

Ultimately, the findings of this research will enable Gujarat to capitalize on FDI more effectively, creating a more resilient, competitive, and prosperous society that benefits both current and future generations.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	[]
2.	Agriculture	[]
3.	Health and wellness	[]
4.	Nutrition	[]
5.	Development of Industrial Problem Solutions	[✓]
6.	Resources management and sustainable development	[✓]
7.	High Impact Teaching	[]
8.	Imparting corporate responsibility, ethics, accountability and values in society	[]
9.	Social entrepreneurship	[]
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Literature Review: Conduct an extensive review of existing studies on the role of Foreign Direct Investment (FDI) in economic growth, with a focus on its impact on GDP, infrastructure, and sector-specific productivity.

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This will identify research gaps and refine the study's focus on Gujarat.

Sectoral Analysis:

Evaluate Gujarat's key sectors that attract FDI (e.g., manufacturing, renewable energy, infrastructure) and analyze how these investments influence productivity, technological advancements, and employment generation.

Impact Assessment:

Measure the impact of FDI on GDP growth and sector-specific development through econometric modeling and empirical analysis using historical data.

Policy and Regulatory Evaluation:

Review the policies and regulations governing FDI inflows in Gujarat, identifying barriers and enablers to attracting more stable investments.

Interviews and Stakeholder Surveys:

Conduct interviews with policymakers, business leaders, and industry experts in Gujarat to gain qualitative insights into the challenges and opportunities related to FDI.

Hypothesis

The study hypothesizes that FDI positively impacts GDP growth in Gujarat, particularly in key sectors like manufacturing and infrastructure, by enhancing productivity, technological capabilities, and job creation. Furthermore, a stable and favorable policy environment will amplify these benefits.

Sampling Plan

The study will use a stratified sampling method, focusing on sectors that attract significant FDI in Gujarat. Key stakeholders, including policymakers, business executives, and industry analysts, will be selected for interviews.

Data Collection

Secondary Data: Collect historical data on FDI inflows, GDP growth, and sectoral performance from government reports and industry publications.

Primary Data: Surveys and interviews with stakeholders.

Data Analysis

Econometric Analysis: Use regression models to analyze the relationship between FDI and GDP growth.

Qualitative Analysis: Analyze interview responses through thematic coding to identify policy gaps and sectoral challenges.

This multi-method approach will provide a comprehensive understanding of FDI's role in Gujarat's economic development.

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11. Suggested plan of action: Define the suggested plan of action in 200 words)

The research will be carried out in a structured and systematic manner, divided into phases for efficiency and clarity.

Phase 1: Literature Review and Framework Development (1st–2nd Month)

The first phase involves a thorough review of existing literature on FDI's role in economic growth and development, particularly in Gujarat. This will inform the development of the research framework and refine the hypothesis. A detailed conceptual model will be outlined to guide the empirical analysis.

Phase 2: Data Collection (3rd–4th Month)

Primary and secondary data will be collected during this phase. Secondary data on FDI inflows, GDP, and sectoral performance will be gathered from government reports, industry publications, and international databases. Additionally, interviews and surveys with policymakers, business leaders, and industry experts in Gujarat will be conducted to collect qualitative insights.

Phase 3: Data Analysis (5th–6th-7th-8th Month)

Quantitative data will be analyzed using econometric techniques, such as regression models, to assess the impact of FDI on GDP growth and sectoral development. Qualitative data from interviews will be analyzed through thematic coding to identify key policy challenges and recommendations.

Phase 4: Report Writing and Policy Recommendations (9th–10th Month)

In the final phase, findings will be synthesized into a comprehensive research report, detailing the implications of the study for Gujarat's economic development. Policy recommendations for optimizing FDI inflows and ensuring sustainable growth will be formulated.

This structured approach ensures comprehensive analysis and actionable outcomes.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review and Framework Development	April	2022	May	2022
2.	Data Collection	June	2022	July	2022
3.	Data Analysis	August	2022	November	2022
4.	Report Writing and Policy Recommendations	December	2022	January	2023

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13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (software and tools)			--------- --------- --------- 45,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	5	16000 total KM	80,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3,000
4.	Stationery and Printing (With justification)			50,000
5.	Any other special requirement (Manpower) (Field Testing, adaptive R&D, Demo/ Training Expenses)			2,72,000
6.	Overhead (10% of recurring)			50,000
	TOTAL			**5,00,000**

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b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**	----------		----------
	a)	----------		----------
	b)	----------		----------
	c)	----------		----------
2.	**B. Glassware**	----------		----------
	a)	----------		----------
	b)	----------		----------
	c)	----------		----------
3.	**C. Any other consumable items (like wires/ electric items etc)**			
	a)			
	b)			
4.	**Travel**	₹80,000	May–December	Travel expenses for visiting cities in the Saurashtra region to collect primary data and conduct stakeholder interviews.
	Visit to various cities of Saurashtra Region			
	Visit to various cities of Saurashtra Region			
5.	**Contingency**	₹3,000	May–March	Covers unexpected expenses, such as minor repairs or miscellaneous needs during fieldwork.
6.	**Stationery and printing**	₹50,000	June–January	For printing questionnaires, reports, and other research materials; includes purchase of office supplies.
	Printing			
	Books			

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7.	**Other Special Requirements**	₹2,72,000	July–February	Includes expenses for fieldwork, training sessions, seminars, and adaptive R&D activities required for the study.
	Field work			
	Conference and seminar		-	
	Publication		-	
	Hospitality Expenses			
8.	**Overhead (10% of total)**	₹50,000	May–March	Institutional overhead costs for administrative support, utilities, and other indirect expenses.
	Grand Total	**₹5,00,000**		

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Application form

Part -A

(General Information)

1.	Title of the proposal	Deep Dive into India's Education System: A Quantitative Analysis of Key Metrics	
2.	Broad area of proposal	Computer Science	
3.	Sub Area of proposal	Data Science	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Miss Vaishali Vaghela	Assistant Professor	7048253632
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	01/06/1998	
8.	Date of joining the Department of PI (DD/MM/YYYY)	15/02/2022	
9.	Whether the PI is registered for Ph.D. on the same topic	NA	
10.	If yes then name of university		

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Computer Science	Atmiya University	2021	-
ii.	Post Graduation	Computer Application	Atmiya University	2020	98.00
iii.	Under Graduation	Computer Application	Saurashtra University	2018	93.00
iv.	CSIR/UGG-NET/ SLET/GATE	NA	NA	NA	NA

2.	Have you previously received any Fellowship from any funding agency?	☐YES	✓NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
		NA			

6.	Total Experience	Teaching Experience: (3 Year + 11 Months)
		Research Experience: (3 Year 7 Months)
7.		National:

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	No. of Publication (Research articles - UGC Approved only)	International: 2
8.	No. of Publication (Book Chapters)	International: 1
	Books Published	NA
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Deep Dive into India's Education System: A Quantitative Analysis of Key Metrics

2. Abstract (Provide a summary of your research proposal in 300 words)

India's education system is vast and complex, marked by significant diversity in access, quality, and outcomes. This study conducts a quantitative analysis of key metrics across various dimensions of education, focusing on enrollment rates, literacy levels, dropout rates, teacher-student ratios, and infrastructure quality. By leveraging data from national sources such as the Unified District Information System for Education (UDISE+), the National Sample Survey (NSS), and National Achievement Surveys (NAS), this research aims to offer a comprehensive understanding of the current state of education in India. The analysis highlights regional disparities, with particular attention given to rural-urban divides and the educational challenges faced by marginalized groups such as low-income households, girls, and children from tribal and backward communities. Additionally, this study explores the influence of socioeconomic factors on educational outcomes, using statistical methods like regression analysis to identify patterns and predictors of academic performance and dropout tendencies. Through this in-depth investigation, the study seeks to provide actionable insights for policymakers and educational leaders, aiming to guide data-driven interventions that can reduce educational inequities and improve the overall quality of education across the country. The findings emphasize the need for targeted policy reforms, better resource allocation, and enhanced support systems to ensure equitable access to quality education for all.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

India, the second-most populous country in the world, faces a complex and multifaceted challenge when it comes to providing quality education to its diverse population. With over 1.4 billion people,

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spanning across rural and urban areas, varying socioeconomic backgrounds, and numerous linguistic and cultural groups, the Indian education system encounters significant barriers to equitable access and quality. Despite substantial progress in enrollment rates and literacy levels over the past few decades, disparities in educational access, outcomes, and infrastructure persist, particularly in rural and underserved regions.

The government of India has made considerable investments in education through policies and programs such as the Right to Education Act, the National Policy on Education, and various schemes aimed at improving infrastructure and teacher quality. However, the challenges remain daunting, with millions of children still out of school and many others receiving education of varying quality. While national initiatives aim to address these issues, the success of such programs often varies across states and regions, influenced by local socioeconomic conditions, governance structures, and community involvement.

This study aims to provide a deep dive into India's education system by quantitatively analyzing key educational metrics such as enrollment rates, dropout rates, learning outcomes, teacher-student ratios, and infrastructural availability. The research leverages data from national educational surveys like UDISE+, NAS, and other government sources to identify trends, regional disparities, and the underlying factors affecting educational outcomes across the country. By examining the interplay between various factors such as gender, income, location, and policy interventions, this study seeks to generate data-driven insights to support effective policy reforms and enhance educational equity in India.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The field of data-driven research on educational access and quality in India has progressed significantly, with the development of comprehensive national datasets like UDISE+, NAS, and ASER. These datasets have provided valuable insights into enrollment rates, teacher-student ratios, infrastructure, and regional disparities. However, challenges persist, such as inconsistent data reporting, gaps in coverage in rural and remote areas, and a lack of real-time data, which hinder the ability to conduct timely and accurate analyses. Additionally, much of the research remains limited to descriptive analysis, with less focus on granular, region-specific studies that could provide more actionable insights.

Current research increasingly focuses on regional disparities and socio-economic inequalities in education, highlighting the gaps between different states and communities. While there is a growing body of evidence on the success of initiatives like the Right to Education Act and Samagra Shiksha Abhiyan, the impact on learning outcomes remains inconclusive. Studies point to significant gaps between policy design and implementation, particularly in rural and tribal areas, where educational access is still a challenge. Learning outcomes, despite increased enrollment, remain poor in many regions, emphasizing the need for deeper studies into the factors influencing educational performance beyond enrollment rates.

Recent trends also show a shift toward incorporating technological interventions in education, driven by the COVID-19 pandemic. While there is increasing research into the role of digital platforms and mobile learning tools, the scalability and long-term sustainability of these interventions in low-resource settings remain underexplored. Furthermore, the use of predictive analytics, machine learning, and AI

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in education is still in its early stages, with limited research on applying these methods to forecast educational trends and inform policy decisions. There is a clear need for more localized, state-specific studies, particularly in states like Gujarat, where unique regional challenges demand tailored solutions.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. **Examine Disparities in Educational Access and Quality**
   To analyze disparities in educational access and quality across different regions of India, focusing on rural-urban, gender, socio-economic, and regional variations, using key metrics such as enrollment rates, dropout rates, and learning outcomes.
2. **Evaluate the Impact of Socioeconomic Factors on Education**
   To assess the influence of socioeconomic factors—such as income, parental education, caste, and gender—on educational access, retention, and academic performance across various demographic groups.
3. **Assess the State of Educational Infrastructure and Resources**
   To evaluate the availability and distribution of educational infrastructure (such as schools, classrooms, sanitation facilities, and technology) and teaching resources (e.g., qualified teachers, learning materials) across different states and regions, and their correlation with student performance.
4. **Analyze the Effectiveness of Educational Policies**
   To assess the effectiveness of key government initiatives and policies, such as the Right to Education Act (RTE), Samagra Shiksha Abhiyan, and the Mid-Day Meal Scheme, in improving educational outcomes and reducing disparities in access and quality.
5. **Identify Predictors of Educational Outcomes**
   To develop predictive models using statistical and machine learning techniques to identify key factors influencing student outcomes, including performance, retention, and dropout rates, across diverse regions and socio-economic groups.
6. **Provide Data-Driven Recommendations for Policy Interventions**
   To provide evidence-based recommendations to policymakers, focusing on strategies to improve educational access and quality, reduce disparities, and optimize resource allocation to achieve equitable educational outcomes.

6. Significance of the proposed study: (300 words)

The proposed study on the *Quantitative Analysis of Key Metrics in India's Education System* holds significant importance at both the national and regional levels, offering several potential benefits to India's educational landscape.

1. **Addressing Educational Inequities**
   The study will highlight and quantify disparities in access to education, particularly in rural, tribal, and economically disadvantaged regions. By identifying these disparities, the research aims to provide insights that can guide targeted interventions, helping to reduce the educational divide between urban and rural areas, as well as among different social and economic groups.

2. **Improving Policy Design and Implementation**
   The findings will offer critical insights into the effectiveness of existing educational policies such as the Right to Education Act, Mid-Day Meal Scheme, and Samagra Shiksha Abhiyan. Understanding their impact will help refine and adapt these policies to ensure better outcomes, particularly in underserved regions.

3. **Optimizing Resource Allocation**
   By analyzing the distribution of educational resources—such as infrastructure, teachers, and teaching materials—across the country, the study will assist in making data-driven decisions regarding resource allocation. This can lead to more equitable investments in education, especially in areas facing severe shortages or underperformance.

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4. **Supporting Data-Driven Governance**
   The research will promote the use of data and evidence in policymaking, encouraging a shift towards more transparent, accountable, and effective governance in the education sector. By leveraging advanced data analysis techniques, the study will demonstrate how data-driven insights can improve policy outcomes.

5. **Enhancing Educational Outcomes**
   By identifying key factors influencing educational performance, the study will offer actionable recommendations to improve learning outcomes, retention rates, and overall quality of education. This will benefit both students and teachers, with a particular focus on vulnerable and marginalized populations.

6. **Contributing to National Development Goals**
   Quality education is crucial for achieving the broader goals of sustainable development in India. By improving access to education and educational outcomes, the study will support India's progress toward achieving Sustainable Development Goal (SDG) 4, ensuring inclusive, equitable, and quality education for all.

7. **Empowering Communities**
   The insights from the study will empower communities, especially in underserved areas, by highlighting barriers to education and suggesting practical solutions. This can foster greater community engagement and ownership of educational improvements.

   In summary, the proposed study will contribute significantly to understanding the state of India's education system, informing policies, and driving systemic changes that ensure quality education for all, especially in the most vulnerable regions.

7. Relevance of the proposed study to Gujarat: (200 words)

1. **The proposed study on the *Quantitative Analysis of Key Metrics in India's Education System* is highly relevant to Gujarat, a state that has seen significant advancements in various sectors but still faces educational challenges, particularly in rural and tribal areas. The study will provide valuable insights tailored to Gujarat's unique educational landscape, supporting efforts to improve access, quality, and equity in education.**

2. **Addressing Regional Disparities**
   Gujarat exhibits noticeable regional variations in educational outcomes, with urban areas like Ahmedabad and Surat performing better than rural and tribal regions. The study will provide data-driven insights into these disparities, helping policymakers and educational authorities identify areas that require more focused intervention, particularly in tribal districts such as Dang, Narmada, and Tapi.

3. **Improving Tribal and Marginalized Communities' Education**
   Gujarat has a significant tribal population, many of whom face barriers to education due to cultural, social, and economic factors. The proposed study will highlight the challenges faced by these communities and offer targeted recommendations for improving access to quality education in these areas, supporting Gujarat's efforts toward inclusivity.

4. **Assessing Policy Impact in Gujarat**
   Gujarat has implemented several initiatives to improve education, such as Gunotsav (a quality education program) and the Samagra Shiksha Abhiyan. The study will assess the effectiveness of these state-specific policies in improving educational access and outcomes, providing insights on potential areas for refinement or expansion.

5. **Optimizing Resource Allocation**
   Gujarat has made significant investments in educational infrastructure and resources, but disparities still exist between districts. The study will provide a comprehensive analysis of the distribution of resources (schools, teachers, facilities) and their impact on student outcomes, helping ensure more equitable resource allocation across the state.

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6. **Gender Disparities in Education**
   While Gujarat has made strides in promoting female education, gender disparities still exist, particularly in rural areas. The study will analyze gender-based differences in enrollment, dropout rates, and learning outcomes, helping to design policies aimed at bridging these gaps.

7. **Supporting State's Development Goals**
   As part of India's economic and social development goals, Gujarat aims to strengthen its human capital by improving the education system. The findings from this study will support the state's vision for a skilled, educated workforce, contributing to long-term sustainable development and economic growth.

8. **Enhancing Teacher Training and Educational Quality**
   The study will identify the impact of teacher-student ratios, teacher quality, and training programs in Gujarat's schools. Insights from this analysis will inform the design of professional development programs to improve teaching quality across both urban and rural schools.

   In essence, this study is highly relevant to Gujarat as it will offer region-specific, data-driven recommendations to improve the educational landscape, address disparities, and contribute to the state's socio-economic development.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings of the proposed research project, *Data-Driven Evaluation of Educational Access and Quality Across Indian States*, will have several important societal benefits, particularly for the state of Gujarat. These benefits will not only improve the overall education system but will also contribute to the broader socio-economic development of the state.

1. Enhanced Educational Equity
   The research will uncover regional and socio-economic disparities in educational access and quality, providing actionable insights to address these gaps. For Gujarat, this means targeted interventions to improve education in marginalized areas, including rural, tribal, and economically disadvantaged regions. The findings will help ensure that children from all backgrounds have equal access to quality education.

2. Improved Learning Outcomes
   The study will identify key factors influencing learning outcomes, such as teacher quality, student-teacher ratios, and infrastructure. In Gujarat, this could lead to the implementation of strategies to enhance teaching practices, optimize resource allocation, and focus on improving foundational learning, resulting in higher academic performance and reduced dropout rates.

3. Informed Policy Reforms and Program Design
   The research will provide evidence-based insights into the effectiveness of existing educational policies in Gujarat, such as Gunotsav and Samagra Shiksha. By evaluating the impact of these programs, the study will guide policymakers in refining and redesigning initiatives to better address regional challenges, improve educational quality, and enhance student retention.

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4. Targeted Resource Allocation
   The study will highlight regions and districts in Gujarat where educational resources, such as infrastructure, teaching materials, and digital tools, are lacking. This will enable the state government to allocate resources more efficiently, ensuring that under-resourced areas receive the necessary investments to meet educational standards, thereby improving overall access and quality.

5. Empowerment of Marginalized Groups
   By focusing on issues such as gender disparities and the challenges faced by tribal and economically disadvantaged communities, the research will offer solutions to empower these groups. In Gujarat, addressing these issues can help increase enrollment rates, reduce gender gaps in education, and create a more inclusive educational environment, contributing to social equity and empowerment.

6. Long-Term Economic Development
   Improved education outcomes directly correlate with better employability and economic productivity. By focusing on enhancing educational access and quality, the findings will help build a more skilled workforce in Gujarat, driving long-term economic growth and contributing to the state's competitiveness in various sectors such as industry, technology, and services.

7. Stronger Community Engagement and Social Cohesion
   The study will foster greater community involvement in the education system by identifying local barriers to education and suggesting community-driven solutions. In Gujarat, this can lead to stronger partnerships between schools, parents, and local authorities, encouraging collective responsibility for educational outcomes and enhancing social cohesion.

8. Support for Sustainable Development Goals (SDGs)
   The findings will align with and contribute to Gujarat's commitment to achieving Sustainable Development Goal 4 (SDG 4) on quality education. By improving educational access and quality, the research will help Gujarat move closer to its SDG targets, contributing to the broader goal of ensuring inclusive and equitable education for all by 2030.

   In summary, the societal benefits of the proposed study in Gujarat include fostering equitable educational opportunities, improving student outcomes, enhancing teacher training, optimizing resource distribution, and empowering marginalized communities. These improvements will not only contribute to a more robust education system but also have long-term positive effects on the state's social fabric and economic prosperity.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐

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2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	✓
8.	Imparting corporate responsibility, ethics, accountability and values in society	✓
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The methodology for the *Data-Driven Evaluation of Educational Access and Quality Across Indian States*, with a focus on Gujarat, will involve a mixed-methods approach, combining quantitative data analysis with qualitative insights to provide a comprehensive evaluation. The following steps outline the methodology:

1. **Data Collection**
    - **Primary Data**: Surveys and interviews with key stakeholders (students, teachers, parents, and policymakers) in selected districts of Gujarat to capture firsthand insights on educational access, challenges, and quality.
    - **Secondary Data**: Utilize large-scale datasets such as UDISE+, National Achievement Surveys (NAS), Annual Status of Education Report (ASER), and state-specific educational reports. These datasets will provide information on enrollment rates, dropout rates, teacher-student ratios, learning outcomes, and infrastructure quality.

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- **Geospatial Data**: Incorporate GIS-based data to analyze geographical and regional variations in educational access, focusing on rural, tribal, and urban areas.

2. **Data Cleaning and Preprocessing**
   - Standardize datasets from multiple sources to ensure consistency.
   - Handle missing data and outliers, using imputation techniques where appropriate.
   - Normalize data for regional comparisons (e.g., urban vs. rural, tribal vs. non-tribal).
3. **Quantitative Analysis**
   - **Descriptive Statistics**: Conduct descriptive analysis to identify trends in educational access, enrollment, quality of learning, and resources across different districts in Gujarat.
   - **Correlation Analysis**: Examine the relationship between socioeconomic factors (e.g., income, parental education, caste, gender) and educational outcomes (enrollment, dropout rates, academic performance).
   - **Regression Models**: Use multivariate regression analysis to assess the impact of infrastructure, teacher availability, and policy interventions on learning outcomes.
   - **Predictive Modeling**: Develop machine learning models (e.g., decision trees, random forests) to predict factors that contribute to student dropouts, low performance, and educational inequality.
4. **Qualitative Analysis**
   - **Interviews and Focus Groups**: Conduct semi-structured interviews with education stakeholders in Gujarat to capture the local context, challenges, and perceptions of educational quality.
   - **Thematic Analysis**: Analyze qualitative data from interviews and focus groups to identify recurring themes regarding barriers to education, including cultural, socio-economic, and infrastructural issues.
5. **Geospatial Analysis**
   - **Mapping and Spatial Visualization**: Use GIS tools to map the geographic distribution of educational resources, student outcomes, and socio-economic

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factors across Gujarat, identifying underserved regions or districts with lower educational outcomes.

- **Hotspot Identification**: Identify areas with high educational deprivation that require targeted interventions.

6. **Policy Evaluation**
   - Assess the impact of state-level educational policies like Gunotsav, Samagra Shiksha, and the Right to Education Act on educational access and quality through a combination of regression analysis and policy review.
7. **Validation and Robustness Check**
   - Cross-validate findings by comparing results from multiple data sources (e.g., UDISE+, ASER, local surveys).
   - Perform sensitivity analysis to check the robustness of the predictive models and findings.
8. **Reporting and Visualization**
   - Present the findings through visualizations (charts, graphs, maps) to clearly communicate disparities, patterns, and areas requiring attention.
   - Provide actionable recommendations based on data insights, tailored for policymakers in Gujarat to address specific educational challenges.

This multi-faceted methodology ensures that the study provides a thorough, data-backed evaluation of educational access and quality, with particular relevance to the state of Gujarat.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The plan of action for the *Data-Driven Evaluation of Educational Access and Quality Across Indian States*, particularly for Gujarat, will be structured into several phases, spanning data collection, analysis, and reporting. Below is a detailed step-by-step action plan:

Phase 1: Literature Review and Framework Development

Literature Review and Framework Development and Data Collection Plan

Phase 2: Data Collection and Cleaning

Secondary Data Collection and Primary Data Collection and Data Cleaning and Preprocessing

Phase 3: Data Analysis

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Descriptive and Exploratory Data Analysis (EDA) , Quantitative Analysis, Qualitative Analysis, Geospatial Analysis **Phase 4: Policy Evaluation and Recommendations** Policy Impact Evaluation, Actionable Recommendations, **Phase 5: Reporting and Dissemination** Final Report Preparation, Policy Briefing, Academic Publications and Conferences

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	**Phase 1**	June	2023	July	2024
2.	**Phase 2**	August	2024	June	2025
3.	**Phase 3**	July	2025	June	2026
4.	**Phase 4**	July	2026	June	2027
5.	**Phase 5**	July	2027	July	2028

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Computer Software & Hardware	NA	2 or as per Requirement	1,30,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	7500	2	15,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3000
4.	Stationery and Printing (With justification)	50	40	2000
5.	Any other special requirement	100	30	3000
6.	Overhead (10% of recurring)			12000

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	TOTAL			**1,65,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
	b)			
	c)			
2.	**B. Glassware**			
	a)			
	b)			
	c)			
3.	**C. Any other consumable items (like wires/ electric items etc)**			
	a)			
	b)			
4.	**Travel**	No. of Times in a month		
	a) Purpose 1	Workshop/Seminar/Conferences (Rs 1,00,000)	5 years	
	b) Purpose 2			
5.	**Contingency**	**As per Consolidated budget**		
6.	**Stationery and printing**			
	a) Purpose 1	As per requirement	5 years	
	b) Purpose 2	As per requirement		
	Grand Total	1,65,000		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Block Chain Technology's role in Business	
2.	**Broad area of proposal**	Financial Technology (Fintech)	
3.	**Sub Area of proposal**	Finance	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Minal V. Bhojani	Assistant Professor, Commerce	9106475838 minal.bhojani@atmiyauni.ac.in
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	--	--	--
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	03/04/1985	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01/02/2022	
9.	**Whether the PI is registered for Ph.D. on the same topic**	N.A.	
10.	**If yes then name of university**	--	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	**Educational Qualification**				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	Ph. D.	**Finance**	**Saurashtra University**	**2017**	--
ii.	Post Graduation	**Finance**	**Saurashtra University**	**2009**	**64%**
iii.	Under Graduation	**Finance**	**Saurashtra University**	**2006**	**54%**
iv.	CSIR/UGG-NET/ SLET/GATE				

2.	**Have you previously received any Fellowship from any funding agency?**	☐ YES	✓ ☐ NO
3.	**If yes, please indicate whether it was a (✓ tick appropriate)**	☐ **short-term fellowship (*viz*Project fellow, Project assistant, etc.)**	
		☐ **pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)**	
		☐ **post-doctoral fellowship (*viz*D S Kothari PDF, or any other)**	
4.	**If yes, mention the details of fellowship and tenure**	**N.A.**	

5.	**Details of on-going and completed research funded projects (if any)**				
	S.N.	**Title**	**Project Cost**	**Sponsoring Agency**	**Duration (Start – End – MM/YYYY)**
		N.A.	**N.A.**	**N.A.**	**N.A.**
		N.A.	**N.A.**	**N.A.**	**N.A.**

6.	**Total Experience**	**Teaching Experience: 6 Year + 2 Months)**
		Research Experience: N.A.
7.	**No. of Publication (Research articles -**	**National: 01**

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	UGC Approved only)	International: 00
8.	No. of Publication (Book Chapters)	N.A.
	Books Published	N.A.
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Block chain technology's role in business

2. Abstract (Provide a summary of your research proposal in 300 words)

This research aims to explore the transformative role of block chain technology in modern businesses. By analyzing its potential to enhance efficiency, transparency, and trust, the study seeks to identify practical applications and address challenges to adoption. The findings will provide actionable insights to guide businesses and policymakers in leveraging block chain for sustainable growth.

Block chain technology has emerged as a disruptive force across various industries, promising enhanced transparency, security, and operational efficiency. Despite its potential, many businesses struggle to understand its applications and integrate it effectively into their operations. This research proposes to investigate block chain's role in business transformation, focusing on its impact on key areas such as supply chain management, finance, and customer trust.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

1. **Comprehensive Literature Review:**
   - → Collect and analyze existing research on block chain technology, focusing on its applications in various industries.
   - → Identify gaps in current literature to highlight areas requiring further exploration.
2. **Industry Case Studies:**
   - → Examine real-world examples of successful block chain implementation in logistics, finance, and healthcare.

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→ Highlight lessons learned and best practices for broader adoption.

3. **Stakeholder Surveys and Interviews:**
   → Design and conduct surveys targeting business executives, technology experts, and policymakers.
   → Conduct in-depth interviews to gain qualitative insights into challenges and expectations.
4. **Economic and Operational Analysis:**
   → Utilize data-driven methods to measure block chain's impact on cost reduction, efficiency, and transparency.
   → Compare block chain-enabled systems with traditional systems in selected industries.
5. **Developing an Adoption Framework:**
   → Propose a strategic framework to guide businesses in block chain integration.
   → Include actionable recommendations tailored to industry-specific needs.
6. **Knowledge Dissemination:**
   → Publish findings in industry journals and present at conferences.
   → Organize workshops to share insights with stakeholders and promote collaboration.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Current research on block chain technology in business reveals both promising advancements and significant gaps. Many studies have highlighted block chain's potential to enhance transparency, reduce transaction costs, and improve data security across industries such as finance, healthcare, and supply chain management. For instance, research demonstrates block chain's ability to ensure traceability and combat fraud in supply chains and its use in smart contracts to streamline financial transactions. However, despite these breakthroughs, adoption remains limited due to challenges such as scalability, regulatory uncertainty, and high implementation costs.

The literature often focuses on theoretical benefits without providing sufficient empirical evidence or actionable strategies for businesses. Moreover, small and medium enterprises (SMEs) are underrepresented in existing research, despite their potential to benefit significantly from block chain adoption. The integration of block chain with emerging technologies like IT and AI is also a nascent area requiring further exploration. This study aims to address these gaps

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by providing practical insights and strategic frameworks tailored to diverse industries, thus contributing to the evolution of block chain research and its applications.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To analyze the impact of block chain technology on business operations.
2. To identify key industries benefiting from block chain adoption.
3. To evaluate challenges and barriers to the widespread adoption of block chain.
4. To propose strategies for effective integration of block chain into business models.

6. Significance of the proposed study: (300 words)

Block chain technology represents a paradigm shift in how businesses operate, offering a decentralized and tamper-proof system for recording and verifying transactions. Its applications span multiple domains, including supply chain management, financial services, healthcare, and beyond. However, despite its transformative potential, adoption rates remain slow due to a combination of technological, economic, and regulatory challenges. This study aims to address these issues through a systematic and multi-dimensional approach.

The importance of this research extends beyond theoretical contributions. It aligns with the broader goal of fostering a digital-first economy, where businesses can harness cutting-edge technologies for sustainable growth. The findings will resonate with diverse stakeholders, including corporations seeking competitive advantages, startups driving innovation, and governments aiming to position themselves as leaders in block chain adoption. By addressing critical gaps and providing actionable insights, this research will pave the way for a more transparent, efficient, and equitable business landscape.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, as one of India's most industrialized states, is a hub of economic activity with a strong presence in sectors such as manufacturing, agriculture, and trade. Block chain technology can significantly enhance the efficiency and transparency of these industries, aligning with Gujarat's vision of becoming a leader in innovation and technology.

For instance, the state's robust supply chain network for agriculture and manufacturing can benefit from block chain-based traceability and fraud prevention solutions, ensuring better quality control and reducing losses. Similarly, the financial services sector, integral to Gujarat's economic framework, can leverage block chain for secure and transparent transactions, reducing operational costs for businesses and enhancing trust among stakeholders.

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Furthermore, Gujarat's thriving small and medium enterprises (SMEs), which often face challenges like lack of technological expertise and inefficiencies, stand to gain immensely from the adoption of blockchain-based solutions tailored to their needs. By addressing these challenges, this research will provide actionable strategies to drive block chain adoption in Gujarat, contributing to its economic growth and reinforcing its position as a technology-driven state.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

1. A comprehensive understanding of block chain's potential in enhancing business operations.
2. Identification of practical use cases and best practices for block chain implementation.
3. A roadmap for overcoming barriers to block chain adoption.
4. Policy recommendations to support block chain innovation in the business sector.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	✓
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

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10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

❖ **Hypothesis:**

1) H_1: Block chain technology significantly enhances operational efficiency
2) H_1: Block chain technology significantly offering measurable benefits in supply chain management
3) H_1: Block chain technology significantly enhances transparency and trust in business processes
4) H_1: Block chain technology significantly offering measurable benefits in finance
5) H_1: Block chain technology significantly offering measurable benefits in customer engagement

❖ **Sampling Plan:**

The study will employ a purposive sampling strategy to target key stakeholders, including:

- Businesses that have adopted block chain technology.
- Industry experts and consultants specializing in block chain.
- Policymakers and regulators overseeing technology implementation.

A sample size of approximately 50 participants, including business leaders and technical experts, will be selected for surveys and interviews to ensure diverse perspectives.

❖ **Data Collection:**

- **Primary Data:** Collected through structured surveys, in-depth interviews, and workshops with stakeholders.
- **Secondary Data:** Derived from industry reports, academic publications, and case studies of block chain implementation.

❖ **Data Analysis:**

1. **Quantitative Analysis:** Statistical techniques will be used to analyze survey responses, focusing on metrics such as cost savings, efficiency gains, and adoption challenges.
2. **Qualitative Analysis:** Content analysis will be applied to interview transcripts and case studies to identify themes, patterns, and insights.
3. **Comparative Analysis:** The performance of blockchain-enabled systems will be compared with traditional business systems to evaluate benefits.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

❖ **Action Plan**

- Literature Review: 2 months
- Data Collection: 3 months
- Analysis and Interpretation: 3 months
- Report Writing and Dissemination: 2 months

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- **Total Duration:** 10 months

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review	June	2022	July	2022
2.	Data Collection (Surveys/Interviews)	August	2022	October	2022
3.	Data Analysis	November	2022	January	2023
4.	Framework Development	February	2023	March	2023
5.	Report Writing and Dissemination	April	2023	May	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			100,000/-
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			25,000/-
3.	Contingency (Upto maximum for Rs. 3000/-)			3,000/-
4.	Stationery and Printing (With justification)			25,000/-
5.	Any other special requirement Technology and Software	Block chain simulation tools and software	1	1,47,000/-
6.	Overhead (10% of recurring)			25000/-
	TOTAL			**3,25,000/-**

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

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S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	A. Chemicals			
	a)			
	b)			
	c)			
2.	B. Glassware			
	a)			
	b)			
	c)			
3.	C. Any other consumable items (like wires/ electric items etc)	100,000/-		
	a)			
	b)			
4.	Travel	25,000/-		
	a) Data Collection	(2 Months)		
	b) Survey	(2 Months)		
5.	Organizing Workshop	100,000/-		
6.	Miscellaneous	100,000/-		
	a) Purpose 1			
	b) Purpose 2			
	Grand Total	3,25,000/-		

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Application form

Part -A

(General Information)

1.	Title of the proposal	A Study on implementation of NEP 2020 in Higher Education in Gujarat	
2.	Broad area of proposal	NEP 2020	
3.	Sub Area of proposal	Implementation	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Dr. Parth Dave	Assistant Professor	8320280075 Parth.dave@atmiyauni.ac.in
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	-	-	-
6.	Whether the proposal is transdisciplinary?	Yes / No	
7.	Date of Birth of PI (DD/MM/YYYY)	11/08/1994	
8.	Date of joining the Department of PI (DD/MM/YYYY)	14/02/2022	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	-	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Commerce	Atmiya University	2022	-
ii.	Post Graduation	Commerce	Saurashtra University	2016	61
iii.	Under Graduation	Commerce	Saurashtra University	2014	60
2.	Have you previously received any Fellowship from any funding agency?		☐ YES	☐ NO	
3.	If yes, please indicate whether it was a (✓tick appropriate)		☐ short-term fellowship (viz Project fellow, Project assistant, etc.)		
			☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)		
			☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)		
4.	If yes, mention the details of fellowship and tenure				
5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-
6.	Total Experience		Teaching Experience: 3 Years + 1 Month		
			Research Experience: 4 Years		
7.	No. of Publication (Research articles - UGC Approved only)		National:3		
			International:1		
8.	No. of Publication (Book Chapters)		-		
	Books Published		-		
(Please enclose the list of papers and books published and/or acceptedduring last five years)					

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

A Study on implementation of NEP 2020 in Higher Education in Gujarat

2. Abstract (Provide a summary of your research proposal in 300 words)

The National Education Policy (NEP) 2020 is a comprehensive framework aimed at transforming the education system in India, including higher education. This study investigates the implementation status of NEP 2020 in the higher education sector in Gujarat. The objectives of this research are to assess the awareness and understanding of NEP 2020 among stakeholders, examine the extent of policy alignment, identify challenges in implementation, and explore best practices adopted by higher education institutions. A representative sample of institutions will be selected, and data will be collected through surveys, interviews, and document analysis. Data analysis will involve both quantitative and qualitative techniques to identify themes and patterns. The study's findings will contribute to the understanding of NEP 2020's progress, challenges, and best practices in Gujarat's higher education landscape, informing future policy decisions and initiatives.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The National Education Policy (NEP) 2020 is a landmark policy document that aims to bring about significant changes in the education system of India. With its focus on transforming higher education, the NEP 2020 sets forth a vision for promoting multidisciplinary education, flexibility and choice for students, research and innovation, technology integration, and improved governance and regulation.

As a key state in India, Gujarat plays a crucial role in the implementation of NEP 2020. The state's higher education institutions, including universities, colleges, and professional institutes, are vital stakeholders in translating the policy's vision into action. Understanding the current status of NEP 2020 implementation in higher education institutions in Gujarat is essential to assess the progress made, identify challenges, and explore best practices.

This study aims to investigate the implementation status of NEP 2020 in the higher education sector in Gujarat. By examining the awareness and understanding of NEP 2020 among

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stakeholders, the extent of policy alignment in institutions, and the challenges encountered, this study will provide valuable insights into the current state of implementation. The outcomes will contribute to the existing literature on NEP 2020 implementation and support the effective implementation of NEP 2020 in Gujarat's higher education landscape.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

1)International:Khare, M. (2021), "Trends and strategies towards internationalisation of higher education in India", International Journal of Comparative Education and Development, Vol. 23 No. 2, pp. 136- 151. At present, internationalisation in India is lopsided and may become a drain on Indian economy if not balanced soon. India is now focussing to correct its adverse inbound–outbound international student (IS) mobility in order to become attractive for international HE community; India aims to strategically "prepare to host," which is subject to institutional abilities to implement new schemes and programmes. International credibility of Indian HE rests largely on quality augmentation. This study aims to explore what are the past trends in internationalisation of higher education (IoHE) in the country and how India's higher education (HE) internationalisation strategies are aligned to make India a regional education hub and a storehouse of global talent pool.

2)National: Ghatol, S. D. (2021). Status of Higher Education in India with a Focus on Gujarat State in Context of New Education Policy. Journal of Educational Planning and Administration, 35(3), 181-203.Though India ranks third in the world in terms of higher education system, its education system is falling behind in world ranking. Gujarat is one of the progressive states in India, which is echoed in its move towards reforms in the education system. Though Gujarat is moving forward speedily to internationalise its education, it falls behind on many important parameters compared to the national averages such as the GER, pupil-teacher ratio, net attendance ratio, gender parity, dropouts, etc. The Gujarat government has been making various efforts to make its education system global and industry orientated but there is urgent need to work in the areas where it is lagging.

Research gap: Stakeholder Awareness and Understanding: Investigating the level of awareness and understanding of NEP 2020 among different stakeholders in Gujarat's higher education institutions, including administrators, faculty members, students, and policymakers.Policy Alignment and Implementation: Assessing the extent to which higher education institutions in Gujarat have aligned their policies, curriculum, and practices with the goals and recommendations of NEP 2020. This includes examining the integration of multidisciplinary education, flexibility and choice, research and innovation, and technology integration.

Challenges and Barriers: Exploring the challenges and barriers faced by higher education institutions in Gujarat in implementing NEP 2020. This may include obstacles related to

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infrastructure, faculty training, financial resources, regulatory frameworks, and cultural or institutional resistance to change.

Best Practices and Innovations: Identifying successful initiatives and innovative practices adopted by higher education institutions in Gujarat to implement NEP 2020. This can involve case studies of institutions that have effectively implemented aspects of the policy and assessing their impact on student learning outcomes and overall educational quality.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

I. To assess the level of awareness and understanding of NEP 2020 among administrators, faculty members, students, and other stakeholders in higher education institutions in Gujarat.

II. To examine the extent to which higher education institutions in Gujarat have aligned their policies, curriculum, and practices with the goals and recommendations outlined in NEP 2020.

III. To identify the challenges and barriers faced by higher education institutions in Gujarat in implementing NEP 2020, including infrastructure limitations, faculty development needs, financial constraints, regulatory complexities, and cultural or institutional resistance.

6. Significance of the proposed study: (300 words)

The study will contribute to the understanding of sustainable entrepreneurship by women entrepreneurs, which is a growing and important field of study. Sustainable entrepreneurship is becoming increasingly important as a means of addressing social and environmental challenges, and understanding the factors that contribute to its success among women entrepreneurs can help inform policies and programs to support sustainable entrepreneurship

The study will provide insights into the specific opportunities and challenges for sustainable business startups by women entrepreneurs in the state of Gujarat. Gujarat has a strong tradition of entrepreneurship, and is also known for its entrepreneurial spirit. However, there is a need to understand the specific challenges faced by women entrepreneurs in this region and to identify best practices for success.

The study will provide insights into the role of women entrepreneurs in sustainable development. Women entrepreneurs can play a critical role in promoting sustainable development by creating businesses that contribute to social and environmental goals. Understanding the factors that contribute to the success of sustainable business startups by women entrepreneurs can help promote sustainable development in the state and beyond.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on the implementation of NEP 2020 in higher education in Gujarat is highly relevant for policy-making. It provides a comprehensive evaluation of NEP 2020

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implementation, identifies implementation challenges, assesses policy alignment, incorporates stakeholder perspectives, highlights best practices, and offers evidence-based policy recommendations. The study's findings and insights can guide policymakers in addressing implementation barriers, refining policy measures, and enhancing the effectiveness of NEP 2020 in Gujarat's higher education sector. Ultimately, the study contributes to informed decision-making and supports the development of policies and interventions that align with the goals of NEP 2020. The proposed study on the implementation of NEP 2020 in higher education in Gujarat holds great relevance for society. By examining the status of NEP 2020 implementation, identifying challenges, and proposing recommendations, the study contributes to improving the quality and accessibility of higher education. It ensures that educational policies align with the evolving needs of society, enhances learning outcomes, and promotes holistic development. The research outcomes have the potential to foster a positive impact on students, educators, and the broader society by creating a more inclusive, innovative, and effective higher education system in Gujarat.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

I.Identifying Implementation Challenges: The research can delve into the specific challenges faced by higher education institutions in Gujarat during the implementation of NEP 2020. By identifying and analyzing these challenges, the study can offer new insights into the complexities and barriers associated with policy implementation in the context of Gujarat.

II.Assessing Policy Alignment: The research can explore the extent to which higher education institutions in Gujarat have aligned their policies and practices with the goals and objectives of NEP 2020. By conducting a comprehensive assessment, the study can shed light on the gaps and areas that require attention in terms of policy alignment

III.Proposing Policy Recommendations: Building on the findings and analysis, the research can propose evidence-based policy recommendations to address the challenges and gaps identified in NEP 2020 implementation. These recommendations can offer new perspectives and innovative strategies for policymakers and institutions to improve the implementation process and outcomes.

IV.Stakeholder Engagement and Collaboration: The research can emphasize the importance of stakeholder engagement and collaboration in successful policy implementation. By highlighting effective approaches to involving stakeholders, fostering collaboration, and promoting ownership, thestudy can contribute to a path-breaking understanding of the critical role of stakeholders in driving policy reforms.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Research method of the study will be Survey, Interviews, Document Analysis, Case Study, Comparative Analysis and Mix Method Approach.

Population of the study – The Population of the study is Universities and Colleges in Gujarat.

Sample of the study (Sampling technique and sample size) - Stratified sampling techniques can be employed to ensure fair representation from different types of higher education institutions (e.g., universities, colleges) and disciplines.

Tools and Techniques – The Tools and Techniques of the study will be SPSS and Microsoft Office.

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Data Collection Procedure – Data collection will be done through Questionnaire, Interviews, Government Database, and University Personnel.

Data Analysis Techniques - Data Analysis Techniques of the study will be Descriptive Statistics, Regression Analysis, T- Test (Independent), Factor Analysis, ANOVA

11. Suggested plan of action: Define the suggested plan of action in 200 words)

To carry out research on "A Study on Implementation of NEP 2020 in Higher Education in Gujarat," the following plan of action is suggested:

1. Literature Review: Begin by conducting a comprehensive review of existing literature on NEP 2020, focusing on its implications for higher education in India and Gujarat. This will provide an understanding of key policies, objectives, and challenges related to its implementation.
2. Research Objectives: Define the core objectives, such as evaluating the current state of NEP 2020 implementation in Gujarat, identifying challenges faced by institutions, and assessing its impact on teaching, learning, and governance.
3. Data Collection: Use both qualitative and quantitative research methods. Conduct surveys and interviews with key stakeholders, including university administrators, faculty, students, and policymakers in Gujarat. Additionally, analyze institutional reports and government documents related to NEP 2020.
4. Case Studies: Select a few representative higher education institutions across Gujarat to conduct in-depth case studies. This will help in understanding the regional differences and challenges faced during implementation.
5. Data Analysis: Analyze the data to identify key trends, successes, gaps, and areas for improvement. Use statistical tools for quantitative analysis and thematic coding for qualitative data.
6. Conclusion and Recommendations: Based on the findings, offer recommendations for improving the implementation of NEP 2020 in Gujarat, ensuring better alignment with the policy's objectives.
7. Dissemination: Present the findings through academic papers, seminars, or workshops for relevant stakeholders.

12. Schedule of the Project Task

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Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature reviews, Background study, Introduction and Data Collection	May	2022	December	2022
2.	Data analysis	January	2023	February	2023
3.	Findings and Conclusion	March	2023	April	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	NA	NA	NA
2.	Travelling (viz. sample collection, should be Minimum and with justification)	31,800/-	16	5,08,800/-
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	73,000/-
4.	Stationery and Printing (With justification)	-	-	1,45,000/-
5.	Any other specialrequirement (Book, Journals, Seminar , Conference and Hospitality)– [Justification given in 13b.]	-	-	6,63,000/-
6.	Overhead (10% of recurring)	-	-	73,000/-
	TOTAL			14,62,800/-

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

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S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	A. Chemicals	NA	NA	NA
2.	B. Glassware	NA	NA	NA
3.	C. Any other consumable items (like wires/ electric items etc)	NA	NA	NA
4.	Travel	No. of Times in a month	1-2	
	a) Purpose 1	2,91,500	2-3M	To meet women entrepreneurs and industry associations
5.	Contingency	73,000	12M	-
6.	Stationery and printing			
	a)Printing and Photocopy	1,45,000	12M	Printing Documents , In case of requirement arise anytime outside of campus
7.	Any Other			
	a)Field visit and Work	5,08,800	12M	Interview and Survey
	b)Seminar and Conferences Participation including travel and accommodation	1,50,000		Books, Conference and Seminar.
	c)Books and Publications in UGC CARE/WoS/Scopus	1,50,000		Books and Publication
	d) Hospitality	71,500		Hospitality
8.	Overhead	73,000		10% of above all
	Grand Total	4,62,800/-		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Development of an Intelligent IoT-Based Health Monitoring System Using Machine Learning	
2.	**Broad area of proposal**	*Engineering*	
3.	**Sub Area of proposal**	Machine Learning	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Rupal Shilu	Assistant Professor – Computer Engineering	Rupal.shilu@atmiyauni.ac.in
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	22/02/1992	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	21/12/2016	
9.	**Whether the PI is registered for Ph.D. on the same topic**	(Yes/No/N.A.)	
10.	**If yes then name of university**		

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.				
ii.	Post Graduation	M.E. – Computer Engineering	Gujarat Technological University	2015	80%
iii.	Under Graduation	B.E. – Computer Engineering	Gujarat Technological University	2013	70%
iv.	CSIR/UGG-NET/ SLET/GATE				

2.	Have you previously received any Fellowship from any funding agency?	☐YES	☐✓NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (9 Year + ... Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles -	National:

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	No. of Publication (Research articles - UGC Approved only)	International:
8.	No. of Publication (Book Chapters)	6
	Books Published	
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Development of an Intelligent IoT-Based Health Monitoring System Using Machine Learning

2. Abstract (Provide a summary of your research proposal in 300 words)

The rapid advancement of the Internet of Things (IoT) and Machine Learning (ML) has revolutionized the healthcare sector, offering innovative solutions for health monitoring and disease management. This paper presents the development of an intelligent IoT-based health monitoring system that integrates real-time data collection, processing, and predictive analytics to enhance patient care and decision-making. The system utilizes wearable IoT devices to continuously monitor critical health parameters such as heart rate, blood pressure, body temperature, oxygen saturation, and electrocardiogram (ECG) signals.

Collected data is transmitted to a cloud-based platform, where it is analyzed using machine learning algorithms to identify patterns, detect anomalies, and predict potential health risks. The proposed system employs advanced supervised and unsupervised ML techniques, including neural networks, decision trees, and clustering algorithms, to ensure high accuracy and reliability. Alerts are generated in real time to notify patients and healthcare providers of potential emergencies, enabling timely intervention.

Key features of the system include personalization, scalability, and security. It offers tailored recommendations and insights based on individual health profiles while ensuring data confidentiality through encryption and secure communication protocols. Scalability is achieved by leveraging modular IoT architecture, making the system adaptable for diverse applications ranging from home-based monitoring to hospital-grade solutions.

The proposed IoT-based health monitoring system addresses the limitations of traditional healthcare systems, such as delayed diagnostics and insufficient patient monitoring. It also empowers individuals with proactive health management and facilitates remote care delivery,

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reducing the burden on healthcare facilities. Experimental results demonstrate the system's efficacy in real-world scenarios, highlighting its potential to transform healthcare delivery. This paper underscores the role of IoT and ML as catalysts for smart healthcare innovation, paving the way for a healthier and more connected future.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The integration of the Internet of Things (IoT) and Machine Learning (ML) has brought transformative potential to various industries, with healthcare being one of the most impactful domains. Traditional healthcare systems often face challenges such as delayed diagnostics, insufficient monitoring, and a lack of personalized care. To address these issues, this study proposes the development of an intelligent IoT-based health monitoring system that leverages ML algorithms for real-time data analysis, anomaly detection, and predictive insights. By combining IoT's capability for ubiquitous data collection with ML's prowess in pattern recognition and decision-making, this system aims to enhance the quality of healthcare delivery and improve patient outcomes.

To achieve the project's goals, the following specific research activities will be pursued during the development period:

1. Requirement Analysis and System Design:

A comprehensive review of existing IoT-based health monitoring systems will be conducted to identify gaps and define the system requirements. This includes selecting appropriate sensors, designing the IoT architecture, and establishing communication protocols for seamless data transmission.

2. Development of IoT Hardware and Data Acquisition Modules:

IoT devices equipped with sensors for monitoring vital health parameters—such as heart rate, blood pressure, body temperature, oxygen saturation, and electrocardiogram (ECG)—will be developed. The devices will ensure continuous data acquisition with minimal power consumption and high reliability.

3. Data Preprocessing and Feature Engineering:

Raw health data collected from IoT devices will be preprocessed to handle noise, missing values, and inconsistencies. Feature engineering techniques will be applied to extract meaningful features, ensuring robust inputs for machine learning algorithms.

4. Machine Learning Model Development and Integration:

Supervised and unsupervised ML algorithms, including decision trees, support vector machines, and deep learning models, will be developed to analyze health data. The focus will be on predicting anomalies, identifying disease trends, and providing actionable insights.

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5. Real-Time Monitoring and Alert Mechanism:

A cloud-based platform will be created to facilitate real-time data visualization and alert generation. Patients and healthcare providers will receive instant notifications in case of detected anomalies or emergencies.

6. Security and Privacy Implementation:

To address the critical concern of data confidentiality, advanced encryption methods and secure communication protocols will be incorporated into the system. This ensures that sensitive health information remains protected.

7. System Testing and Validation:

The system will undergo extensive testing in real-world environments to evaluate its accuracy, reliability, and usability. Validation studies will involve collaboration with healthcare professionals to ensure the system meets clinical standards.

8. Scalability and Personalization Features:

Modular design principles will be adopted to ensure the system's scalability. Additionally, ML algorithms will be tailored to provide personalized recommendations based on individual patient profiles and historical data.

The importance of developing an intelligent IoT-based health monitoring system using machine learning lies in its ability to address critical challenges in healthcare and pave the way for a more proactive, personalized, and efficient approach to patient care.

The proposed system shifts the focus from reactive to preventive care by enabling continuous health monitoring and early detection of potential health issues. For instance, abnormalities in heart rate or blood pressure can be detected before they escalate into serious conditions, reducing the risk of hospitalizations.

By leveraging IoT devices, the system facilitates remote health monitoring, which is particularly beneficial for elderly individuals, patients in rural areas, and those with limited mobility. Remote care capabilities reduce the need for frequent hospital visits, thereby improving convenience and reducing healthcare costs.

Machine learning models provide tailored recommendations based on individual health data, allowing patients and healthcare providers to make informed decisions. This personalized approach fosters patient engagement and adherence to treatment plans.

The system alleviates the burden on healthcare facilities by enabling at-home monitoring and early intervention. It also optimizes resource allocation by prioritizing critical cases, thus improving the efficiency of healthcare delivery.

The data generated by the system can be anonymized and utilized for large-scale health research, facilitating the discovery of new disease patterns, drug efficacy evaluations, and advancements in predictive medicine.

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The proposed study addresses limitations such as the high cost of conventional monitoring devices, limited accuracy of standalone systems, and concerns about data security. By integrating IoT and ML, the system offers a cost-effective, accurate, and secure solution for health monitoring.

The development of an intelligent IoT-based health monitoring system represents a significant advancement in modern healthcare. By leveraging real-time data collection and machine learning algorithms, the proposed system promises to enhance preventive care, improve accessibility, and foster personalized healthcare. The research activities outlined in this study will ensure a robust and scalable solution that addresses current healthcare challenges and sets the foundation for future innovation. As IoT and ML technologies continue to evolve, this study aims to establish a benchmark for smart healthcare systems, ultimately contributing to a healthier and more connected society.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The integration of IoT and Machine Learning in healthcare has gained significant traction in recent years, driven by advancements in sensor technology, cloud computing, and artificial intelligence. Current research focuses on developing IoT-enabled health monitoring systems for continuous data collection and real-time analysis of critical health parameters. Studies have demonstrated the efficacy of wearable IoT devices in tracking metrics such as heart rate, blood pressure, and blood glucose levels.

Machine learning techniques, particularly deep learning models, are increasingly employed for predictive analytics, anomaly detection, and disease diagnosis. For instance, ML algorithms have shown high accuracy in detecting arrhythmias from ECG data and predicting complications in chronic conditions like diabetes. Research also highlights the importance of interoperability and scalability in IoT systems, ensuring adaptability across diverse healthcare applications.

However, significant challenges remain. Issues like data security, sensor accuracy, and energy efficiency of IoT devices hinder widespread adoption. Moreover, existing systems often lack personalization, limiting their ability to cater to individual patient needs. Despite promising results in controlled environments, many solutions face difficulties in real-world implementation due to the complexity of clinical workflows.

Continued research is essential to address these gaps, focusing on robust ML integration, enhanced security measures, and system validation in practical healthcare settings.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Real-Time Health Monitoring:

Develop an IoT-based system capable of continuously monitoring vital health parameters, such as heart rate, blood pressure, oxygen saturation, and body temperature, ensuring real-time data acquisition and analysis.

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2. Predictive Analytics for Early Intervention:

Utilize advanced machine learning algorithms to analyze collected health data for early detection of abnormalities and prediction of potential health risks, enabling timely intervention and improved patient outcomes.

3. Personalized Healthcare Solutions:

Design the system to offer tailored health insights and recommendations based on individual patient profiles, historical data, and lifestyle factors, fostering a personalized approach to healthcare.

4. Secure and Reliable Data Handling:

Ensure the security and privacy of sensitive health information by implementing robust encryption protocols and secure communication frameworks within the IoT ecosystem.

5. Scalable and Modular System Design:

Develop a scalable and modular architecture to accommodate various healthcare applications, ranging from home-based monitoring for chronic conditions to hospital-grade systems for critical care.

6. Enhanced Accessibility and Remote Care:

Facilitate remote health monitoring, particularly for underserved populations such as the elderly, individuals in rural areas, and patients with limited mobility, reducing the dependency on in-person visits and healthcare facility resources.

6. Significance of the proposed study: (300 words)

The development of an intelligent IoT-based health monitoring system using machine learning holds transformative potential for modern healthcare. This innovation addresses critical challenges such as delayed diagnoses, insufficient patient monitoring, and the growing burden on healthcare systems, paving the way for a more efficient, personalized, and proactive approach to patient care.

One significant benefit is real-time health monitoring. By utilizing IoT devices, the system continuously collects vital health data, ensuring timely detection of abnormalities. This shift from episodic to continuous monitoring empowers healthcare providers and patients to intervene promptly, reducing complications and improving outcomes.

The integration of machine learning algorithms enables predictive analytics, facilitating the early detection of diseases and potential health risks. For instance, predictive models can analyze trends in heart rate or blood pressure data to preemptively identify conditions such as arrhythmias or hypertension. This capability not only enhances preventive care but also reduces the need for costly emergency interventions.

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The system also contributes to personalized medicine, as ML algorithms adapt to individual health profiles and generate tailored recommendations. This fosters patient engagement, adherence to treatment plans, and overall satisfaction with care.

Moreover, the proposed system enhances accessibility by enabling remote monitoring, particularly benefiting individuals in rural or underserved areas, the elderly, and those with mobility constraints. This reduces dependency on physical healthcare facilities while improving convenience and cost-effectiveness.

By addressing issues such as data security through robust encryption and ensuring scalability for diverse applications, the system ensures trustworthiness and broad usability.

In conclusion, this intelligent IoT-based health monitoring system represents a paradigm shift in healthcare, driving improved quality, efficiency, and equity in care delivery while laying the groundwork for future innovations in smart healthcare.

7. Relevance of the proposed study to Gujarat: (200 words)

The development of an intelligent IoT-based health monitoring system using machine learning is highly relevant to Gujarat, a state experiencing rapid industrialization, urbanization, and a growing population with diverse healthcare needs. This innovation addresses critical gaps in healthcare accessibility, preventive care, and resource optimization, particularly in Gujarat's semi-urban and rural regions.

Gujarat's significant rural population often faces challenges in accessing quality healthcare due to geographic barriers and limited medical infrastructure. An IoT-based health monitoring system can enable remote healthcare services, allowing individuals in these areas to receive timely monitoring and intervention without frequent hospital visits. This is particularly beneficial for managing chronic diseases like diabetes and hypertension, which are prevalent in the state.

The system aligns with Gujarat's focus on smart cities and digital infrastructure development. By leveraging advanced technologies, it integrates seamlessly with ongoing initiatives, fostering a robust healthcare ecosystem. The use of machine learning enhances predictive analytics, which can support local healthcare providers in delivering personalized care and improving health outcomes.

Additionally, the system reduces the burden on healthcare facilities in urban centers like Ahmedabad and Surat, ensuring efficient utilization of resources. Its scalable and secure architecture makes it a valuable asset for addressing Gujarat's unique healthcare challenges, contributing to a healthier and more connected state.

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8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The development of an intelligent IoT-based health monitoring system using machine learning has the potential to deliver transformative benefits at the societal level, particularly in Gujarat. The state, characterized by its rapid industrial growth, urbanization, and significant rural population, faces unique healthcare challenges that the proposed system can effectively address.

One of the key benefits is improved access to healthcare. By enabling remote monitoring through IoT devices, the system can extend quality healthcare services to underserved regions, including rural and semi-urban areas of Gujarat. This ensures timely medical intervention, reducing health disparities and improving overall health outcomes across the state.

The system promotes preventive healthcare, shifting the focus from reactive treatments to proactive health management. Machine learning algorithms can predict potential health risks based on real-time data, allowing for early diagnosis and timely care. This reduces the prevalence and impact of chronic diseases, which are increasingly common in Gujarat's aging population.

For urban centers like Ahmedabad, Surat, and Vadodara, the system can alleviate the pressure on healthcare infrastructure. By reducing hospital visits through home-based monitoring, it ensures more efficient resource allocation, enabling healthcare facilities to prioritize critical cases.

The economic benefits are also significant. Early detection and remote care reduce healthcare costs for individuals and families, fostering economic stability. Moreover, the system aligns with Gujarat's smart city initiatives and technological development goals, positioning the state as a leader in health-tech innovation.

On a broader societal level, the system enhances public health awareness by empowering individuals to take charge of their health. This contributes to a healthier, more informed population, strengthening Gujarat's workforce and overall quality of life.

In conclusion, the proposed system has the potential to revolutionize healthcare delivery in Gujarat, fostering equity, efficiency, and innovation in the state's healthcare ecosystem.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐✓
4.	Nutrition	☐

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5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

To develop an intelligent IoT-based health monitoring system using machine learning, the research will involve specific activities and a structured methodology, including hypothesis formulation, sampling plan, data collection, and data analysis.

Hypothesis

- Primary Hypothesis: The integration of IoT devices and machine learning algorithms can significantly improve real-time health monitoring, anomaly detection, and personalized healthcare delivery compared to traditional methods.

- Secondary Hypothesis: The proposed system can enhance accessibility and efficiency in healthcare delivery, particularly in underserved regions.

Research Activities

1. Requirement Analysis and System Design:

Conduct a comprehensive review of existing IoT health monitoring systems to identify technological gaps. Design a modular architecture for seamless IoT device integration, real-time data transmission, and machine learning analytics.

2. Development of IoT Devices and Sensors:

Prototype and deploy IoT devices to monitor vital health parameters such as heart rate, blood pressure, oxygen saturation, and body temperature.

3. Data Preprocessing and Feature Engineering:

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Implement data preprocessing techniques to clean, normalize, and transform raw health data into structured formats suitable for ML model training.

4. Machine Learning Model Development:

Develop supervised and unsupervised machine learning algorithms for anomaly detection, disease prediction, and personalized health recommendations.

5. System Testing and Validation:

Test the system in real-world environments and validate its accuracy, scalability, and usability with healthcare professionals and patients.

Sampling Plan

A stratified random sampling method will be employed to ensure diverse representation. The sample will include patients from urban, semi-urban, and rural regions, focusing on individuals with chronic diseases and those at risk of acute conditions. A sample size of 300 participants will be selected to ensure statistically significant results.

Data Collection

Data will be collected using IoT devices deployed in participants' homes and clinics over six months. Parameters such as heart rate, blood pressure, and ECG data will be captured in real-time and transmitted to a cloud-based platform.

Data Analysis

Collected data will undergo preprocessing, including noise reduction and normalization. Machine learning models, such as decision trees, neural networks, and clustering algorithms, will analyze the data to detect anomalies and predict health risks. Statistical analysis will validate the models' accuracy and reliability. Findings will be used to refine the system and ensure its real-world applicability.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The development of the intelligent IoT-based health monitoring system using machine learning will be carried out through a structured, phased approach to ensure systematic progress and successful implementation.

1. Phase 1: Literature Review and Requirement Analysis (Months 1-2)

Conduct a thorough review of existing systems to identify strengths and limitations. Define the specific requirements for the IoT-based system, including the selection of sensors, IoT architecture, and communication protocols.

2. Phase 2: System Design and Prototype Development (Months 3-4)

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Design the system architecture, including the IoT devices, cloud platform, and data processing layers. Develop the initial prototypes of IoT devices with sensors for health parameters such as heart rate, blood pressure, and ECG.

3. Phase 3: Data Collection and Preprocessing (Months 5-6)

Deploy IoT devices for data collection in a diverse sample group. Collect real-time health data over a period of 3-6 months, ensuring comprehensive representation from rural and urban participants. Perform data preprocessing to clean and normalize the collected data.

4. Phase 4: Machine Learning Model Development and Integration (Months 7-8)

Develop and train machine learning models to analyze health data for anomaly detection, risk prediction, and personalized recommendations. Integrate these models with the IoT platform.

5. Phase 5: System Testing and Validation (Months 9-10)

Test the system in real-world environments. Validate its performance with healthcare professionals and end-users. Refine the system based on feedback and real-time data accuracy.

6. Phase 6: Deployment and Monitoring (Months 11-12)

Finalize system deployment, ensuring scalability, security, and user-friendliness. Monitor system performance and make any necessary adjustments.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Requirement Analysis and Literature Survey	August	2022	September	2022
2.	System Design and Prototype Development	October	2022	November	2022
3.	Data Collection and Preprocessing	December	2022	January	2023
4.	Machine Learning Model Development and Integration	February	2023	March	2023
5.	IoT Integration and Hardware Prototype Development	April	2023	May	2023
6.	System Testing and Performance Evaluation	June	2023	July	2023
7.	Final Report Writing and Presentation Preparation	August	2023	August	2023

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13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Microcontroller (e.g., Raspberry Pi/Arduino) Travel & Contingency	5000	5	25000
	Sensors (Heart Rate, Temperature, etc.)	1700	10	17000
	Cloud Storage & Computing Services (AWS/GCP)	8000	6 Months	48000
	Communication Modules (Wi-Fi, Bluetooth)	1500	5	7500
	Machine Learning Development (Software/Tools)	20000	1	20000
	Prototype Development (Hardware Assembly)	20000	1	20000
	Mobile App Development	20000	1	20000
	Testing and Validation Equipment	5000	5	25000
	Miscellaneous Expenses (Cables, Power Supply, etc.)	5000	1	5000
	Project Team Salaries (Developers, Researchers)	7500	4 persons * 4 Months	120000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			12500
3.	Contingency (Upto maximum for Rs. 3000/-)			
4.	Stationery and Printing (With justification)			
5.	Any other special requirement			
6.	Overhead (10% of recurring)			
	TOTAL			**320000**

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b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	Microcontroller (e.g., Raspberry Pi/Arduino) Travel & Contingency	25000	May 2022 - June 2022	Required for developing the core processing unit of the IoT system. Initial purchases are necessary for prototype testing.
	Sensors (Heart Rate, Temperature, etc.)	17000	May 2022 - June 2022	Essential for capturing patient data (heart rate, temperature, etc.). Multiple sensors will ensure accurate and diverse data collection for testing.
	Cloud Storage & Computing Services (AWS/GCP)	48000	June 2022 - March 2023	Enables secure storage and processing of large datasets required for machine learning models. Monthly usage for real-time analysis.
	Communication Modules (Wi-Fi, Bluetooth)	7500	June 2022 - July 2022	Required for wireless data transmission between devices and cloud servers. Testing and implementation demand multiple units.
	Machine Learning Development (Software/Tools)	20000	July 2022 - October 2022	Development and training of machine learning models to analyze patient data effectively. Covers software and license costs.
	Prototype Development (Hardware Assembly)	20000	August 2022 - October 2022	Physical assembly and integration of components to create a working prototype for initial trials.
	Mobile App Development	20000	September 2022 - November 2022	Development of a user-friendly mobile application for monitoring and interacting with the system. Includes design, coding, and testing phases.

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	Testing and Validation Equipment	25000	November 2022 - January 2023	Equipment and tools for rigorous testing and calibration of the system to ensure reliability and accuracy.
	Miscellaneous Expenses (Cables, Power Supply, etc.)	5000	May 2022 - March 2023	Covers unforeseen expenses, including cables, connectors, and minor hardware replacements during the project lifecycle.
	Project Team Salaries (Developers, Researchers)	120000	May 2022 - March 2023	Salaries for 4 team members working full-time across research, development, and testing phases. Allocated for 10 months.
2.	**A. Chemicals**			
	a)			
	b)			
	c)			
3.	**B. Glassware**			
	a)			
	b)			
	c)			
4.	**C. Any other consumable items (like wires/ electric items etc)**			
	a)			
	b)			
4.	**Travel**	No. of Times in a month		
	a) Purpose 1	12500	May 2022 - March 2023	Covers travel for field testing, presentations, and unanticipated project requirements.
	b) Purpose 2			

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5.	**Contingency**			
6.	**Stationery and printing**			
	a) Purpose 1			
	b) Purpose 2			
	Grand Total	3,20,000		

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Application form

Part -A
(General Information)

1.	**Title of the proposal**	Mobile Banking Adoption and Usage Patterns Among Customers of Public and Private Sector Banks	
2.	**Broad area of proposal**	Digital Banking/Financial Technology	
3.	**Sub Area of proposal**	• Mobile Banking Adoption • Consumer Behavior in Banking • Comparative Analysis of Public and Private Sector Banks • Technology Adoption Models in Banking (e.g., TAM, UTAUT) • Usage Patterns of Mobile Banking Services	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Sweta Savaliya	Assistant Professor & Management	9712962013
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	08/01/1992	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	29/01/20022	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	-	

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***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Finance	Atmiya University, Rajkot	July 2022	Pursuing
ii.	Post Graduation	Finance	GTU	2015	75%
iii.	Under Graduation	Finance and Accounting	Saurashtra University, Rajkot	2013	74%
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐~~YES~~	☐NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-

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6.	Total Experience	Teaching Experience: (9 Year +4 Months)
		Research Experience: -
7.	No. of Publication (Research articles - UGC Approved only)	National:-
		International:-
8.	No. of Publication (Book Chapters)	-
	Books Published	-
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Mobile Banking Adoption and Usage Patterns Among Customers of Public and Private Sector Banks

2. Abstract (Provide a summary of your research proposal in 300 words)

The rapid evolution of digital technology has transformed banking, with mobile banking emerging as a vital service channel. This research explores the adoption and usage patterns of mobile banking among customers of public and private sector banks in India. The study aims to uncover key factors influencing customer preferences, including ease of use, perceived security, trust, service quality, and demographic variables, while examining differences between the two banking sectors.

Mobile banking adoption has surged due to increasing smartphone penetration and digital literacy, yet challenges persist. Public sector banks often face perceptions of outdated technology, while private sector banks are associated with innovation but higher costs. This research seeks to understand these dynamics and identify barriers to adoption, such as digital literacy gaps, security concerns, and service inefficiencies.

A mixed-method approach will be employed, combining quantitative surveys and qualitative interviews to gather insights from a diverse customer base. Data analysis will involve statistical techniques to identify trends and thematic analysis to explore customer experiences. The study will also evaluate how institutional reputation and customer trust influence mobile banking

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adoption across sectors.

Findings will provide actionable recommendations for banks to enhance mobile banking services, build trust, and address customer pain points. Public sector banks can leverage insights to modernize their digital platforms, while private sector banks can refine strategies to ensure broader accessibility.

This research contributes to the understanding of mobile banking's role in driving financial inclusion and optimizing customer experiences. By addressing adoption barriers and improving service quality, banks can promote sustainable growth and strengthen customer relationships in an increasingly digital economy.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Introduction

Mobile banking has emerged as a transformative force in the financial services industry, reshaping how customers interact with banks. With the rapid proliferation of smartphones and increasing internet penetration, mobile banking has become a critical channel for delivering banking services. However, the patterns of adoption and usage vary significantly between public and private sector banks, driven by differences in customer demographics, technological capabilities, and institutional trust. This study aims to explore these dynamics to offer insights into optimizing mobile banking services.

Research Objectives

To identify the factors influencing mobile banking adoption among customers of public and private sector banks.

To compare the adoption and usage patterns between the two sectors.

To analyze barriers to mobile banking adoption, such as digital literacy, security concerns, and accessibility.

To provide recommendations for enhancing mobile banking services to foster trust, satisfaction, and financial inclusion.

Research Activities

To achieve the objectives, the following activities will be pursued during the project:

1. **Literature Review**

   A thorough review of existing research will be conducted to identify gaps in the current understanding of mobile banking adoption. Studies related to technology acceptance

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models, customer behavior in digital banking, and comparative analysis of public and private sector banks will form the foundation.

2. **Survey Design and Data Collection**

   A structured survey will be designed to gather quantitative data from mobile banking users across both sectors. Key factors to be analyzed include perceived ease of use, security, trust, and service quality.

3. **Interviews and Focus Groups**

   Qualitative methods will be employed to gain deeper insights into customer experiences and attitudes. Interviews with banking professionals will also provide industry perspectives.

4. **Data Analysis**

   Advanced statistical tools will be used to identify trends, correlations, and differences in adoption patterns. Thematic analysis will be applied to qualitative data to uncover underlying themes.

5. **Comparative Analysis**

   The study will compare adoption rates, satisfaction levels, and barriers between public and private sector banks to identify sector-specific challenges and opportunities.

6. Policy and Strategic Recommendations

   Based on the findings, actionable strategies will be proposed for banks to enhance their mobile banking platforms and address customer concerns.

Importance of the Study

Mobile banking is pivotal in driving financial inclusion by bridging gaps in accessibility and convenience. In a country like India, where the banking sector is divided into public and private institutions, understanding the nuances of customer behavior is crucial. Public sector banks, often viewed as traditional and service-oriented, face challenges in adapting to digital trends. In contrast, private sector banks are perceived as technology-driven but sometimes exclusive due to higher fees.

This study holds significance in several ways:

1. **Addressing Digital Inequality**

   The research will highlight disparities in mobile banking usage caused by digital literacy and infrastructure gaps. Identifying these issues will help banks design more inclusive platforms.

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2. **Enhancing Trust and Security**

   By examining customer concerns regarding security and trust, the study will provide insights into improving customer confidence, a critical factor in mobile banking adoption.

3. **Optimizing User Experience**

   The findings will help banks streamline their mobile banking interfaces to enhance usability, ensuring a seamless customer experience.

4. **Comparative Insights for Better Strategies**

   The study's comparative approach will enable public sector banks to learn from the innovative strategies of private banks while guiding private banks to adopt more inclusive practices.

5. **Policy Contributions**

   Insights from this research can inform policies aimed at promoting digital banking adoption, aligning with government initiatives such as Digital India.

6. **Practical Implications**

   Banks can use the findings to improve their digital strategies, boost customer engagement, and enhance loyalty, ultimately contributing to sustainable growth in the banking sector.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The field of mobile banking adoption and usage has seen substantial research, particularly in the context of technological advancements and their impact on customer behavior. Scholars have extensively studied factors influencing mobile banking adoption, including the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT), highlighting the roles of perceived ease of use, usefulness, and trust. However, most studies have been conducted in developed economies, leaving a knowledge gap in emerging markets like India, where socio-economic and digital literacy disparities play significant roles.

Research focusing on India has explored adoption barriers, such as security concerns, lack of digital infrastructure, and limited trust in technology among rural populations. Public sector banks have been identified as lagging in technological innovation compared to private sector counterparts, which often leads to slower adoption rates. However, existing studies lack a comprehensive comparative analysis of public and private sector banks, particularly regarding customer satisfaction, service quality, and accessibility in mobile banking.

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Moreover, with the increasing prevalence of fintech and super-app ecosystems, the integration of advanced features like AI-driven personalization and seamless user interfaces remains underexplored. This study aims to bridge these gaps, offering a nuanced understanding of mobile banking dynamics and actionable recommendations to foster financial inclusion and customer engagement.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. **To identify the factors influencing mobile banking adoption**
   Investigate the key drivers, such as perceived ease of use, trust, security concerns, and service quality, that impact customer adoption of mobile banking services.
2. **To compare adoption and usage patterns**
   Analyze differences in mobile banking usage between customers of public and private sector banks, focusing on demographic, technological, and institutional factors.
3. **To examine barriers to mobile banking adoption**
   Identify challenges such as digital literacy gaps, security concerns, and infrastructure limitations that hinder the adoption of mobile banking services.
4. **To evaluate the role of trust and service quality**
   Assess how trust in banking institutions and the perceived quality of mobile banking services influence customer satisfaction and retention.
5. **To study the impact of digital literacy and accessibility**
   Explore the effect of customers' digital competence and the availability of technological infrastructure on mobile banking adoption.
6. **To provide strategic recommendations**
   Develop actionable insights for banks to enhance mobile banking platforms, address customer concerns, and promote financial inclusion across both public and private sector banks.

6. Significance of the proposed study: (300 words)

The proposed study on **mobile banking adoption and usage patterns** among customers of public and private sector banks in India holds significant academic, practical, and policy implications. The increasing prevalence of mobile banking in India, driven by the government's push for digital financial inclusion, demands a deeper understanding of the factors that influence adoption and usage patterns. The findings of this research will contribute to the broader literature on digital banking and customer behavior in emerging markets, where mobile banking is rapidly gaining prominence.

Academic Significance

While existing studies on mobile banking adoption predominantly focus on developed

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countries, limited research has been conducted in the context of India, where socio-economic, technological, and institutional factors vary greatly. This study will provide valuable insights into the unique challenges and opportunities in India's banking sector. By comparing adoption trends between public and private sector banks, it will fill a critical gap in literature, particularly regarding the role of institutional trust, technology infrastructure, and service quality in shaping customer preferences.

Practical Significance

From a practical standpoint, the study will offer actionable insights for both public and private sector banks to optimize their mobile banking platforms. Understanding customer concerns, such as security risks, usability, and access to services, will enable banks to enhance user experiences, build trust, and increase adoption rates. Furthermore, recommendations for improving service quality, addressing digital literacy gaps, and ensuring accessibility will help banks tailor their strategies to diverse customer segments, including rural and underserved populations.

Policy Significance

The findings will also have policy implications, particularly for initiatives like **Digital India** and **financial inclusion**. By identifying the barriers and drivers of mobile banking adoption, the study can inform policymakers and regulators on how to create an enabling environment for mobile banking growth, ensuring that financial services reach a wider, more diverse customer base.

In conclusion, the proposed study is poised to provide valuable contributions to the academic understanding, practical application, and policy frameworks surrounding mobile banking in India.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, one of India's most industrialized and economically vibrant states, has witnessed significant strides in digital banking and financial inclusion in recent years. The state's strong infrastructure, combined with high smartphone penetration, positions it as an ideal context for examining mobile banking adoption and usage patterns. While Gujarat has made notable progress in digitizing financial services, there remain significant challenges, particularly among rural populations and small-town customers, where adoption rates tend to lag behind urban areas.

This proposed study is highly relevant to Gujarat, as it aims to understand the factors influencing mobile banking adoption across diverse demographic groups. The study will explore how digital literacy, socio-economic status, and access to technological infrastructure impact mobile banking usage in both urban and rural areas of Gujarat. Furthermore, by comparing the adoption patterns between public and private sector banks, the research will shed light on

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regional variations and the role of institutional trust in shaping customer preferences.

With the state government's focus on Digital Gujarat and financial inclusion, the findings of this study will offer actionable insights to local banks and policymakers. It will help identify gaps in mobile banking service delivery, contributing to enhanced financial inclusion and economic empowerment, particularly for underserved and remote communities in Gujarat. Thus, the study aligns with both the state's digital transformation goals and its efforts to provide accessible banking services to all citizens.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The expected findings of the proposed research on mobile banking adoption and usage patterns will have significant societal benefits, particularly for the state of Gujarat. As mobile banking becomes an increasingly essential tool for financial inclusion, understanding the factors that drive or hinder its adoption will allow policymakers, banks, and community organizations to better address the needs of diverse population groups, including underserved rural areas.

1. Improved Financial Inclusion

The research will provide valuable insights into the barriers preventing mobile banking adoption in rural and semi-urban areas of Gujarat. By identifying these obstacles—such as digital illiteracy, limited internet access, or security concerns—the study will help formulate strategies to bridge these gaps. Enhanced mobile banking adoption can lead to broader financial inclusion, ensuring that marginalized communities gain access to essential banking services like savings, loans, and insurance, which are critical for improving their economic well-being.

2. Empowering Women and Vulnerable Groups

The findings could also highlight opportunities for empowering women and other vulnerable populations in Gujarat, who may face social or logistical barriers in accessing traditional banking services. Mobile banking platforms offer convenience, privacy, and accessibility, making it easier for these groups to manage their finances independently. Addressing adoption challenges in these communities can have a transformative impact on their financial independence and socio-economic mobility.

3. Economic Growth and Digital Literacy

By examining the role of digital literacy in mobile banking adoption, the research will provide insights into how digital education programs can be integrated into local communities. This can drive wider adoption of digital financial services, ultimately leading to greater economic participation and financial autonomy for individuals in Gujarat.

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4. Informing Policy and Government Programs

The study will assist the state government in refining initiatives like Digital Gujarat, which aim to promote digital literacy and financial inclusion. Data-driven recommendations can enhance existing policies, ensuring that mobile banking services reach all segments of society and contribute to Gujarat's overall economic development and digital transformation goals.

In summary, the societal benefits of this research will extend beyond improving banking access; they will contribute to empowering marginalized communities, promoting financial literacy, and driving economic growth across Gujarat.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	Digital Banking, Financial Inclusion, and Technology Adoption

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

This study on mobile banking adoption and usage patterns among customers of public and private sector banks will adopt a **mixed-method research approach**, combining both **quantitative** and **qualitative** techniques to gather comprehensive insights. The methodology is

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designed to evaluate the factors influencing mobile banking adoption, compare usage patterns, and identify barriers and drivers specific to public and private sector banks.

Research Activities

1. **Literature Review**:

   The first phase will involve reviewing existing literature on mobile banking adoption, technology acceptance models (such as TAM and UTAUT), and comparative studies between public and private sector banks. This will help in framing the research questions and refining the methodology.

2. **Survey Design**:

   A structured questionnaire will be developed to collect quantitative data on customer behavior, adoption factors, and usage patterns. The survey will incorporate items on perceived ease of use, perceived security, trust, service quality, demographic details, and banking preferences.

3. **Interviews and Focus Groups**:

   In-depth interviews and focus group discussions will be conducted to gain qualitative insights into customers' experiences, perceptions, and challenges related to mobile banking. This will help in capturing richer, context-specific data not possible through surveys alone.

4. **Data Collection**:

   Data will be collected from a representative sample of mobile banking users across various regions of Gujarat. A combination of online surveys and in-person interviews will ensure a wide-reaching data set. The survey will target both urban and rural customers, capturing insights from different demographic groups.

Hypothesis

- **H1**: There is a significant difference in mobile banking adoption between customers of public and private sector banks in Gujarat.
- **H2**: Factors such as perceived security, trust, and digital literacy positively influence the adoption of mobile banking in both public and private sector banks.
- **H3**: Barriers to mobile banking adoption differ based on customer demographic characteristics (e.g., age, income, education).

Sampling Plan

A **stratified random sampling** technique will be used to ensure representation from both public

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and private sector bank customers. The sample will be stratified based on factors such as:

- **Demographics**: Age, gender, income, education level, and geographic location (urban/rural).
- **Banking Sector**: Public and private sector bank customers.
- **Usage Patterns**: Frequent, occasional, and non-users of mobile banking.

A sample size of approximately 500 respondents will be selected to ensure statistical significance.

Data Analysis

1. **Quantitative Analysis**:

   Data from the surveys will be analyzed using **descriptive statistics** to summarize customer profiles and usage patterns. **Inferential statistical techniques** such as **Chi-square tests**, **t-tests**, and **regression analysis** will be used to identify relationships between adoption factors (like security, ease of use, trust) and mobile banking usage.

2. **Qualitative Analysis**:

   The interviews and focus group discussions will be transcribed and analyzed using **thematic analysis**. Key themes such as barriers to adoption, user preferences, and institutional trust will be identified and compared across public and private sector users.

3. **Comparative Analysis**:

   A **comparative analysis** between public and private sector bank customers will be conducted to assess differences in adoption rates, usage satisfaction, and perceived barriers.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The research will be carried out in a structured and systematic manner, following a step-by-step approach to ensure effective execution:

1. **Phase 1: Literature Review and Research Framework (1 month)**
   - Conduct an in-depth review of relevant literature on mobile banking adoption, customer behavior, and comparative studies between public and private sector banks.
   - Develop a conceptual framework for the study based on existing theories such as the Technology Acceptance Model (TAM) and UTAUT.

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2. **Phase 2: Survey and Interview Design (1 month)**
    - Design a structured questionnaire and interview guide based on the identified research objectives and literature review.
    - Pilot test the survey to refine questions and ensure clarity.
3. **Phase 3: Data Collection (2-3 months)**
    - Administer surveys to a representative sample of mobile banking users across Gujarat.
    - Conduct interviews and focus group discussions with a diverse group of bank customers to gather qualitative data.
4. **Phase 4: Data Analysis (2 months)**
    - Analyze quantitative data using statistical tools (e.g., regression, chi-square tests) to identify trends and patterns.
    - Perform thematic analysis of qualitative data from interviews and focus groups to extract key insights.
5. **Phase 5: Report Writing and Recommendations (1 month)**
    - Compile the findings into a detailed report, highlighting key insights, comparisons, and actionable recommendations for banks and policymakers.
    - Submit the final research report to stakeholders and for publication.

This plan ensures a systematic approach, allowing for effective data collection, analysis, and actionable results.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review and Research Framework	May	2025	June	2025
2.	Survey and Interview Design	June	2025	July	2025
3.	Data Collection (Surveys and Interviews)	July	2025	September	2025
4.	Data Analysis and Interpretation	October	2025	November	2025

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5.	Report Writing and Recommendations	December	2025	March	2026

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			100,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			50,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3,000
4.	Stationery and Printing (With justification)			50,000
5.	Any other special requirement			97,000
6.	Overhead (10% of recurring)			50,000
	TOTAL			**3,50,000**

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
	b)			
	c)			
2.	**B. Glassware**			

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	a)			
	b)			
	c)			
3.	**C. Any other consumable items (like wires/ electric items etc)**	100,000		
	a)			
	b)			
4.	**Travel**	50,000		
	a) Purpose 1			
	b) Purpose 2			
5.	**Contingency**	3,000		
6.	**Stationery and printing**	50,000		
	a) Purpose 1			
	b) Purpose 2			
7	**Any other special requirement**	97,000		
8	**Overhead**	50,000		
	Grand Total	3,50,000		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Data-Driven Evaluation of Educational Access and Quality Across Indian States	
2.	**Broad area of proposal**	Computer Science	
3.	**Sub Area of proposal**	Data Science	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Miss Vaishali Vaghela	Teaching Assistant	6353801481
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	05/05/1992	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01/02/2022	
9.	**Whether the PI is registered for Ph.D. on the same topic**	NA	
10.	**If yes then name of university**		

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	NA	NA	NA	NA
ii.	Post Graduation	Computer Science	Saurashtra University	2016	77.11
iii.	Under Graduation	Computer Application	Saurashtra University	2012	70.50
iv.	CSIR/UGG-NET/ SLET/GATE	NA	NA	NA	NA

2.	Have you previously received any Fellowship from any funding agency?	☐YES	✓NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
		NA			

6.	Total Experience	Teaching Experience: (9 Year + 7 Months)
		Research Experience: (1 Year)
7.	No. of Publication (Research articles -	National:

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	UGC Approved only)	International:1
8.	No. of Publication (Book Chapters)	International: 1
	Books Published	NA
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Data-Driven Evaluation of Educational Access and Quality Across Indian States

2. Abstract (Provide a summary of your research proposal in 300 words)

This study presents a data-driven analysis of educational access and quality across Indian states, leveraging publicly available datasets such as the National Sample Survey (NSS), Unified District Information System for Education (UDISE), and National Achievement Survey (NAS). The research examines disparities in enrollment rates, infrastructure availability, and learning outcomes to provide a comprehensive understanding of regional variations in educational development. A multidimensional approach is adopted, combining statistical techniques with machine learning models to identify critical factors influencing educational performance. Key findings reveal significant inter-state disparities, with economic, social, and policy variables playing pivotal roles. The study also highlights successful initiatives from high-performing states that can serve as models for others. This analysis aims to assist policymakers in crafting targeted interventions to ensure equitable and quality education across the country, aligning with the goals of the National Education Policy (NEP) 2020.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Education is the cornerstone of societal progress, serving as a key determinant of economic growth, social mobility, and individual empowerment. In a country as diverse as India, characterized by significant variations in socio-economic, cultural, and geographic landscapes, the equitable provision of quality education is both a challenge and an imperative. Despite numerous policy initiatives aimed at improving educational access and quality, stark disparities persist across states and regions. These disparities necessitate a data-driven approach to understand, evaluate, and address the underlying factors influencing educational outcomes. This project seeks to undertake a comprehensive evaluation of educational access and quality across Indian states, leveraging data analytics to uncover patterns,

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assess disparities, and propose actionable solutions.

The proposed study aims to investigate three core aspects: (1) the extent and nature of disparities in educational access and quality, (2) the socio-economic and systemic factors contributing to these disparities, and (3) the efficacy of existing policies and interventions. By employing advanced statistical techniques and machine learning models, this research will analyze large-scale datasets, including government surveys, academic performance records, and socio-economic indicators, to draw meaningful insights. Furthermore, the study will integrate qualitative data to provide context and depth to quantitative findings, ensuring a holistic understanding of the educational landscape.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The field of data-driven research on educational access and quality in India has progressed significantly, with the development of comprehensive national datasets like UDISE+, NAS, and ASER. These datasets have provided valuable insights into enrollment rates, teacher-student ratios, infrastructure, and regional disparities. However, challenges persist, such as inconsistent data reporting, gaps in coverage in rural and remote areas, and a lack of real-time data, which hinder the ability to conduct timely and accurate analyses. Additionally, much of the research remains limited to descriptive analysis, with less focus on granular, region-specific studies that could provide more actionable insights.

Current research increasingly focuses on regional disparities and socio-economic inequalities in education, highlighting the gaps between different states and communities. While there is a growing body of evidence on the success of initiatives like the Right to Education Act and Samagra Shiksha Abhiyan, the impact on learning outcomes remains inconclusive. Studies point to significant gaps between policy design and implementation, particularly in rural and tribal areas, where educational access is still a challenge. Learning outcomes, despite increased enrollment, remain poor in many regions, emphasizing the need for deeper studies into the factors influencing educational performance beyond enrollment rates.

Recent trends also show a shift toward incorporating technological interventions in education, driven by the COVID-19 pandemic. While there is increasing research into the role of digital platforms and mobile learning tools, the scalability and long-term sustainability of these interventions in low-resource settings remain underexplored. Furthermore, the use of predictive analytics, machine learning, and AI in education is still in its early stages, with limited research on applying these methods to forecast educational trends and inform policy decisions. There is a clear need for more localized, state-specific studies, particularly in states like Gujarat, where unique regional challenges demand tailored solutions.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. **Analyze Disparities in Educational Access and Quality**
   To examine the disparities in educational access and quality across Indian states, focusing on rural-urban, gender, and socio-economic dimensions, using large-scale datasets such as UDISE+ and National Achievement Surveys.
2. **Evaluate the Impact of Socioeconomic Factors**
   To assess the influence of socioeconomic variables, such as household income, parental education, and caste or

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tribal status, on educational access and learning outcomes at the state and district levels.

3. **Identify Infrastructure and Resource Gaps**
   To identify gaps in school infrastructure, teacher availability, and resource allocation and evaluate their correlation with variations in student performance and retention rates.
4. **Develop Predictive Models for Educational Outcomes**
   To employ machine learning and statistical models to predict educational performance and dropout risks, enabling proactive interventions by policymakers.
5. **Assess Policy Effectiveness**
   To critically evaluate the effectiveness of existing education policies and initiatives, such as the Right to Education Act and Samagra Shiksha Abhiyan, in reducing disparities and improving educational quality.
6. **Provide Data-Driven Recommendations**
   To propose actionable, data-driven recommendations for state and central governments to enhance equitable access and quality of education across diverse demographic and geographic contexts.

6. Significance of the proposed study: (300 words)

The proposed study on *Data-Driven Evaluation of Educational Access and Quality Across Indian States* holds significant importance for policy-making, equitable development, and the overall improvement of the education system in India.

1. **Addressing Regional Disparities**
   By systematically analyzing data, the study will highlight regional and socio-economic disparities in access to education and learning outcomes. This can help policymakers design targeted interventions for underprivileged areas and marginalized communities.

2. **Evidence-Based Policy Formulation**
   The study will provide empirical evidence on the effectiveness of existing education policies and programs, guiding more informed decision-making and allocation of resources.

3. **Promoting Equity in Education**
   Identifying and addressing inequities in access and quality can promote inclusive education, ensuring that no child is left behind, irrespective of their socio-economic background, gender, or geographic location.

4. **Enhancing Resource Allocation**
   The findings will enable more efficient utilization of resources by pinpointing infrastructure and teacher shortages, ensuring that investments yield maximum impact.

5. **Advancing Data-Driven Governance**
   Integrating advanced analytics and predictive modeling in policy evaluation can establish a framework for data-driven governance in education, serving as a model for other sectors.

6. **Improving Learning Outcomes**
   The study's insights can directly influence strategies to enhance learning outcomes, reducing dropout rates and improving the overall quality of education, contributing to national development goals.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on *Data-Driven Evaluation of Educational Access and Quality* is highly relevant to Gujarat, a state known for its developmental initiatives but also marked by significant educational challenges.

1. Addressing Regional Disparities
   Gujarat has marked disparities in education across districts, with rural areas and tribal regions like Dang, Narmada, and Tapi facing challenges in access to quality education. The study can identify these gaps and provide targeted insights for improvement.

2. Improving Tribal and Marginalized Communities' Education
   The state has a significant tribal population with lower literacy and enrollment rates compared to non-tribal regions.

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The study will be crucial in designing strategies to enhance educational access and quality for these marginalized communities.

3. Guiding Policy Implementation
With initiatives like Gunotsav and Samagra Shiksha Abhiyan in place, Gujarat has shown commitment to improving education. The proposed study will critically evaluate the effectiveness of these programs, offering data-driven recommendations for better outcomes.

4. Enhancing Learning Outcomes
Learning outcomes in Gujarat have been a concern, as indicated by National Achievement Surveys. The study's focus on predictive models can assist in identifying at-risk students and districts, allowing timely interventions.

5. Optimizing Resource Allocation
By analyzing infrastructure, teacher-student ratios, and resource gaps, the study will guide more equitable and effective distribution of resources across the state.

6. Supporting Gujarat's Development Goals
As Gujarat aspires to lead in socio-economic development, improving education is vital for creating a skilled workforce. The study will align with the state's goals by providing actionable insights to strengthen its education system.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research project on *Data-Driven Evaluation of Educational Access and Quality Across Indian States*, with a focus on Gujarat, is anticipated to yield numerous benefits for society, particularly within the state.

1. Enhanced Educational Equity
By identifying disparities in access and quality, the research will help address the educational needs of marginalized groups, including tribal communities, girls, and economically weaker sections. This will promote social inclusion and equity in Gujarat's education system.

2. Improved Learning Outcomes
Findings from the study will enable the design of targeted interventions to enhance learning outcomes, reduce dropout rates, and improve foundational skills among students across the state.

3. Better Resource Allocation
Data-driven insights will guide more effective allocation of resources such as school infrastructure, teaching staff, and digital tools, ensuring that under-resourced areas receive adequate support.

4. Strengthening Local Economies
A more educated workforce contributes to local economic development. By improving education quality, the research will support Gujarat's industrial and entrepreneurial growth, aligning with its socio-economic aspirations.

5. Informed Policy Design

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The study will provide policymakers with evidence-based recommendations for refining and implementing educational policies and programs like Gunotsav and Samagra Shiksha, ensuring maximum impact at the grassroots level.

6. Empowering Communities
   Improved education access and quality will empower communities, fostering greater civic participation, reduced socio-economic inequalities, and long-term societal well-being.

7. Long-Term Development Goals
   By contributing to Sustainable Development Goal (SDG) 4—quality education—the research will support Gujarat's broader goals of sustainable and inclusive development.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	✓
8.	Imparting corporate responsibility, ethics, accountability and values in society	✓
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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The methodology for the *Data-Driven Evaluation of Educational Access and Quality Across Indian States*, with a focus on Gujarat, will involve a mixed-methods approach, combining quantitative data analysis with qualitative insights to provide a comprehensive evaluation. The following steps outline the methodology:

1. **Data Collection**
    - **Primary Data**: Surveys and interviews with key stakeholders (students, teachers, parents, and policymakers) in selected districts of Gujarat to capture firsthand insights on educational access, challenges, and quality.
    - **Secondary Data**: Utilize large-scale datasets such as UDISE+, National Achievement Surveys (NAS), Annual Status of Education Report (ASER), and state-specific educational reports. These datasets will provide information on enrollment rates, dropout rates, teacher-student ratios, learning outcomes, and infrastructure quality.
    - **Geospatial Data**: Incorporate GIS-based data to analyze geographical and regional variations in educational access, focusing on rural, tribal, and urban areas.
2. **Data Cleaning and Preprocessing**
    - Standardize datasets from multiple sources to ensure consistency.
    - Handle missing data and outliers, using imputation techniques where appropriate.
    - Normalize data for regional comparisons (e.g., urban vs. rural, tribal vs. non-tribal).
3. **Quantitative Analysis**
    - **Descriptive Statistics**: Conduct descriptive analysis to identify trends in educational access, enrollment, quality of learning, and resources across different districts in Gujarat.
    - **Correlation Analysis**: Examine the relationship between socioeconomic factors (e.g., income, parental education, caste, gender) and educational outcomes (enrollment, dropout rates, academic performance).
    - **Regression Models**: Use multivariate regression analysis to assess the impact of infrastructure, teacher availability, and policy interventions on learning outcomes.
    - **Predictive Modeling**: Develop machine learning models (e.g., decision trees, random forests) to predict factors that contribute to student dropouts, low

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performance, and educational inequality.

4. **Qualitative Analysis**
   - **Interviews and Focus Groups**: Conduct semi-structured interviews with education stakeholders in Gujarat to capture the local context, challenges, and perceptions of educational quality.
   - **Thematic Analysis**: Analyze qualitative data from interviews and focus groups to identify recurring themes regarding barriers to education, including cultural, socio-economic, and infrastructural issues.
5. **Geospatial Analysis**
   - **Mapping and Spatial Visualization**: Use GIS tools to map the geographic distribution of educational resources, student outcomes, and socio-economic factors across Gujarat, identifying underserved regions or districts with lower educational outcomes.
   - **Hotspot Identification**: Identify areas with high educational deprivation that require targeted interventions.
6. **Policy Evaluation**
   - Assess the impact of state-level educational policies like Gunotsav, Samagra Shiksha, and the Right to Education Act on educational access and quality through a combination of regression analysis and policy review.
7. **Validation and Robustness Check**
   - Cross-validate findings by comparing results from multiple data sources (e.g., UDISE+, ASER, local surveys).
   - Perform sensitivity analysis to check the robustness of the predictive models and findings.
8. **Reporting and Visualization**
   - Present the findings through visualizations (charts, graphs, maps) to clearly communicate disparities, patterns, and areas requiring attention.
   - Provide actionable recommendations based on data insights, tailored for policymakers in Gujarat to address specific educational challenges.

This multi-faceted methodology ensures that the study provides a thorough, data-backed evaluation of educational access and quality, with particular relevance to the state of Gujarat.

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11. Suggested plan of action: Define the suggested plan of action in 200 words)

The plan of action for the *Data-Driven Evaluation of Educational Access and Quality Across Indian States*, particularly for Gujarat, will be structured into several phases, spanning data collection, analysis, and reporting. Below is a detailed step-by-step action plan:

Phase 1: Literature Review and Framework Development

Literature Review and Framework Development and Data Collection Plan

Phase 2: Data Collection and Cleaning

Secondary Data Collection and Primary Data Collection and Data Cleaning and Preprocessing

Phase 3: Data Analysis

Descriptive and Exploratory Data Analysis (EDA) , Quantitative Analysis, Qualitative Analysis, Geospatial Analysis

Phase 4: Policy Evaluation and Recommendations

Policy Impact Evaluation, Actionable Recommendations,

Phase 5: Reporting and Dissemination

Final Report Preparation, Policy Briefing, Academic Publications and Conferences

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	**Phase 1**	June	2023	July	2024
2.	**Phase 2**	August	2024	June	2025
3.	**Phase 3**	July	2025	June	2026
4.	**Phase 4**	July	2026	June	2027
5.	**Phase 5**	July	2027	July	2028

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			

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1.	Consumables a. Computer Software & Hardware	NA	2 or as per Requirement	1,81,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	9500	2	19,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3000
4.	Stationery and Printing (With justification)	100	60	6000
5.	Any other special requirement	150	40	6000
6.	Overhead (10% of recurring)			15000
	TOTAL			**2,30,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
	b)			
	c)			
2.	**B. Glassware**			
	a)			
	b)			
	c)			
3.	**C. Any other consumable items (like wires/ electric items etc)**			
	a)			
	b)			
4.	**Travel**	No. of Times in a month		
	a) Purpose 1	Workshop/Seminar/Conferences (Rs 1,00,000)	5 years	
	b) Purpose 2			

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5.	**Contingency**	**As per Consolidated budget**		
6.	**Stationery and printing**			
	a) Purpose 1	As per requirement	5 years	
	b) Purpose 2	As per requirement		
	Grand Total	2,30,000		

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Application for Research Project

Part -A

(General Information)

1.	**Title of the proposal**	Optimization of Microbial Pigment Production from Kitchen Waste	
2.	**Broad area of proposal**	Life Science	
3.	**Sub Area of proposal**	Industrial microbiology	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Vivek B. Pattani	Assistant Professor, Department of Microbiology	vivek.pattani@atmiyauni.ac.in 9408774627
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
		N.A.	
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**	09/09/1988	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01/01/2022	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No.	
10.	**If yes then name of university**	N.A.	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
	i. Ph. D.	Microbiology	Marwadi University, Rajkot	pursuing	--
	ii. Post Graduation	Microbiology	NIMS University, Jaipur	2010	69.75
	iii. Under Graduation	Microbiology	Sardar Patel University, Vallabh Vidhyanagar	2008	48.5
	iv. CSIR/UGG-NET/ SLET/GATE	ASRB-NET	ICAR	2021	Qualified

2.	**Have you previously received any Fellowship from any funding agency?**		☐**NO**
3.	**If yes, please indicate whether it was a (√ tick appropriate)**	☐**Short-term fellowship (*viz* Project fellow, Project assistant, etc.)**	
		☐ **pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)**	
		☐ **post-doctoral fellowship (*viz* D S Kothari PDF, or any other)**	
4.	**If yes, mention the details of fellowship and tenure**	N.A.	

5.	**Details of on-going and completed research funded projects (if any)**				
	S.N.	**Title**	**Project Cost**	**Sponsoring Agency**	**Duration (Start – End – MM/YYYY)**

		Teaching Experience: (9 Year + 1 Months)

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6.	Total Experience	Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 2
		International: 4
8.	No. of Publication (Book Chapters)	
	Books Published	13
(Please enclose the list of papers and books published and/or accepted during last five years)		

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Optimization of Microbial Pigment Production from Kitchen Waste

2. Abstract (Provide a summary of your research proposal in 300 words)

The optimization of microbial pigment production from kitchen waste offers a sustainable solution for both waste management and the generation of valuable bio-based products. This research aims to identify suitable microbial strains capable of producing pigments using kitchen waste as a substrate, and to optimize fermentation conditions for maximum pigment yield. Kitchen waste, rich in organic matter, presents an underutilized resource for microbial growth and metabolite production. Through the use of bacterial strains such as, this study will explore the potential of kitchen waste to serve as a cost-effective feedstock for pigment production. Key factors such as pH, temperature, and substrate concentration will be optimized to enhance production efficiency. The research also aims to evaluate the quality, stability, and economic feasibility of the pigments under varying conditions. Expected outcomes include the development of an eco-friendly, low-cost process for microbial pigment production, contributing to both sustainable waste management and the reduction of industrial dependence on synthetic dyes. The project's findings could have broad applications across industries such as food, textiles, cosmetics, and pharmaceuticals, offering a greener alternative to traditional colorants while advancing circular economy principles.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Microbial pigments have gained significant attention due to their natural origin, biocompatibility, and wide applications in food, pharmaceuticals, cosmetics, and textiles. However, the production costs are often high, largely due to expensive raw materials and complex downstream processing. Utilizing kitchen waste as a substrate for microbial pigment production offers a dual advantage: reducing production costs and contributing to waste valorization. This approach aligns with the principles of the circular economy and sustainable development.

The current status of bacterial pigment production reflects a growing interest in sustainable alternatives to synthetic colorants, driven by environmental and health concerns. Bacterial pigments, derived from various strains, are being explored for their potential applications

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across multiple industries, including food, textiles, and pharmaceuticals. However, challenges remain in scaling production to meet industrial demands.

Advantages of Bacterial Pigments

Natural and Safe: Bacterial pigments are non-toxic and often possess additional health benefits, such as antibacterial and antioxidant properties.

Diverse Sources: Various bacteria, including Flavobacterium, Serratia, and Chromobacterium, produce a range of pigments suitable for different applications.

Biotechnological Potential: Bacterial pigments can be utilized in food, cosmetics, and pharmaceuticals, offering a renewable resource compared to synthetic alternatives.

Challenges in Production

Scalability Issues: Current production methods are insufficient to meet industrial needs, necessitating advancements in genetic engineering and bioprocess optimization.

Economic Viability: Utilizing low-cost substrates and improving strain performance are critical for enhancing the commercial viability of bacterial pigments.

Despite the promising attributes of bacterial pigments, the transition from research to widespread industrial application remains a significant hurdle, highlighting the need for continued innovation in production techniques.

Optimizing microbial pigment production from kitchen waste aligns with multiple United Nations Sustainable Development Goals (SDGs), offering a sustainable solution to food waste management and resource recovery. By converting kitchen waste into valuable pigments, this process supports SDG 12 (Responsible Consumption and Production) by reducing food waste and promoting recycling. It also contributes to SDG 13 (Climate Action) by lowering the carbon footprint of both food waste and dye production. The innovation in microbial fermentation supports SDG 9 (Industry, Innovation, and Infrastructure), driving cleaner, more sustainable industrial practices. Additionally, microbial pigments provide eco-friendly alternatives to synthetic dyes, contributing to SDG 3 (Good Health and Well-being) by reducing harmful chemical exposure. This approach also creates new economic opportunities, supporting SDG 8 (Decent Work and Economic Growth) through the development of green industries. Ultimately, microbial pigment production from kitchen waste helps advance a circular economy, supporting environmental sustainability, economic growth, and better public health outcomes.

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4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Microbial pigments such as carotenoids, melanin, prodigiosin, and violacein are produced by various bacteria, fungi, and algae. Substrates like agricultural residues and food waste have been explored for their cost-effectiveness. Kitchen waste, being rich in organic matter, is an underutilized resource for microbial growth and metabolite production. Studies suggest that organisms like *Monascus purpureus, Serratia marcescens*, and *Rhodotorula glutinis* can utilize such waste efficiently. Bacterial pigment production is an active area of research with significant potential for various industrial applications. Pigments from bacteria are gaining demand in food, leather, textile, cosmetic, and pharmaceutical industries due to their natural origin and bioactive functions (Ramesh et al., 2022). These pigments offer unique advantages such as sustainability, short production cycles, and low sensitivity to seasonal changes (Celedón & Díaz, 2021). Recent studies have identified a diverse range of pigment-producing bacteria from various sources, including soil, water, and marine environments (Choksi et al., 2020). Similarly, marine bacterial symbionts associated with soft coral have been found to produce carotenoid pigments with antioxidant activity (Kusmita et al., 2017). The current status of bacterial pigment production involves optimizing growth conditions, exploring novel sources, and investigating potential applications. Researchers are focusing on using inexpensive and eco-friendly agro-industrial residues for mass production of microbial pigments through submerged fermentation(Ramesh et al., 2022). Additionally, the unique properties of bacterial pigments, such as their ability to protect against environmental stress conditions and their role in pathogenesis, are being studied for various applications (Pavan et al., 2020). However, challenges remain in terms of pigment stability, color changes due to pH variations, low yields, and high production costs (Silva et al., 2021). Despite these challenges, the diverse properties and potential applications of bacterial pigments continue to drive research and development in this field.

Bacterial pigment production from kitchen waste presents an innovative approach to waste management and sustainable resource utilization. Kitchen waste, being rich in nutrients, serves as an excellent substrate for microbial growth and pigment production (Zeba et al., 2020). This process not only addresses the issue of waste disposal but also creates valuable products with diverse applications. Several studies have demonstrated the potential of using kitchen waste for bacterial pigment production. For instance, Wang et al. (2023) describes the isolation of 104 strains from kitchen waste, with 12 dominant strains showing high degradability and potential for pigment production. The compound microbial agent "YH" developed from these strains showed significant efficacy in waste reduction and

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deodorization during composting. Similarly, Xu and Chen (2020) and (Xie et al., 2023) highlight the importance of bacterial communities in the composting process, which can be leveraged for pigment production. Bacterial pigments produced from kitchen waste offer numerous advantages over synthetic alternatives. They are non-toxic, biodegradable, and non-carcinogenic, making them suitable for use in various industries, including pharmaceuticals, textiles, cosmetics, and food (Agarwal et al., 2023; Numan et al., 2018). These pigments also possess therapeutic properties, such as antimicrobial, anticancer, and antioxidant activities (Numan et al., 2018). The growing demand for natural pigments in various industries further underscores the potential of bacterial pigment production from kitchen waste (Chatragadda & Dufossé, 2021).

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To identify suitable microbial strains capable of producing pigments using kitchen waste.
2. Study the properties of the kitchen waste to use as media.
3. To optimize the growth conditions (pH, temperature, substrate concentration, etc.) for maximum pigment production.
4. To evaluate the quality and stability of pigments under different conditions.
5. To assess the economic feasibility and environmental impact of the process.

6. Significance of the proposed study: (300 words)

Bacterial pigment production from kitchen waste presents a promising solution for sustainable waste management and resource recovery. By transforming food waste into valuable bio-based pigments, this process not only helps address global food waste issues but also creates eco-friendly alternatives to synthetic dyes across multiple industries, including food, pharmaceuticals, cosmetics, and textiles. Ongoing research and development could lead to the discovery of novel pigments with unique properties, further enhancing the potential of this approach. With advancements in biotechnology and process optimization, microbial pigment production from kitchen waste could become a mainstream practice, promoting environmental sustainability, reducing industrial waste, and contributing to a more circular economy. This innovative approach offers both environmental and economic benefits, opening new markets and opportunities for the production of sustainable, bio-based products.

1. Environmental Impact: Mitigating food waste by converting it into value-added products.
2. Industrial Benefits: Lowering costs for industries relying on natural pigments.
3. Economic Value: Enhancing the profitability of microbial pigment production.
4. Sustainability: Promoting renewable and green alternatives in industrial applications.

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7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on the optimization of microbial pigment production from kitchen waste holds significant relevance to Gujarat, a state with a strong agricultural base, rapidly growing industrial sectors, and a rich cultural heritage where color plays an important role in various traditional and industrial applications. Gujarat generates substantial amounts of organic waste, particularly from households and food processing industries. By harnessing this waste for microbial pigment production, the study can help in addressing the growing waste disposal challenges while simultaneously contributing to the state's sustainability goals.

The successful application of this research could reduce the environmental burden associated with waste disposal, particularly the accumulation of organic waste in landfills and open dumpsites, which can lead to pollution and health risks. Furthermore, the production of natural pigments could boost local industries such as food processing, textiles, cosmetics, and pharmaceuticals, which have a large presence in Gujarat. Natural pigments offer a safer, eco-friendly alternative to synthetic dyes, aligning with global trends towards sustainability.

Additionally, the study can create opportunities for local innovation, supporting Gujarat's vision of fostering a circular economy and promoting environmentally friendly technologies. The research can also enhance Gujarat's position as a hub for sustainable biotechnology development, creating new avenues for employment and economic growth.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research on the optimization of microbial pigment production from kitchen waste can yield several significant societal benefits, particularly for the state of Gujarat. These benefits would be both environmental and economic, contributing to sustainable development and enhanced public welfare:

1. Waste Management and Environmental Benefits:

Reduction in Organic Waste: Kitchen waste, if not properly managed, leads to significant environmental issues, such as landfill overflow and methane emissions. The proposed research would offer an innovative solution by converting this waste into valuable resources, thus reducing the environmental burden of waste disposal.

Reduction in Pollution: The improper disposal of organic waste often leads to soil and water pollution. The proposed project would contribute to better waste segregation and utilization, minimizing pollution and its adverse effects on ecosystems in Gujarat.

Conservation of Natural Resources: By producing microbial pigments from waste, the study

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reduces the need for synthetic dyes, many of which are toxic and polluting. This would help preserve natural resources and reduce dependency on harmful chemical alternatives.

2. Economic Benefits:

Creation of Green Jobs: The research could lead to the development of new industries focused on microbial pigment production, creating employment opportunities in waste management, biotechnology, and pigment production sectors. This aligns with Gujarat's goals of fostering a circular economy.

Support for Local Industries: Gujarat is a major hub for textiles, food processing, and cosmetics. Natural microbial pigments could provide sustainable alternatives to synthetic dyes, benefiting industries such as textiles and food processing that have a strong presence in the state.

Boost to Biotechnology Sector: The project could also lead to advancements in the state's biotechnology sector, positioning Gujarat as a leader in sustainable biotechnology practices.

3. Health and Safety:

Safer Alternatives to Synthetic Dyes: Microbial pigments are natural and non-toxic, making them safer for use in food, pharmaceuticals, and cosmetics. The shift towards natural pigments could enhance public health, especially in industries where synthetic chemicals pose risks to human well-being.

Promoting Healthy Diets: The use of microbial pigments in food products can provide safe, natural coloring agents, promoting healthier and more environmentally-friendly food options.

4. Social and Cultural Benefits:

Cultural Relevance: In Gujarat, colors play an important role in traditional practices, festivals, and crafts. By producing pigments locally, the study could enhance the cultural vibrancy of the region while supporting local artisans and manufacturers of colored products.

Public Awareness and Engagement: This research has the potential to raise awareness about sustainable practices among the general public. It could encourage communities to view waste as a resource, fostering greater environmental responsibility and sustainability at the grassroots level.

In conclusion, the findings of this proposed research could have far-reaching societal benefits, particularly for Gujarat, by improving waste management, driving economic growth, fostering sustainable industries, and promoting health and environmental well-being.

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9. The proposal can be broadly classified into any of the below mentioned focus areas:
(Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	✓
2.	Agriculture	✓
3.	Health and wellness	✓
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	✓
9.	Social entrepreneurship	☐
10.	Others (if any)	

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10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Sr. no.	Objective	approaches
1	To identify suitable microbial strains capable of producing pigments using kitchen waste.	Screening based on different Samples.
2	Study the properties of the kitchen waste to use as media.	Study Chemical Properties of the Kitchen waste.
3	To optimize the growth conditions (pH, temperature, substrate concentration, etc.) for maximum pigment production.	Use of Statistical strategies with experimental design.
4	To evaluate the quality and stability of pigments under different conditions.	Study at pilot scale.
5	To assess the economic feasibility and environmental impact of the process.	Analysis of the data and report.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

1. Collection and Preparation of Kitchen Waste
- Collect kitchen waste from residential and commercial sources.
- Segregate biodegradable components (e.g., fruit peels, vegetable scraps).
- Pre-treat the waste by shredding, drying, and sterilizing for uniform substrate preparation.

2. Microbial Screening and Selection
- Screen pigment-producing microorganisms.
- Test their growth and pigment production efficiency on prepared kitchen waste.

3. Optimization of Fermentation Parameters
- Use statistical approaches to optimize parameters such as: pH, Temperature & Substrate.

4. Pigment Extraction and Analysis
- Extract pigments using suitable solvents.
- Analyze pigment yield and quality.

. Scale-up and Economic Feasibility
- Perform scale-up studies in Pilot bioreactor.
- Evaluate production costs, waste reduction, and overall sustainability.

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review	August	2022	October	2022
2	Microbial Screening	November	2022	March	2023
3.	Substrate Preparation and Optimization	April	2023	November	2023
4.	Extraction and Analysis	December	2023	April	2024
5.	Scale-up and Feasibility Studies	May	2024	December	2024
6.	Report Writing and Documentation	January	2025	May	2025

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13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	RateperUnit	No. of Unit Required	TotalAmount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electricitems d. Otheritems(specify)	Asper 13.b.1 13.b.2		288000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	3000	4	12000
3.	Contingency (Upto maximum for Rs. 3000/-)			3000
4.	Stationery and Printing (With justification)			2000
5.	Any others pecial requirement	Outsourcing for nutritive value & Identification of the bacteria.		55000
6.	Overhead(10%of recurring)			40000
	TOTAL			**400000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount(Rs)	Timeline	Justification
1	**A. Chemicals**			
	Media & Chemicals	155000		For growth
2	**B. Glassware**	133000		For media preparation and extraction, For solvent extraction, Growth of microbes, Extraction and quantification
3	**C. Any other consumable items(like wires/ electric items etc)**			
	a)			
	b)			

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4	**Travel**	No. of Times in a month		
		12000		Sample Collection & Sample analysis
				Writing, sample preparation and sample transportation
5	**Contingency**	3000		
6	**Stationery and printing**	2000		Report and Documentation
	a)Purpose1			
	b)Purpose2			
7	Any other special requirement	55000		Genomic and analytical services
	Overhead	40000		
	Grand Total	**400000***		

* Subject to variation

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Application form

Part -A

(General Information)

1.	Title of the proposal	Aqua Smart: Efficient Drip Irrigation for Sustainable Farming	
2.	Broad area of proposal	Engineering	
3.	Sub Area of proposal	Sustainable Farming	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Mr. Vivek Solanki	Assistant Professor, Civil Engineering	vivek.solanki@atmiyauni.ac.in, 9106955032, 1107
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Mr. Shaileshsinh R. Jadeja-	Assistant Professor, Civil Engineering	shaileshsinh.jadeja@atmiyauni.ac.in, 9898804243, 1107
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	15/12/1994	
8.	Date of joining the Department of PI (DD/MM/YYYY)	01/04/2022	
9.	Whether the PI is registered for Ph.D. on the same topic	N.A.	
10.	If yes then name of university	-	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	-	-	-
ii.	Post Graduation	Water Resource Management	The Maharaja Sayajirao University of Baroda	2018	72.50
iii.	Under Graduation	Civil Engineering	Gujarat Technological University	2016	56.80
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	YES	☐ NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐short-term fellowship (viz Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	-	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (2Year + 8 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 0
		International: 0
8.	No. of Publication (Book Chapters)	0

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	Books Published	0
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Aqua Smart: Efficient Drip Irrigation for Sustainable Farming

2. Abstract (Provide a summary of your research proposal in 300 words)

The proposed research, "Aqua Smart: Efficient Drip Irrigation for Sustainable Farming," aims to revolutionize water management in agriculture by developing a cutting-edge, efficient drip irrigation system tailored to enhance sustainable farming practices. As climate change and population growth put increasing pressure on water resources, improving water use efficiency in agriculture is critical. Drip irrigation, a method that delivers water directly to plant roots, offers a potential solution to reduce water wastage, increase crop yield, and conserve resources.

This project seeks to design and implement an advanced drip irrigation system that leverages smart technology. Through the integration of sensors, IoT (Internet of Things), and AI (artificial intelligence), Aqua Smart will monitor soil moisture, weather conditions, and crop requirements in real-time. The system will automatically adjust water flow and distribution based on these data inputs, ensuring optimal water usage and minimizing excess. This intelligent system will be coupled with a mobile application for farmers, providing easy-to-use tools for monitoring and adjusting irrigation remotely.

Additionally, Aqua Smart will focus on sustainability by using eco-friendly materials for the drip lines and designing a low-energy consumption model. The system will be tested in diverse agricultural settings, from smallholder farms to larger commercial operations, with a focus on water-scarce regions.

By combining technological innovation with environmental sustainability, Aqua Smart aims to improve agricultural productivity, reduce water waste, and contribute to long-term food security. This project will demonstrate how smart irrigation technologies can drive the transition to sustainable farming practices, supporting both ecological health and agricultural profitability.

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The "Aqua Smart: Efficient Drip Irrigation for Sustainable Farming" project will follow a comprehensive research approach consisting of several key activities designed to optimize drip irrigation systems for improved water efficiency, crop yield, and sustainable farming practices. The specific research activities to be undertaken during the project are as follows:

1. **Development of Smart Irrigation System Design**

-Objective**: Design a smart drip irrigation system that integrates sensors, IoT devices, and AI-based control mechanisms.

- Activities**:

- **Sensor Integration**: Incorporate soil moisture sensors, temperature sensors, and weather forecasting devices to monitor environmental conditions in real time.

- **IoT and AI Integration**: Develop an IoT platform capable of collecting sensor data and feeding it to an AI algorithm that adjusts the irrigation schedule and water distribution based on weather patterns, soil conditions, and crop type.

- **Prototype Design**: Create an initial working prototype for testing in controlled environments, such as greenhouses and controlled field plots.

2. **Field Trials and Testing**

- **Objective**: Test the prototype in different agricultural settings to evaluate its performance, adaptability, and potential impact on water savings and crop yields.

- **Activities**:

- **Pilot Farm Selection**: Partner with smallholder farms and commercial agricultural operations in regions with water scarcity issues to test the system in diverse environments.

- **Test Variables**: Conduct controlled trials by adjusting parameters like soil types, crop types, and irrigation schedules.

- **Data Collection**: Collect data on water usage, soil moisture levels, crop growth, and yield. Analyze these data to determine the system's efficiency and effectiveness in different conditions.

- **Performance Assessment**: Measure the water savings, crop yield improvements, and sustainability of farming practices in each trial.

3. **Optimization of Drip Irrigation Components**

- **Objective**: Improve the efficiency of individual components of the drip irrigation system, such as drip emitters, hoses, and distribution networks.

- **Activities**:

- **Material Testing**: Test different eco-friendly materials for drip hoses and emitters to identify the most durable, cost-effective, and environmentally sustainable options.

- **Flow Rate Optimization**: Analyze how varying drip emitter flow rates impact water usage and crop yield in

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different soil and crop types.

- **Pressure Regulation**: Develop techniques to maintain consistent water pressure throughout the irrigation system to ensure uniform water distribution.

4. **Development of the Mobile Application for Farmers**

- **Objective**: Create a user-friendly mobile application to allow farmers to monitor and control the smart irrigation system remotely.

- **Activities**:

- **App Design and Development**: Collaborate with software developers to design a simple, intuitive app that displays real-time data on soil moisture, weather forecasts, and irrigation status.

- **App Features**: Include features such as alerts for watering schedules, system health checks, weather-based irrigation adjustments, and maintenance reminders.

- **Farmer Training**: Provide training for farmers on how to use the app to make informed decisions regarding irrigation and water management.

Importance of the Proposed Study

The **Aqua Smart: Efficient Drip Irrigation for Sustainable Farming** project addresses one of the most pressing challenges in modern agriculture: water scarcity. With an increasing global population and the intensifying effects of climate change, the demand for food production is rising, while fresh water resources are becoming increasingly scarce. Agriculture accounts for approximately 70% of global freshwater use, and inefficient irrigation practices contribute significantly to water waste, reducing the sustainability of farming systems.

The research proposed in this project is of paramount importance for several key reasons:

1. **Water Conservation**

The innovative smart irrigation system developed by Aqua Smart will enable farmers to reduce water waste significantly. Traditional irrigation methods often lead to over-irrigation or uneven water distribution, causing water runoff or inadequate hydration. By using real-time data from sensors and AI algorithms, Aqua Smart ensures that crops receive the precise amount of water they need at the right time, optimizing water usage and reducing waste. This is particularly critical in water-scarce regions where every drop of water matters.

2. **Enhanced Agricultural Productivity**

Efficient irrigation systems directly correlate with improved crop yields. By ensuring that crops receive optimal water, Aqua Smart helps farmers maintain healthy plant growth, even in dry periods or regions with inconsistent rainfall. The system's ability to monitor soil moisture levels and adjust irrigation schedules dynamically enhances crop resilience, leading to higher productivity, fewer crop failures, and more stable harvests. This contributes to global food security by ensuring that crops thrive despite climate challenges.

3. **Sustainability and Environmental Benefits**

Aqua Smart promotes sustainable agricultural practices by reducing the environmental footprint of farming. The system minimizes water usage, lowers energy consumption, and reduces soil erosion caused by excessive irrigation. Additionally, by using eco-friendly materials for the irrigation infrastructure and reducing reliance on unsustainable water sources, Aqua Smart supports the long-term health of the ecosystem and encourages more responsible resource management.

4. **Economic Viability for Farmers**

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One of the key barriers to adopting new agricultural technologies is the financial cost. Aqua Smart's design prioritizes cost-effectiveness, using affordable components and ensuring that the system pays for itself through water savings and improved crop yields. Furthermore, the system's ability to optimize irrigation schedules means that farmers will spend less on energy and labor, making it a viable option for both smallholder farmers and large commercial operations. The mobile app further reduces the learning curve, enabling farmers to manage the system efficiently without requiring advanced technical knowledge.

In conclusion, the Aqua Smart project is poised to revolutionize the way water is managed in agriculture. It aligns with global goals of water conservation, food security, and sustainable farming practices. By combining technology with environmental stewardship, Aqua Smart offers a solution that benefits not only farmers but also the planet as a whole.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The current research in the field of drip irrigation, especially in the context of smart and efficient systems, has made significant strides but still faces challenges in terms of scalability, affordability, and integration with emerging technologies. Traditional drip irrigation systems have been widely adopted, particularly in regions facing water scarcity, due to their ability to minimize water waste and enhance crop yields. However, these systems often lack real-time adaptability and are limited by manual or static control methods.

Recent advancements in sensor technology, IoT, and AI have spurred the development of "smart" irrigation systems that offer more precise water management. These systems can monitor soil moisture, weather forecasts, and crop needs, adjusting irrigation schedules dynamically to optimize water usage. However, most of the current research remains focused on specific regional contexts, and the integration of these technologies is still in its early stages.

While promising prototypes exist, large-scale, cost-effective deployment remains a challenge. Many farmers, particularly smallholders, are reluctant to invest in such high-tech systems due to upfront costs and the need for technical expertise. Furthermore, research on the environmental sustainability of these systems, including their long-term impact on soil health and water cycles, is still limited.

The Aqua Smart project seeks to address these gaps by designing a more affordable, scalable, and user-friendly smart drip irrigation system, ensuring it is adaptable to various agricultural contexts.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. **Design and Develop a Smart Drip Irrigation System**: To create an advanced drip irrigation system that integrates IoT sensors, real-time weather data, and AI algorithms to optimize water use based on soil moisture, weather conditions, and crop requirements.

2. **Enhance Water Use Efficiency**: To significantly reduce water wastage by enabling the irrigation system to deliver precise amounts of water directly to plant roots, thus improving water conservation and addressing water scarcity in agricultural regions.

3. **Improve Agricultural Productivity**: To assess the impact of the smart drip irrigation system on crop yield and health, ensuring that crops receive the optimal amount of water for growth, particularly in regions facing unpredictable rainfall and drought.

4. **Ensure Cost-Effectiveness and Scalability**: To develop a cost-effective irrigation solution that is affordable for both smallholder and commercial farmers, with a focus on scalability for diverse agricultural settings and ease of adoption across different regions.

5. **Promote Sustainability in Agriculture**: To evaluate the environmental benefits of the Aqua Smart system, including reduced energy consumption, minimized water runoff, and enhanced soil health, thereby supporting sustainable farming practices.

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6. **Develop a User-Friendly Mobile Application for Farmers**: To create an intuitive mobile platform that allows farmers to monitor, control, and adjust the smart irrigation system remotely, providing them with real-time data and alerts for efficient water management.

6. Significance of the proposed study: (300 words)

The proposed study is of significant importance due to its potential to address the critical challenges facing modern agriculture—particularly water scarcity, climate change, and the need for sustainable farming practices. Agriculture accounts for around 70% of global freshwater use, with conventional irrigation methods often leading to water wastage, inefficiency, and environmental degradation. By developing a smart drip irrigation system, Aqua Smart aims to optimize water use, ensuring crops receive only the precise amount of water they need, which is essential in areas where water is a limited resource.

The integration of Internet of Things (IoT) sensors and artificial intelligence (AI) will enable real-time monitoring of soil moisture, weather conditions, and crop needs, allowing for dynamic adjustments to the irrigation system. This precision reduces water waste and increases crop productivity by ensuring consistent and adequate watering, especially in regions prone to drought or erratic rainfall patterns. This technology-driven approach can help farmers adapt to the impacts of climate change, improving resilience to shifting weather conditions.

Additionally, the Aqua Smart system will support sustainable farming practices by minimizing water usage, lowering energy consumption, and reducing soil erosion, thus promoting environmental conservation. The system is designed to be cost-effective and scalable, making it accessible for both smallholder and large commercial farmers, enhancing agricultural productivity without compromising the environment.

Through its integration of cutting-edge technology and a focus on water conservation, the proposed study has the potential to transform irrigation practices worldwide, improve food security, and contribute to long-term sustainability in agriculture. By making farming more resource-efficient, Aqua Smart will empower farmers to achieve higher yields, reduce costs, and protect vital water resources for future generations.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study, is highly relevant to Gujarat, a region that faces significant water scarcity and agricultural challenges. Gujarat is one of India's most important agricultural states, but its farmers often struggle with irregular rainfall, prolonged dry spells, and over-reliance on traditional irrigation methods, such as flood irrigation, which leads to inefficient water use and soil degradation.

The adoption of smart drip irrigation systems in Gujarat can drastically improve water use efficiency, which is crucial in this water-scarce state. By leveraging advanced technologies such as IoT sensors and AI, Aqua Smart will enable farmers to optimize irrigation schedules based on real-time soil moisture levels and weather forecasts, ensuring that water is used precisely where and when it's needed. This is particularly important in Gujarat, which faces periods of drought, and where groundwater levels have been depleting rapidly.

Additionally, the state has a significant proportion of smallholder farmers who could benefit from cost-effective, easy-to-use irrigation systems. Aqua Smart's affordability, scalability, and mobile interface will empower these farmers to make informed decisions, boost crop yields, and improve overall farm productivity.

In essence, the study's focus on sustainable irrigation aligns perfectly with Gujarat's agricultural needs and can support the state's efforts toward water conservation, climate resilience, and enhancing agricultural sustainability.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The expected findings of the proposed research project, **"Aqua Smart: Efficient Drip Irrigation for Sustainable Farming,"** have the potential to deliver substantial societal benefits, particularly for the state of Gujarat, which faces water scarcity and agricultural challenges. The project's impact can be realized in several key areas:

1. **Water Conservation**: Gujarat is a water-stressed state, with irrigation accounting for a significant portion of

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water usage. The Aqua Smart system, by optimizing water delivery through advanced drip irrigation, will reduce water wastage and ensure that water is used efficiently. This can help mitigate the pressure on both surface and groundwater resources, which are increasingly depleted due to overuse.

2. **Increased Agricultural Productivity**: By providing precise irrigation tailored to the needs of crops, Aqua Smart can improve crop yields in Gujarat. This is especially important in regions where crop failure due to drought or improper irrigation is common. With increased productivity, farmers can generate higher incomes, contributing to poverty alleviation and economic stability in rural communities.

3. **Climate Resilience**: Gujarat faces unpredictable rainfall patterns and frequent droughts. The smart irrigation system will help farmers adapt to these changing climate conditions by ensuring that crops receive adequate water even in dry spells. This adaptability will enhance the resilience of the agricultural sector, reducing vulnerability to climate-related risks.

In conclusion, the expected findings of the Aqua Smart project can have far-reaching benefits, not only improving agricultural sustainability but also supporting Gujarat's broader efforts toward economic development, water conservation, and climate resilience.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	✓
2.	Agriculture	✓
3.	Health and wellness	✓
4.	Nutrition	✓
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

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10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The **Aqua Smart** project will undertake a series of structured research activities aimed at optimizing water use, enhancing crop productivity, and promoting sustainability in agriculture through a smart drip irrigation system. The specific activities to be pursued include:

1. **System Design and Prototype Development**:

- Develop and integrate IoT sensors (for soil moisture, weather conditions) and AI algorithms (for real-time irrigation scheduling).

- Design a user-friendly mobile application to enable remote control of the irrigation system by farmers.

- Create and test a prototype of the smart drip irrigation system.

2. **Field Trials and Pilot Testing**:

- Select diverse pilot farm sites across Gujarat to test the prototype under varying soil types, crop varieties, and climatic conditions.

- Install the system and monitor its performance in terms of water use efficiency, crop yield, and system reliability.

3. **Optimization and Refinement**:

- Optimize the water delivery system based on trial results, adjusting flow rates, pressure regulation, and system materials.

- Use data from field trials to refine AI models for better predictive irrigation adjustments.

Hypothesis, Sampling Plan, Data Collection, and Data Analysis

Hypothesis:

The core hypothesis of the Aqua Smart project is that the integration of smart technologies (IoT sensors, AI, and mobile applications) into drip irrigation systems will result in significant water savings, increased crop yields, and enhanced sustainability compared to traditional irrigation methods.

Sampling Plan:

The sampling plan will focus on selecting representative farms from different regions of Gujarat, considering factors such as:

- **Farm size**: Including smallholder and commercial farms.

- **Soil type**: Selecting farms with different soil textures (loamy, sandy, clay).

- **Crop types**: Including staple crops such as wheat, cotton, and vegetables.

- **Climate zones**: Ensuring a diverse representation across various climatic conditions in Gujarat.

At least 10 pilot farms will be selected for testing, with additional farms as controls using traditional irrigation methods for comparison. Farms will be selected based on farmer interest, water availability, and existing irrigation practices.

Data Collection:

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- **Water usage data**: Monitoring water consumption through the smart system's sensors and comparing it to conventional irrigation methods.

- **Crop yield data**: Tracking the growth, health, and final yield of crops on the test farms, using both qualitative observations (visual inspections) and quantitative measures (weight and size of harvested crops).

- **Soil moisture levels**: Real-time data on soil moisture from installed sensors at various soil depths.

Data Analysis:

- **Comparative Analysis**: Compare water usage and crop yield data between the smart irrigation system and traditional methods using statistical tests (e.g., t-tests or ANOVA) to determine the significance of differences.

- **Correlation Analysis**: Analyze the relationship between soil moisture levels, irrigation schedules, and crop productivity to refine the AI model and improve irrigation efficiency.

This comprehensive approach will allow for robust conclusions regarding the efficacy, scalability, and sustainability of the Aqua Smart system, ultimately contributing to the development of a technology-driven solution for water-efficient, sustainable farming.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

As per above description

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Initial Research, Design, and Planning	July	2022	December	2022
2.	Concept Design and Prototyping	January	2023	December	2023
3.	Field Trials and Evaluation	January	2024	December	2024
4.	Scaling and Commercialization	January	2025	December	2025
5.	Market Launch and Implementation	January	2026	December	2026
6.	Evaluation, Maintenance, and Expansion	January	2027	April	2027
7.	Publication	May	2027	June	2027

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13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Project Planning & Initial Research	-	-	Rs. 50,000/-
2.	Design & Prototyping	-	-	Rs. 1,25,000/-
3.	Testing & Field Trials	-	-	Rs. 1,00,000/-
4.	System Refinement & Iteration	-	-	Rs. 50,000/-
5.	Marketing & Commercialization	-	-	Rs. 75,000/-
6.	Production Scaling & Distribution	-	-	Rs. 50,000/-
7.	Post-Deployment Monitoring & Maintenance	-	-	Rs. 50,000/-
	TOTAL	-	-	Rs. 5,00,000/-

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from July 2022 to June 2027):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	A. Initial Research and Planning			
	Market Research	Rs. 15000/-	July – August 2022	
	Feasibility Study and System Design Requirements	Rs. 20000/-	September – October 2022	
	Project Management & Administrative Costs	Rs. 15000/-	November – December 2022	
2.	B. Design and Prototyping			
	System Architecture and Design	Rs. 40000/-	January – March	

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			2023	
	Prototyping Materials & Components	Rs. 50000/-	April – August 2023	
	Software Development for Automation and Control	Rs. 35000/-	September – December 2023	
3.	C. Testing & Field Trials			
	Field Trial Setup & Equipment	Rs. 50000/-	January – June 2024	
	Data Collection and Analysis	Rs. 30000/-	July – September 2024	
	Laboratory & Controlled Testing Costs	Rs. 20000/-	October – December 2024	
4.	System Refinement & Iteration			
	Product Enhancements & Revisions	Rs. 30000/-	January – March 2025	
	Testing of Revised Prototype	Rs. 20000/-	April – December 2025	
5.	Marketing & Commercialization			
	Marketing & Outreach Campaigns	Rs. 40000/-	January – March 2026	
	Sales Materials & Promotion	Rs. 20000/-	April – June 2026	
	Customer Education & Training Programs	Rs. 15000/-	April – June 2026	
6.	Production Scaling & Distribution			
	Mass Production Costs	Rs. 30000/-	January – March 2027	

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	Distribution & Logistics	Rs. 15000/-	April – June 2027	
	Conference Participation	Rs. 5000/-	April – June 2027	
7.	Post-Deployment Monitoring & Maintenance	Rs. 50000/-	January 2026 – June 2027	
	Grand Total	Rs.5,00,000/-		

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Research Proposal Planning
June - 2022

1.	Title of the proposal	Leveraging blockchain for trust in IoT in Healthcare	
2.	Name of Principle Investigator	Yesha J. Gandhi	
3.	Designation & Department	Designation	Assistant Professor
		Faculty	FoET
		Department	Diploma Computer Engineering
4.	Contact details (e-mail, mobile number, Ext. no.)	Mobile Number (WhatsApp Number)	9428602666
		Email	Yesha.gandhi@atmiyauni.ac.in
		Departmental Extension number	1436

Application form

Part -A

(General Information)

1.	Title of the proposal	Leveraging blockchain for trust in IoT in Healthcare
2.	Broad area of proposal	Blockchain
3.	Sub Area of proposal	Healthcare
4.	Details of Principal Investigator (PI)	

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	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Yesha J. Gandhi	Assistant Professor, Computer Engineering, Faculty of Engineering and Technology	9428602666
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Bhumika S. Zalavadia	Assistant Professor, Computer Engineering, Faculty of Engineering and Technology	9099063203
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	29/05/1999	
8.	Date of joining the Department of PI (DD/MM/YYYY)	15/02/2022	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	NA	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.				
ii.	Post Graduation	Information Security	Gujarat Technological University	2022	90%
iii.	Under Graduation	Computer Engineering	Gujarat Technological University	2020	87%

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iv.	CSIR/UGG-NET/ SLET/GATE				
2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☐ NO		
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐ short-term fellowship (viz Project fellow, Project assistant, etc.)			
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)			
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)			
4.	If yes, mention the details of fellowship and tenure	-			
5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-
	-	-	-	-	-
6.	Total Experience	Teaching Experience: (2 Year + 1 Months)			
		Research Experience: (.....Year + ... Months)			
7.	No. of Publication (Research articles - UGC Approved only)	National: 0			
		International: 2			
8.	No. of Publication (Book Chapters)	-			
	Books Published	-			
(Please enclose the list of papers and books published and/or accepted during last five years)					

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

The integration of Internet of Things (IoT) technologies into healthcare systems has revolutionized patient care, enabling real-time monitoring, remote diagnosis, and personalized treatment. However, IoT devices often face significant challenges related to security, privacy, and data integrity, which are crucial in the sensitive healthcare domain. Blockchain technology, known for its decentralized and immutable nature, offers a promising solution to address these concerns. By leveraging blockchain, healthcare IoT systems can establish trust among various stakeholders, including patients, healthcare providers, and device manufacturers.

Blockchain's ability to provide secure, transparent, and auditable records for IoT interactions can enhance data integrity and ensure that patient data is tamper-proof. Additionally, blockchain can facilitate decentralized access control, enabling patients to have greater control over their personal health data. This approach mitigates risks associated with centralized data storage, such as data breaches and unauthorized access. Furthermore, smart contracts can automate and enforce privacy regulations, ensuring compliance with healthcare standards like HIPAA or GDPR.

This research explores how blockchain can be implemented within healthcare IoT ecosystems to improve trust, security, and overall system reliability, with the ultimate goal of fostering a more secure and efficient healthcare environment.

2. Abstract (Provide a summary of your research proposal in 300 words)

The integration of Internet of Things (IoT) devices into healthcare systems has the potential to significantly enhance patient care by enabling real-time health monitoring, remote diagnostics, and personalized treatment. However, the widespread adoption of IoT in healthcare is hindered by security and privacy concerns, as these devices often handle sensitive medical data that can be vulnerable to cyberattacks, unauthorized access, and data manipulation. This paper explores the application of blockchain technology to address these challenges and enhance trust in healthcare IoT systems.

Blockchain, with its decentralized and immutable structure, offers a robust solution for securing IoT data in healthcare environments. By utilizing blockchain's distributed ledger system, healthcare IoT networks can ensure data integrity, transparency, and accountability. Blockchain can enable secure, auditable data exchange between IoT devices, healthcare providers, and patients, mitigating the risks associated with centralized data storage and reducing the likelihood of data breaches. Additionally, blockchain's use of cryptographic techniques ensures the privacy and confidentiality of sensitive health information, giving patients greater control over their data.

This research examines how blockchain can be leveraged to establish trust within healthcare IoT ecosystems by offering secure access control mechanisms, automated compliance via smart contracts, and enhanced traceability of medical data. The study also explores the potential benefits of integrating blockchain with existing healthcare systems, such as improved patient outcomes, reduced healthcare costs, and more efficient data management. Challenges, such as

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scalability and regulatory concerns, are discussed, along with potential solutions. Overall, this paper highlights the transformative potential of blockchain technology in fostering a secure, transparent, and trustworthy healthcare IoT environment, paving the way for the broader adoption of IoT in healthcare settings.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The healthcare sector is undergoing a significant transformation with the increasing adoption of Internet of Things (IoT) devices. These devices, such as wearable health trackers, smart medical devices, and remote monitoring tools, are enabling real-time data collection and enhanced patient care. The ability to monitor patients continuously and remotely has the potential to improve health outcomes, reduce healthcare costs, and enhance the overall quality of life for patients. However, despite these benefits, the widespread use of IoT in healthcare also introduces a range of challenges related to security, privacy, and data integrity, which must be addressed to ensure the system's efficacy and reliability.

IoT devices in healthcare generate vast amounts of data, from heart rate measurements to blood sugar levels, which are essential for diagnosing and monitoring patient health. These devices often communicate across interconnected networks, making the data vulnerable to a variety of cybersecurity threats, including unauthorized access, data breaches, and even data manipulation. In this context, traditional security solutions—such as centralized databases and access control mechanisms—are increasingly seen as insufficient to meet the needs of the evolving healthcare IoT landscape. The inherent vulnerabilities associated with centralized data storage models, where sensitive health data is stored on a single server or database, make it a prime target for cyberattacks. Moreover, healthcare organizations and patients alike are concerned about how their sensitive health information is accessed and shared, especially given the rise in data breaches and the financial and reputational consequences they can incur.

Blockchain technology, initially popularized by its application in cryptocurrency networks like Bitcoin, has emerged as a potential solution to many of these challenges. Blockchain is a distributed ledger technology that enables secure, transparent, and tamper-proof data storage and transfer. In a blockchain system, data is stored across a decentralized network of computers, known as nodes, in the form of blocks linked together in a chain. Each block contains a timestamp, a record of the data, and a cryptographic hash of the previous block, ensuring that data once recorded cannot be altered without altering the entire chain—a process that is computationally infeasible. This immutable nature, combined with the decentralization of control, offers a promising framework for addressing the key issues of data integrity, privacy, and trust in healthcare IoT applications.

In the healthcare IoT domain, blockchain has the potential to create an ecosystem where patient data is securely shared and accessed by authorized parties without relying on a central authority. This would enable patients to have greater control over their personal health data, potentially reducing the risks of unauthorized access and cyberattacks. Furthermore, blockchain could improve transparency in healthcare transactions by providing auditable records of who accessed patient data, when it was accessed, and for what purpose. This level of accountability is particularly important in healthcare, where sensitive data must be handled in compliance with privacy regulations such as the Health Insurance Portability and Accountability Act (HIPAA) in the United States or the General Data Protection Regulation (GDPR) in the European Union.

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Moreover, blockchain can enhance security by offering decentralized access control mechanisms. In a traditional healthcare system, access to sensitive data is often managed by a central authority, such as a hospital or a health insurer. This centralization of control can create single points of failure and increase the risk of data breaches. Blockchain, on the other hand, distributes data access across a network of nodes, allowing patients to manage who can access their data via private keys. In this way, patients themselves can grant and revoke access to their health data, empowering them with control over their own information while reducing the potential for unauthorized access.

In addition to security and privacy enhancements, blockchain's ability to support smart contracts offers a powerful tool for automating and ensuring compliance with healthcare regulations. Smart contracts are self-executing contracts with the terms of the agreement directly written into code. These contracts are executed automatically when predefined conditions are met, eliminating the need for intermediaries and reducing administrative overhead. In healthcare, smart contracts could automate the enforcement of privacy and security policies, ensuring that sensitive patient data is only shared in accordance with legal and ethical standards. For example, a smart contract could automatically ensure that a healthcare provider complies with HIPAA guidelines when accessing patient data, providing an auditable trail of compliance.

Despite its potential benefits, the integration of blockchain into healthcare IoT systems is not without challenges. One of the key hurdles is scalability. The decentralized nature of blockchain means that every transaction is verified by multiple nodes in the network, which can lead to slower transaction speeds and increased computational costs as the network grows. For healthcare IoT systems, where real-time data processing and low-latency communication are often critical, ensuring that blockchain solutions are both scalable and efficient is a significant concern. Solutions such as off-chain storage, where data is stored off the blockchain but its integrity is ensured through blockchain verification, and layer-two protocols, which facilitate faster and more scalable blockchain transactions, are being explored to address these scalability challenges.

Another challenge is the regulatory landscape. The use of blockchain in healthcare must comply with a complex web of privacy regulations and standards, which vary by jurisdiction. While blockchain's transparency and immutability may align with regulatory goals such as auditability and data integrity, ensuring that blockchain-based systems comply with data protection laws like HIPAA or GDPR is a non-trivial task. Developing industry-wide standards and frameworks for blockchain implementation in healthcare will be essential for its successful integration into existing healthcare infrastructures.

In conclusion, blockchain technology holds significant promise for improving trust, security, and data integrity in healthcare IoT systems. By decentralizing data storage and access, enhancing patient privacy, and providing transparent and auditable records, blockchain can address many of the key challenges faced by healthcare organizations and patients in the era of IoT. However, technical and regulatory challenges remain, and further research is needed to fully realize the potential of blockchain in healthcare. This paper will explore these challenges and propose solutions for effectively integrating blockchain into healthcare IoT ecosystems, ultimately aiming to create a more secure, transparent, and patient-centric healthcare.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

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Current research on leveraging blockchain for trust in Internet of Things (IoT) systems in healthcare is rapidly growing, focusing on enhancing security, privacy, and data integrity. Several studies have explored blockchain's potential to decentralize data storage, addressing the vulnerabilities of traditional, centralized healthcare systems. Research is particularly focused on developing blockchain frameworks that can securely manage sensitive health data generated by IoT devices, ensuring that data remains immutable and tamper-proof. Key studies highlight the ability of blockchain to enable patients to have greater control over their data through decentralized access and private key mechanisms.

A growing body of work also investigates the integration of smart contracts to automate data-sharing protocols and ensure compliance with healthcare regulations like HIPAA and GDPR. Furthermore, blockchain's ability to provide auditable records of data access is seen as a solution to the transparency challenges in healthcare IoT ecosystems.

Despite these advancements, challenges such as scalability, real-time transaction speeds, and the energy consumption of blockchain networks remain critical areas of focus. Researchers are actively exploring hybrid models that combine blockchain with off-chain storage and Layer-2 solutions to improve performance. Additionally, regulatory and legal concerns, including the alignment of blockchain with existing healthcare standards, are also being addressed in ongoing studies, suggesting a promising but still evolving field of research.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Investigate how blockchain can enhance security and privacy in healthcare IoT systems.
2. Develop frameworks that enable decentralized data management for healthcare applications.
3. Explore the integration of smart contracts for automating compliance with healthcare regulations.
4. Address scalability and performance challenges in blockchain for healthcare IoT.
5. Evaluate the impact of blockchain on patient control over data access and sharing.
6. Analyze the legal and regulatory implications of blockchain adoption in healthcare IoT ecosystems.

6. Significance of the proposed study: (300 words)

The significance of this proposed study lies in its potential to revolutionize the security, privacy, and trustworthiness of healthcare IoT systems through the integration of blockchain technology. As healthcare systems increasingly rely on IoT devices for real-time monitoring, diagnostics, and patient management, the volume of sensitive data generated grows exponentially, raising critical concerns about data privacy, integrity, and security. Centralized data storage models in traditional healthcare systems are vulnerable to cyberattacks, data breaches, and unauthorized access, creating substantial risks for patients and healthcare providers alike. Blockchain, with its decentralized, immutable, and transparent nature, offers a robust solution to these challenges.

By implementing blockchain in healthcare IoT ecosystems, this study aims to enhance data integrity, ensuring that health information transmitted by IoT devices is tamper-proof and auditable. This would significantly reduce the risk of data manipulation, enhancing the reliability of medical decisions based on this data. Additionally, the study focuses on empowering patients by giving them greater control over who can access their personal health

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information, offering a more secure and privacy-respecting model of healthcare data management.

The use of smart contracts in this research will further streamline healthcare processes by automating compliance with regulations such as HIPAA and GDPR, reducing administrative overhead and ensuring consistent, lawful data usage. This study is also significant because it addresses key scalability issues inherent in blockchain technology, making it viable for large-scale healthcare systems.

Ultimately, the findings from this study could guide the broader adoption of blockchain in healthcare IoT applications, leading to a more secure, efficient, and patient-centric healthcare ecosystem. The insights gained will contribute to both technological advancements and the formulation of regulatory standards for blockchain-based healthcare solutions.

7. Relevance of the proposed study to Gujarat: (200 words)

The relevance of this proposed study to Gujarat lies in the state's growing focus on digital healthcare transformation and the increasing adoption of IoT technologies in healthcare. Gujarat has made significant strides in improving its healthcare infrastructure, with initiatives aimed at digitizing medical records, enhancing telemedicine services, and expanding the use of IoT devices for remote patient monitoring. However, as with many other regions, the rapid adoption of these technologies also brings challenges related to data security, patient privacy, and regulatory compliance, which the study aims to address through blockchain integration.

By exploring how blockchain can enhance the security and trustworthiness of healthcare IoT systems, this study aligns with Gujarat's goal of creating a more robust and patient-centric healthcare ecosystem. The state has also taken initiatives like the "e-Health Project," which could benefit from blockchain's ability to ensure data integrity and prevent unauthorized access, making it an ideal environment for the study's findings.

Furthermore, Gujarat's healthcare sector, which serves a large and diverse population, could greatly benefit from blockchain's ability to provide transparent, auditable, and decentralized data management, reducing the risks associated with data breaches and improving patient care. The study will contribute valuable insights into the practical implementation of blockchain in healthcare IoT, supporting the state's vision for a secure, efficient, and technologically advanced healthcare system.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The expected benefits of the proposed research on leveraging blockchain for trust in healthcare IoT systems will have significant societal implications, particularly for the state of Gujarat. As Gujarat continues to expand its digital healthcare infrastructure, integrating blockchain technology into healthcare IoT systems can enhance the overall security, privacy, and efficiency of patient care. The findings of this study will directly benefit various stakeholders, including patients, healthcare providers, and policymakers.

For patients, the integration of blockchain in healthcare IoT will empower them with greater control over their personal health data, enabling secure, transparent access and sharing of

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information. This can significantly reduce concerns about data breaches and unauthorized access, fostering trust in digital healthcare systems. In a state like Gujarat, with a large and diverse population, ensuring data security and patient privacy is critical to fostering public confidence in the healthcare system.

Healthcare providers will benefit from more secure, interoperable data management systems that reduce the administrative burden associated with ensuring regulatory compliance. The use of blockchain's immutable and auditable features can simplify tracking and reporting, reducing the risk of errors and fraud in patient records, and improving overall care quality. Additionally, smart contracts could automate compliance with healthcare regulations, streamlining processes and reducing costs for healthcare facilities.

At a broader societal level, the findings could contribute to the state's vision of becoming a leader in technological innovation. By enabling secure, decentralized healthcare data systems, Gujarat could set an example for other regions in India and beyond, demonstrating how blockchain can drive efficiency, reduce healthcare fraud, and ensure better patient outcomes. Furthermore, the integration of blockchain in healthcare IoT aligns with Gujarat's push for digital transformation and its goal of building a robust, transparent, and patient-centric healthcare ecosystem.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	✓
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐

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10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Methodology

The methodology for this proposed study will be structured around a combination of theoretical analysis, system design, experimental implementation, and case study evaluations. The goal is to explore the integration of blockchain technology into healthcare IoT ecosystems to enhance security, privacy, and trust. The methodology will be organized into four main stages: literature review, system development, experimental setup, and evaluation.

1. Literature Review

The study will begin with an extensive literature review to analyze existing research on blockchain technology, healthcare IoT systems, and their intersection. This will include:

- A review of blockchain's theoretical foundations and its applications in various industries, particularly healthcare.
- An analysis of current security, privacy, and data integrity challenges in healthcare IoT systems.
- Examination of smart contract implementations in healthcare for automating regulatory compliance and improving transparency.
- Identification of existing blockchain frameworks and platforms that are being tested or used in healthcare IoT, with a particular focus on case studies from similar regions or contexts.

2. System Development

The next phase involves the design and development of a prototype blockchain-based framework tailored to healthcare IoT systems. This system will be designed to:

- Decentralize Data Management: Develop a blockchain-based system where patient data from IoT devices (e.g., wearable health monitors, sensors) is securely stored, processed, and shared between authorized parties without central control.
- Implement Access Control: Utilize blockchain's private key/public key mechanism to give patients control over their health data, enabling them to authorize access for healthcare providers.
- Incorporate Smart Contracts: Integrate smart contracts to automate the enforcement of healthcare regulations (e.g., HIPAA or GDPR) ensuring that health data is accessed and used according to predefined legal and ethical standards.
- Ensure Interoperability: The system will be designed to ensure interoperability with existing healthcare IoT platforms and legacy healthcare systems.

3. Experimental Setup

The system will then be implemented in a controlled experimental environment. The setup will consist of:

- IoT Devices: A range of simulated or actual healthcare IoT devices will be integrated to collect real-time patient data, such as heart rate, blood sugar levels, or ECG readings.

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- Blockchain Platform: A suitable blockchain platform, such as Ethereum or Hyperledger, will be selected for system implementation, ensuring scalability, privacy, and performance.
- Smart Contract Execution: Smart contracts will be designed and executed on the blockchain to automate patient consent and data-sharing protocols in compliance with healthcare standards.
- Security Testing: Various cybersecurity tests will be conducted to assess the robustness of the system against data manipulation, unauthorized access, and potential attacks.

4. Evaluation and Case Study Analysis

Once the prototype is deployed, a comprehensive evaluation process will be conducted, which will include:

- Performance Metrics: Evaluate the system's efficiency in terms of transaction speed, scalability, and data processing. Metrics such as transaction throughput, latency, and system load will be analyzed.
- Security Assessment: Assess the effectiveness of blockchain in mitigating security risks such as data breaches, unauthorized access, and data corruption. Penetration testing and vulnerability analysis will be conducted.
- User Experience: Feedback from healthcare professionals and patients (if feasible in a real-world or simulated environment) will be collected to understand the usability and acceptance of the blockchain-based IoT system.
- Regulatory Compliance: The framework's ability to comply with healthcare regulations will be evaluated, ensuring it meets standards such as HIPAA and GDPR.

Additionally, a case study evaluation will be conducted focusing on Gujarat's existing healthcare infrastructure. The study will assess how the proposed blockchain framework can be integrated into the state's digital healthcare initiatives, such as e-health platforms and telemedicine services.

Data Analysis

The results from the experiments and case studies will be analyzed using qualitative and quantitative methods. For quantitative analysis, performance data such as transaction times, security breach incidents, and data access logs will be analyzed to assess system performance. Qualitative analysis will focus on feedback from users regarding ease of use, trust in the system, and perceived benefits and challenges. The findings will be synthesized to identify the potential benefits, limitations, and areas for future improvement of blockchain in healthcare IoT systems.

Through this methodological approach, the research will not only provide insights into the practical application of blockchain in healthcare IoT but will also contribute to the development of a scalable, secure, and patient-centered healthcare ecosystem, particularly for regions like Gujarat.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The suggested plan of action for this proposed research will follow a structured, phased approach to ensure comprehensive investigation and effective outcomes.

Phase 1: Literature Review and Requirement Analysis (1–2 Months)

- Conduct an extensive review of existing literature on blockchain in healthcare, IoT security challenges, and regulatory standards (e.g., HIPAA, GDPR).

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- Identify gaps in current research, particularly regarding blockchain's application in healthcare IoT, focusing on security, privacy, and data integrity.
- Define key requirements for the proposed blockchain framework based on insights from the literature.

Phase 2: System Design and Framework Development (3–4 Months)

- Develop a conceptual model for a blockchain-based IoT healthcare system, focusing on decentralized data management, patient-controlled access, and regulatory compliance via smart contracts.
- Select appropriate blockchain platforms (e.g., Ethereum, Hyperledger) for prototype development.
- Design the system architecture, ensuring it is scalable and interoperable with existing healthcare IoT systems.

Phase 3: Prototype Implementation and Testing (3–4 Months)

- Implement the blockchain-based framework and integrate IoT devices (real-time health monitoring tools).
- Conduct initial testing for security vulnerabilities, system performance, and data integrity.
- Implement smart contracts for automating healthcare regulatory compliance.

Phase 4: Evaluation and Case Study Analysis (2–3 Months)

- Evaluate system performance using metrics such as transaction throughput, security robustness, and user feedback.
- Conduct a case study focused on Gujarat's healthcare ecosystem to assess the practical feasibility of integrating blockchain technology.

Phase 5: Final Report and Recommendations (1 Month)

- Compile research findings, conclusions, and policy recommendations for blockchain adoption in Gujarat's healthcare IoT systems.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review and Requirement Analysis	June	2022	December	2022
2.	System Design and Framework Development	January	2023	June	2023
3.	Prototype Implementation and Testing	July	2023	June	2024
4.	Evaluation and Case Study Analysis	July	2024	December	2024

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5.	Final Report and Recommendations	January	2025	June	2025

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	-	-	150000
2.	Travelling (viz. sample collection, should be Minimum and with justification)	-	-	10000
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	3000
4.	Stationery and Printing (With justification)	-	-	10000
5.	Any other special requirement	-	-	47000
6.	Overhead (10% of recurring)	-	-	-
	TOTAL	-	-	2,20,000/-

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	A. Subscription	-	-	140000
2.	Travel	No. of Times in a month	-	
	a) Conference	-	3 Days	50000
	b) Paper Publication	2	-	20000
3.	Stationery and printing	-	-	-
	a) Purpose 1	-	-	5000
	b) Purpose 2	-	-	5000
	Grand Total	-	-	2,20,000/-

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Application for Research Project

Part -A

(General Information)

1.	Title of the proposal	Gomayamrut for Sasyavivardhan: Bioremediation of xenobiotics (azodyes) by using cow dung	
2.	Broad area of proposal	Life Science	
3.	Sub Area of proposal	Environmental Microbiology	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Dr Abhijeet Joshi	Assistant Professor, Department of Microbiology	9423138178
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
6.	Whether the proposal is transdisciplinary?	Yes	
7.	Date of Birth of PI (DD/MM/YYYY)	01/02/1985	
8.	Date of joining the Department of PI (DD/MM/YYYY)	01st April 2020	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	NA	

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Microbiology	Swami Ramanand Teerth Marathwada University, Nanded(MS)	2020	Microbiology
ii.	Post Graduation	Microbiology	Swami Ramanand Teerth Marathwada University, Nanded(MS)	2007	56.83
iii.	Under Graduation	Microbiology	Swami Ramanand Teerth Marathwada University, Nanded(MS)	2005	63.33
iv.	CSIR/UGG-NET/ SLET/GATE	ASRB-NET	ICAR	2016	63

2.	Have you previously received any Fellowship from any funding agency?		☐NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐short-term fellowship (vizProject fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (vizCSIR/UGC JRF or any other)	
		☐post-doctoral fellowship (vizD S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (16Year+8Months)
		Research Experience: (02 Year + 08 Months)

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7.	No. of Publication (Research articles - UGC Approved only)	National: 03
		International: 03
8.	No. of Publication (Book Chapters)	03
	Books Published	-
(Please enclose the list of papers and books published and/or accepted during last five years)		

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Part -C
PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Gomayamrut for Sasyavivardhan: Bioremediation of xenobiotics (azodyes) by using cow dung

2. Abstract (Provide a summary of your research proposal in 300 words)

In vedic scriptures cow was called as "Mata" not only of her use in various sectors but for its potential to fulfill the demand/s of human being for both forms of life. Her name Kamdhenu "matrah sarvabhutanam, gavahsarvsukhprada"is a symbol of worship for all human beings. In indian subcontinent, cow had been used for milk production, agricultural practices and for treatment of some disorders. (Randhawa and Sharma, 2015)

But industrialization and production of xenobiotics raise a problem over its use and disposal. The direct introduction of such xenobiotics in nature, now a days alters the food chain and web of an ecology niche. So here an attempt was carried out to degrade one of the prominent and complex xenobiotic from contaminated site.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The development of efficient techniques for remediating wastewater polluted with dyes is a critical environmental issue. Textile companies and other industrial operations often release synthetic dyes into agricultural fields, resulting in soil and water contamination. These dyes can cause significant harm to the ecological environment and human health, obstructing sunlight frompenetrating water bodies, hindering photosynthesis in aquatic organisms, and accumulating in the human body through the food chain. This accumulation can result in cancer, genetic mutations, and birth defects. An effective method to tackle this problem is the use of microbial biodegradation. Various groups of microorganisms, including white-rot fungus and anaerobic bacterial consortia, have shown the capacity to remove color and break down different kinds of dyes. Pure bacterial strains are often unable to fully degrade colors and produce carcinogenic aromatic amines as intermediate products that need to be further broken down. Microbial consortia, on the other hand, have shown improved degradation capabilities due to thesynergisticinteractionsamongthemicrobialpopulationinthebreakdownofsyntheticdyes.

The objective of the "A Culture Dependent and Independent Approach to Screen Potential Dye Degraders fromContaminatedAgriculturalSites" project isto investigatebothculture-

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dependent and culture-independent techniques for identifying and characterizing microorganisms that can efficiently break down dyes in polluted agricultural areas. The utilization of both culture- dependent and culture-independent methods is crucial because relying solely on culture- dependent techniques mayresult inthe exclusionofa significant number of microorganisms that are difficult to cultivate in a laboratory setting. Culture-independent techniques, such as metagenomic analysis, offer a more comprehensive insight into microbialcommunities and their metabolic capacities. The study aims to methodically assess the effectiveness of isolated microbialcommunities andthe knowledge obtained frommetagenomics in eliminating color and nitrogen from synthetic dye wastewater. Additionally, the study will investigate the breakdown route and intermediate products of degradation, as well as evaluate the toxicity of the dyes and their biotransformed compounds to guarantee the safety and effectiveness of the bioremediation method. The project seeks to combine culture-dependent and culture-independent approaches to reveal the various metabolic abilities of microbial communities in polluted agricultural areas, aiming to create strong, efficient, and eco-friendly methods for treating wastewater containing dyes.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The Bhadar River in Gujarat state is known for its high pollution levels and modest per capita income. An evaluation of the river's seasonal influence was conducted from December 2018 to January 2020, revealing elevated levels of pollutants present. The presence of a significant amount of phenolic compounds, ammonium ions, and heavy metals emphasises the need for immediate bioremediation. The source ofthis information is GEMI, inthe year 2021. Additional investigation of the pollution of the Bhadar river in Gujarat indicates that the industrialoperations in the Jetpur and Gondal areas are significant factors in the elevated amounts of pollutants found in the river. The main contributors of phenolic compounds, ammonium, and heavy metals in the river are the wastewater discharged by textile dyeing and printingenterprises, as well as chemical and metal-based production facilities.

Furthermore, research has shown that the close proximityofthese businesses to the Bhadar river has resulted in substantial environmental deterioration, impacting not only the water quality but also the surrounding ecosystem and nearby residents. The imperative need for bioremediation solutions to alleviate the pollution and reinstate the biological equilibrium

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of the river isapparent.

Resolving the pollution of the Bhadar river requires a comprehensive strategy that involves collaboration among government authorities, environmental organisations, local residents, and the companies accountable for the contamination. It is crucial to enforce strict regulations, encourage sustainable industrial practices, and work together on effective ways to fix problemsin order to safeguard the health of the river and the well-being of the people and animals who rely on it. (GEMI, 2021)

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Screening of potent microbes by using metagenomic approach.
2. Isolation of potent organisms and consortia development.
3. Check out enhancement in azo-dye degradation by the developed consortia.

6. Significance of the proposed study: (300 words)

The bioremediation programme implemented in the Bhadar River in Jetpur, Gujarat, has the potential to greatly enhance the water quality and restore the ecological equilibrium of the river by harnessing biological processes. The programme relies on the use of certain microbes to decompose pollutants, phytoremediation to absorb toxins, and bioaugmentation to introduce advantageous bacteria. This method as greatly enhanced the overall ecological well-being of the river.The microorganisms used in this study have a plant growth promoting activity which will further be useful for the restoration of agricultural land.

7. Relevance of the proposed study to Gujarat: (200 words)

The bioremediation programme implemented in the Bhadar River in Jetpur, Gujarat, has the potential to greatly enhance the water quality and restore the ecological equilibrium of the river by harnessing biological processes. The programme relies on the use of certain microbes to decompose pollutants, phytoremediation to absorb toxins, and bioaugmentation to introduce advantageous bacteria. This method as greatly enhanced the overall ecological well-being of the river. The programme also has the ability to promote community engagement and awareness, resulting in the adoption of sustainable practices and responsible waste management. The microorganisms used in this study have a plant growth promoting activity which will further be useful for the restoration of agricultural land.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

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Gujrat has a varied geography that offers significant agricultural and commercial opportunities. Gujarat cultivates a wide range of economically significant crops owing to its diversified agricultural terrain and favourable climatic conditions. The increase in groundnut output is expected to enhance the Gross Domestic Product (GDP). In the Kharif season, Gujarat is expected to produce 33.45 lakh metric tonnes (lt) of groundnuts, which is an increase of 11.50 percent compared to the previous year's production of 30 lakh metric tonnes. The Solvent Extractors' Association of India (SEA) recently performed the Groundnut Kharif Crop Survey 2023, revealing a decline of 74,000 hectares (4.33 percent) in Gujarat's groundnut crop.

Gujrat is a prolific producer of a wide range of agricultural and industrial goods. The textile fabric industryis a prominent sector. This facilitated thedevelopment ofenduring textiles likeas patoda and bandhani that are still in use today. Synthetic dyes are more cost-effective thannatural dyes and exhibit greater durability against light, temperature, detergents, and microbial degradation. As a result, textile and dyeing industries favour their use. The textile and other industries rely on around 10,000 synthetic dyes, mostly azo dyes, due to their economic reliability over natural hues. However, these dyes have a detrimental effect on the natural microbiome, which may include useful bacteria for agricultural soil. (9) The structure of these agents provides them with enhanced durability for colouring fabrics. Azo dyes and their breakdown products are resistant to biodegradation due to their complex and xenobiotic nature. Multiple investigations have consistently shown that they possess carcinogenic and mutagenic properties. (15)The presence of industrial waste in rivers and ponds poses a significant risk. The use of irrigation systems presents significant health hazards. Therefore, the over use of textile dye might have detrimental effects on plant variety, microbiology, and human health. There are several techniques available for remedying polluted land and water. Microbes may be used to biologically remediate waste water effluent. Agricultural soil-derived bacteria may be used to remediate waste water effluent. (16) Beneficial microorganisms, known as plant growth-promoting microbes (PGP), have the ability to degrade colours and enhance the fertility of soil, so enabling the treatment of dye-contaminated wastewater while simultaneously improving soil productivity. (17, 18, 19, 20) These versatile bacteria serve the dual aim of safeguarding plants from dye poisoning. Dual-functional isolates has the ability to mitigate textile pollution on agricultural land and simultaneously enhance soil fertility via their plant growth-promoting (PGP) capabilities. (21, 22)

Out-puts of this project is as follows:

1. Isolation and identification of potent microorganisms.
2. Enhancement in azodye degradation

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3. Utilization of non-lactating cow's excretory product in bioremediation and reduction in excretion of methane (CH_4) in atmosphere.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	✓
2.	Agriculture	✓
3.	Health and wellness	✓
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Objective	Time line (In months)
Literature review	02
Sampling of cow dung/Urine of different ages (Gir and Jersy)	04
Isolation of metagenomic DNA	06
Next generation sequencing of samples and identification of functional diversity (Kim et al.,2017)	02
Isolation of potent (dye degrading) cultivable microorganisms and its Consortia preparation	12-15
Azodye degradation and product characterization by analytical methods	12-25
Field application	18-24

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Developing efficient techniques to handle wastewater tainted with dyes is an urgent environmental issue. Textile companies and other industrial operations often release synthetic

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colours into agricultural regions, resulting in contamination of soil and water. The discharge of dye wastewaters may cause significant harm to the ecological environment and human health. These wastewaters can obstruct the penetration of sunlight, hinder the process of photosynthesis, and accumulate in the human body via the food chain. This accumulation can result in the development of cancer, genetic mutations, and birth defects. The present research project seeks to use a dual methodology, integrating culture-dependent and culture-independent techniques, in order to find and characterize possible microorganisms capable of degrading dyes in agricultural locations that have been polluted. Soil and water samples will be gathered from agricultural locations that are recognized to be polluted with artificial colours. The main goal is to examine and assess the efficiency of a combination method that involves both culture-dependent and culture-independent techniques in finding microorganisms that have the ability to break down dye chemicals present in polluted agricultural areas.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Sample collection	June	2022	October	2022
2.	Metagenome sequencing & identification of functional diversity	November	2022	July	2023
3.	Isolation and Screening of Dye Decolorizing Bacteria	August	2023	December	2023
4.	Impact of dyes on plant growth promoting traits of Bacterial communities	January	2024	March	2024
5.	Dye decolorization and characterization of by Analytical techniques– Extraction and analysis	April	2024	December	2024
6.	Stability study of a potent bacterial consortium with reference to plant growth Promotion activity	January	2025	March	2025
7.	Characterization of dye decoloring and PGP bacteria By systematic approach	April	2025	May	2025
8.	Field application	June	2025	June	2027

13. Budget Requirements

a. Consolidated budget: 1556000/-

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S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			1008280
2.	Travelling (viz. sample collection, should be Minimum and with justification)	1500/- visit to Jetpur for collection of samples	04 Seasonal study	6000
3.	Contingency			50000
4.	Stationery and Printing (With justification)			
5.	Any other special requirement	Genomic and analytical services	20	200000
6.	Overhead (10% of recurring)			121728
	NON-RECURRING			169992
	TOTAL			1556000

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount(Rs)	Timeline	Justification
1.	A. Chemicals			
	reactive red 120	8558		Positive control
	Remazol brilliant Blue R	4880		Positive control
	M9 Minimal Medium Salts (5X)	4500 x 4 =18000		Dye degradation study
	Minimal Broth, Davis	5289 x 4 = 21156		Growth of microbes
	Agar agar	5000 x 5 = 25000		Growth of bacteria on agar plates
	Pikovaskaya medium	2000 x 4 = 8000		To detect phosphate solubilizers from soil
	Ashbay's medium	2500 x 4 = 10000		To detect Nitrogen fixers from soil

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	Mannitol Salt agar medium	2500 x 2 =5000		To determine stress physiology of isolates
	QIA seq-Fast Select–5S/16S/23S Kit (24)	$2,773.00*		Metagenome amplification
	Solvents for LCMS analysis	100000		Extraction of degraded dye products
	MacConkeys agar	2500 x 2 =5000		For confirmation of enterobacteriaceae family of isolate
	EMB agar	2500 x 2 =5000		For confirmation of enterobacteriaceae family of isolate
	Yeast Mannitol agar	2500 x 2 =5000		To enrich the sample
	Potato Dextrose Agar	2500 x 2 =5000		To enrich the sample
	Soyabean Casein digest Agar	2500 x 2 =5000		To enrich the sample
	Hi-Media API Kit for microbial detection	12250*20= 245000		Biochemical identification of potent isolate
	Antibiotics – (All Classes)	5000 x 8 = 40000		To confirm the antibiotic susceptibility of organisms
	Proteases/DNases/RNases	120386		
2.	B. Glassware	908280		
	a) Conical flasks-50 (50ml -10, 100ml-15, 250ml-15 and 500ml – 10)	50000		For media preparation and extraction
	b)Beakers-20 (50ml-2, 100ml-2, 250ml-2 and 500ml–2, 1000ml-2)	20000		For solvent extraction

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	c)Petri plates 250(Stdsize)	25000		For growth of microbes
	d)Measuring cylinder 2(10ml–1,100ml-1)	5000		For quantification of solvents
		100000		
3.	C. Any other consumable items (like wires/ electric items etc)			
	a)			
	b)			
4.	Travel	No. of Times in a month		
	a)Purpose1	3000		Collection of samples
	b)Purpose2	3000		Analysis of samples
		6000		
5.	Contingency	50000		Writing, sample preparation and sample transportation
6.	Stationery and printing			
	a)Purpose1			
	b)Purpose2			
7	Any other special requirement	200000		Genomic and analytical services
	Overhead	121728		
	NON-RECURRING	169992		Handy pH meter
	Grand Total	1556000		

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Application form

Part -A

(General Information)

1.	Title of the proposal	Evaluating the Economic Impact of 9R Model Implementation in small and medium enterprises (SMEs): a study of Gujarat and Maharashtras	
2.	Broad area of proposal	Commerce	
3.	Sub Area of proposal	Sustainability and Circular Economy	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Dr. Alpa V. Joshi	Assistant Professor Commerce Department	7096109876
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	----------	----------	----------
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	12/08/1982	
8.	Date of joining the Department of PI (DD/MM/YYYY)	20/10/2008	
9.	Whether the PI is registered for Ph.D. on the same topic	No	

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10.	If yes then name of university	----------

Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
I.	PhD	Banking	RK	2018	NA
II.	MBA	HR	IGNOU	2012	63
III.	MCOM	Finance	Saurashtra	2004	60.08
IV.	MPHIL	Commerce	MK	2007	62
V.	UGC NET Commerce	Commerce	UGC	2012	NA

2.	Have you previously received any Fellowship from any funding agency?	[]YES	NO ✓
3.	If yes, please indicate whether it was a (✓tick appropriate)	[]short-term fellowship (viz Project fellow, Project assistant, etc.)	
		[] pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		[] post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	----------	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
		----------	----------	----------	----------
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6.	Total Experience	Teaching Experience: (20 years and 6 months)
		Research Experience: No
7.	No. of Publication (Research articles - UGC Approved only)	National:8
		International:12
8.	No. of Publication (Book Chapters)	0
	Books Published	4
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Evaluating the Economic Impact of 9R Model Implementation in small and medium enterprises (SMEs): a study of Gujarat and Maharashtras

2. Abstract (Provide a summary of your research proposal in 300 words)

In an era of increasing environmental concerns and the urgent need for sustainable industrial practices, the adoption of resource-efficient frameworks such as the 9R model—Reduce, Reuse, Recycle, Redesign, Remanufacture, Refurbish, Repair, Recover, and Repurpose—has gained prominence globally. Small and medium enterprises (SMEs), which form the backbone of India's economy, face significant challenges in integrating sustainable practices due to limited resources and technical expertise. This research aims to evaluate the economic impact of implementing the 9R model within SMEs in Gujarat and Maharashtra, two of India's most industrialized states, to identify pathways for achieving resource efficiency while maintaining economic viability. The study will adopt a mixed-methods approach over five years, beginning with a baseline assessment of current sustainability practices in SMEs. Selected SMEs will participate in pilot projects to implement sector-specific 9R practices. Quantitative data, such as operational costs, revenue, and

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resource consumption, along with qualitative insights on adoption barriers, will be collected and analyzed using statistical and econometric models. The research also aims to develop a comprehensive policy framework and actionable strategies to facilitate widespread 9R adoption.

By addressing the economic and operational challenges of transitioning to sustainable practices, this study provides SMEs with practical solutions to enhance competitiveness while reducing environmental footprints. Policymakers will gain evidence-based recommendations to create enabling environments, while the outcomes will contribute to global efforts to achieve the Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production) and SDG 8 (Decent Work and Economic Growth). This study offers both localized and globally relevant insights, ensuring that SMEs play a pivotal role in fostering sustainable development. Findings will be disseminated through publications, workshops, and reports to ensure maximum impact and scalability.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

In an era marked by heightened environmental consciousness and the urgent need for sustainable development, the adoption of resource-efficient and circular economy practices has gained substantial momentum worldwide. Among the various frameworks facilitating this transition, the 9R model (Reduce, Reuse, Recycle, Redesign, Remanufacture, Refurbish, Repair, Recover, and Repurpose) emerges as a comprehensive approach to achieving sustainability. This funded five-year research project aims to evaluate the economic impact of implementing the 9R model within small and medium enterprises (SMEs) across Gujarat and Maharashtra, two of India's most industrially vibrant states. The study seeks to analyze the financial benefits, challenges, and transformative potential of integrating the 9R framework in SMEs, thereby contributing to the academic and practical discourse on sustainable industrial practices.

Importance of the Proposed Study

SMEs form the backbone of the Indian economy, contributing significantly to employment generation, industrial output, and exports. However, their resource-intensive operations often lead to substantial environmental degradation. With increasing pressure to adopt sustainable practices, SMEs have the opportunity to align their operational goals with ecological imperatives. The 9R model offers a structured methodology for achieving resource efficiency while reducing environmental footprints. Understanding the economic ramifications of its implementation in SMEs is critical for scaling up these practices and ensuring their adoption across diverse sectors.

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The states of Gujarat and Maharashtra have been selected as focal points for this study due to their industrial diversity and policy environment. Gujarat's thriving manufacturing sector, particularly in textiles, chemicals, and engineering, along with Maharashtra's dominance in sectors like pharmaceuticals, automotive, and electronics, provide a rich and varied landscape for assessing the impact of the 9R model. By focusing on these two states, the study aims to generate insights that are not only locally relevant but also broadly applicable to other regions in India and beyond.

Research Activities

This research project will be conducted over five years, encompassing a series of systematic and interrelated activities aimed at evaluating the economic impact of the 9R model in SMEs:

Comprehensive Literature Review

The initial phase will involve an extensive review of existing literature on the 9R model, circular economy practices, and sustainable development in SMEs. This will include analyzing case studies, government reports, and academic research to identify gaps and establish a conceptual framework for the study. Special emphasis will be placed on understanding the socio-economic context of Gujarat and Maharashtra.

Stakeholder Identification and Engagement

To ensure the research remains grounded and practical, the study will identify and engage key stakeholders, including SME owners, industry associations, policymakers, and sustainability experts. Workshops and focus group discussions will be organized to gather qualitative insights and build collaborative networks.

Baseline Assessment

A baseline assessment of SMEs' current practices will be conducted to understand their operational models, resource consumption patterns, and existing sustainability initiatives. This will involve conducting surveys and in-depth interviews with SME representatives from various sectors in Gujarat and Maharashtra.

Pilot Implementation of 9R Practices

Selected SMEs will be chosen for pilot studies to implement specific components of the 9R model. These pilots will provide valuable data on the practical challenges, costs, and benefits associated with

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adopting these practices. Customized interventions will be designed based on the sectoral needs and resource availability of the participating SMEs.

Data Collection and Analysis

Quantitative and qualitative data will be collected throughout the project period to evaluate the economic impact of 9R implementation. Key performance indicators (KPIs) such as cost savings, revenue generation, operational efficiency, and waste reduction will be assessed. Statistical tools and econometric models will be employed to analyze the data and establish correlations between 9R practices and economic performance.

Policy and Framework Development

Based on the findings, the study will propose a comprehensive framework for the widespread adoption of the 9R model in SMEs. Policy recommendations will be formulated to address systemic barriers and incentivize sustainability transitions. These recommendations will be aligned with national and state-level sustainability goals.

Dissemination of Findings

The outcomes of the study will be disseminated through academic publications, industry reports, and policy briefs. Workshops and seminars will be organized to share findings with stakeholders and promote the adoption of 9R practices.

Significance and Expected Outcomes

The proposed study holds immense significance for both academia and industry. By focusing on SMEs, the research addresses a critical gap in the current understanding of how smaller enterprises can contribute to and benefit from sustainable practices. The study is expected to achieve the following outcomes:

Economic Insights: Provide robust evidence on the financial viability of 9R practices, thereby encouraging SMEs to adopt these models.

Sectoral Strategies: Develop sector-specific strategies and best practices that can be replicated across industries.

Policy Influence: Inform policymakers about the economic and environmental benefits of the 9R model, leading to the formulation of supportive policies and incentives.

Capacity Building: Enhance the capacity of SMEs to implement sustainable practices through knowledge sharing and training.

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Contribution to Sustainable Development Goals (SDGs): Align the research with global goals, particularly SDG 12 (Responsible Consumption and Production) and SDG 8 (Decent Work and Economic Growth).

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The proposed study holds immense significance for both academia and industry. By focusing on SMEs, the research addresses a critical gap in the current understanding of how smaller enterprises can contribute to and benefit from sustainable practices. The study is expected to achieve the following outcomes:

Economic Insights: Provide robust evidence on the financial viability of 9R practices, thereby encouraging SMEs to adopt these models.

Sectoral Strategies: Develop sector-specific strategies and best practices that can be replicated across industries.

Policy Influence: Inform policymakers about the economic and environmental benefits of the 9R model, leading to the formulation of supportive policies and incentives.

Capacity Building: Enhance the capacity of SMEs to implement sustainable practices through knowledge sharing and training.

Contribution to Sustainable Development Goals (SDGs): Align the research with global goals, particularly SDG 12 (Responsible Consumption and Production) and SDG 8 (Decent Work and Economic Growth).

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To evaluate the current status of resource usage and waste generation in SMEs across Gujarat and Maharashtra.
2. To analyze the economic benefits and challenges associated with the implementation of the 9R model in SMEs.
3. To identify sector-specific opportunities and barriers to adopting 9R practices.
4. To design and conduct pilot studies to assess the practical feasibility of 9R interventions in selected SMEs.
5. To develop a comprehensive policy framework and actionable strategies to promote the adoption of 9R practices among SMEs.

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6. To disseminate findings and build capacity within SMEs to integrate sustainability into their operational models.

6. Significance of the proposed study: (300 words)

The proposed study is crucial in addressing the dual challenges of economic growth and environmental sustainability faced by SMEs. By evaluating the 9R model's economic impact, the research provides actionable insights for SMEs to transition towards resource efficiency and circular economy practices. The focus on Gujarat and Maharashtra leverages their industrial diversity, allowing for the development of strategies tailored to distinct sectors. This study aims to bridge the gap between academic research and practical application, offering a scalable framework for sustainability.

SMEs contribute significantly to employment and industrial output but are often constrained by limited resources and technical knowledge. This research not only identifies cost-effective sustainability measures but also equips SMEs with tools and strategies for their implementation. Policymakers will benefit from evidence-based recommendations to create enabling environments, fostering broader adoption of the 9R model. The study's findings align with global efforts to achieve sustainable development goals, promoting inclusive economic growth while mitigating environmental degradation. By focusing on localized solutions with global relevance, this research ensures that SMEs play a pivotal role in driving sustainability transitions, contributing to a resilient and sustainable industrial ecosystem.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, as one of India's most industrialized states, plays a crucial role in the nation's economic landscape. With its robust manufacturing sector spanning textiles, chemicals, engineering, ceramics, and pharmaceuticals, the state has a high concentration of small and medium enterprises (SMEs). However, this industrial prowess also brings significant environmental challenges, including resource depletion, waste generation, and carbon emissions. The proposed study to evaluate the economic impact of the 9R model implementation is highly relevant to Gujarat as it aligns with the state's goals of promoting sustainable industrial growth and resource efficiency.

The 9R model offers SMEs in Gujarat a pathway to achieve operational efficiency while reducing environmental impact. By adopting practices such as reuse, recycling, redesign, and remanufacturing, SMEs can lower production costs, minimize waste, and improve competitiveness in global markets. This research will provide sector-specific insights into the challenges and opportunities of

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implementing the 9R framework, particularly for Gujarat's industries that heavily rely on natural resources.

Furthermore, the findings will support policymakers in crafting targeted incentives and regulatory frameworks that promote sustainable practices. By focusing on Gujarat's unique industrial ecosystem, the study ensures that its outcomes contribute significantly to the state's economic and environmental objectives.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings of this research project are poised to deliver multifaceted benefits at the societal level, particularly for Gujarat. Firstly, by integrating the 9R model, SMEs in Gujarat can achieve enhanced resource efficiency, leading to significant cost savings and improved profitability. This, in turn, can bolster employment opportunities, thereby contributing to the socio-economic development of the state.

The adoption of sustainable practices also promises to mitigate environmental challenges such as waste accumulation and resource depletion. By reducing industrial pollution and promoting cleaner production methods, the study aligns with Gujarat's broader environmental goals, enhancing the quality of life for its residents. Additionally, the project's findings will inform local policymakers, enabling the creation of incentives and regulatory frameworks that encourage sustainable industrial practices.

At a community level, the successful implementation of the 9R model can inspire a culture of sustainability, fostering greater awareness and participation among citizens. Educational initiatives stemming from this research can empower communities to engage in sustainable practices, further reinforcing Gujarat's leadership in environmental stewardship.

By addressing the unique industrial dynamics of Gujarat, this project ensures that the benefits extend beyond economic gains, contributing to a more sustainable and resilient society. The outcomes will serve as a model for other regions, showcasing Gujarat's commitment to sustainable development and resource efficiency.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)

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1.	Environment	[]
2.	Agriculture	[]
3.	Health and wellness	[]
4.	Nutrition	[]
5.	Development of Industrial Problem Solutions	[ر]
6.	Resources management and sustainable development	[ر]
7.	High Impact Teaching	[]
8.	Imparting corporate responsibility, ethics, accountability and values in society	[]
9.	Social entrepreneurship	[]
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Hypothesis

The primary hypothesis of the study is that the implementation of the 9R model in SMEs leads to significant economic benefits, including cost savings, increased revenue, and enhanced operational efficiency, while also contributing to environmental sustainability.

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Sampling Plan

The study will adopt a stratified sampling approach to ensure representation across different sectors and regions. SMEs from key industries in Gujarat and Maharashtra, such as textiles, chemicals, engineering, pharmaceuticals, and electronics, will be included. A sample size of approximately 200 SMEs will be targeted to ensure statistical robustness and sectoral diversity.

Data Collection

Both primary and secondary data will be collected. Primary data will be gathered through structured surveys, interviews, and focus group discussions with SME owners and managers. Secondary data will include industry reports, government publications, and academic studies. Data on resource usage, waste generation, production costs, and financial performance will be collected to evaluate the impact of the 9R model.

Data Analysis

Quantitative data will be analyzed using statistical tools and econometric models to assess the relationship between 9R practices and economic outcomes. Techniques such as regression analysis and cost-benefit analysis will be employed. Qualitative data from interviews and focus groups will be analyzed thematically to identify patterns, challenges, and opportunities related to 9R adoption. Insights from both types of data will be integrated to draw comprehensive conclusions.
This structured methodology ensures that the research is thorough, actionable, and capable of addressing the objectives of the proposed study.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Year 1: Foundation and Framework Development
Conduct a comprehensive literature review on the 9R model, circular economy practices, and sustainability in SMEs.
Identify gaps in existing research to define the conceptual framework and research hypotheses.
Engage stakeholders, including SME owners, policymakers, and sustainability experts, through workshops and focus group discussions.
Design research tools such as structured surveys, interview guides, and data collection instruments.
Conduct baseline assessments to evaluate current sustainability practices, resource usage, and waste

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generation in SMEs across Gujarat and Maharashtra.

Year 2: Stakeholder Engagement and Pilot Design

Finalize the sample of SMEs for the study using a stratified sampling approach.

Organize workshops to share preliminary findings and refine pilot interventions.

Develop sector-specific 9R model implementation plans for selected SMEs.

Begin pilot implementation of select 9R practices tailored to participating SMEs' needs.

Year 3: Pilot Implementation and Data Collection

Execute pilot studies across diverse SME sectors in Gujarat and Maharashtra.

Monitor the implementation, collect quantitative data on financial and operational metrics, and gather qualitative insights on adoption challenges.

Analyze early-stage pilot results and refine the intervention models as necessary.

Year 4: Data Analysis and Policy Development

Conduct detailed statistical and econometric analyses of quantitative data.

Perform thematic analysis of qualitative data to identify adoption patterns, challenges, and opportunities.

Develop a comprehensive policy framework and practical strategies for broader adoption of the 9R model in SMEs.

Year 5: Dissemination and Capacity Building

Publish findings in academic journals, industry reports, and policy briefs.

Organize stakeholder workshops, conferences, and training sessions to share insights and promote adoption.

Provide recommendations to policymakers to support sustainability transitions in SMEs through incentives and regulatory measures.

Finalize and submit the project report to funding and oversight bodies.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Foundation and Framework Development	July	2022	June	2023
2.	Stakeholder Engagement and Pilot Design	July	2023	June	2024

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3.	Pilot Implementation and Data Collection	July	2024	June	2025
4.	Data Analysis and Policy Development	July	2025	June	2026
5.	Dissemination and Capacity Building	July	2026	June	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (software and tools)			--------- --------- ---------
2.	Travelling (viz. sample collection, should be Minimum and with justification)	8	67488	539904
3.	Contingency (Upto maximum for Rs. 3000/-)			3000
4.	Stationery and Printing (With justification)			61200
5.	Any other special requirement (Manpower) (Field Testing, adaptive R&D, Demo/ Training Expenses)			595896
6.	Overhead (10% of recurring)			-
	TOTAL			1200000

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	**Synthesis, Characterization and Anticancer Evaluation of Pyrazole Bearing Thaizole Derivatives**	
2.	**Broad area of proposal**	*Chemical Science*	
3.	**Sub Area of proposal**	Organic &Medicinal Chemistry	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Anilkumar S. Patel	Associate Professor Chemistry	anil.patel@atmiyauni.ac.in Mo. 9909961159 Ext. No. 2118
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Dr. Pankajkumar B. Nariya	Associate Professor & Head Chemistry	pankaj.nariya@atmiyauni.ac.in Mo. 9898081779 Ext. No. 2118
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**	03/09/1985	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	30/08/2016	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	**Educational Qualification**				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	Ph. D.	Chemistry	Saurashtra University	2011	-
ii.	Post Graduation	Organic Chemistry	Saurashtra University	2007	70
iii.	Under Graduation	Chemistry	Saurashtra University	2005	68.71
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	**Have you previously received any Fellowship from any funding agency?**	√ **YES**
3.	**If yes, please indicate whether it was a (✓ tick appropriate)**	Short-term fellowship (*viz* Project fellow, Project assistant, etc.)
		✓ **pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)**
		✓**post-doctoral fellowship (*viz*D S Kothari PDF, or any other)**
4.	**If yes, mention the details of fellowship and tenure**	1. UGC-BSR Fellowship during Ph.D (2010-2011) 2. Post-doctoral Fellowship at Academia Sinica, Taipei (2013-2014)

5.	**Details of on-going and completed research funded projects (if any)**				
	S.N.	**Title**	**Project Cost**	**Sponsoring Agency**	**Duration (Start – End – MM/YYYY)**
	-	-	-	-	-

6.	**Total Experience** (13 Years + 9 Months)	**Teaching Experience:** (11 Years + 01 Months)
		Research Experience: (2 Years + 8 Months)

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7.	No. of Publication (Research articles - UGC Approved only)	National:02
		International:19
8.	No. of Publication (Book Chapters)	-
	Books Published	07
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Synthesis, Characterization and Anticancer Evaluation of Pyrazole Bearing Thaizole Derivatives

2. Abstract (Provide a summary of your research proposal in 300 words)

The proposed study leverages the proven anticancer activity of pyrazole and thiazole moieties. Pyrazole derivatives, such as Ruxolitinib and Darolutamide, and thiazole-based drugs, like Dasatinib and Dabrafenib, have demonstrated their therapeutic potential. However, the combination of these scaffolds into a single hybrid molecule remains underexplored. This research aims to design and synthesize new pyrazole-thiazole derivatives to harness the synergistic effects of these pharmacophores for enhanced anticancer activity.

The project involves the development of a library of compounds using environmentally friendly synthetic methods and their subsequent evaluation against cancer cell lines. Early investigations revealed promising results, with one compound exhibiting significant cytotoxicity in several cancer cell lines, including HCT-116, A549, and NCI-H460. The project also includes molecular docking studies to elucidate the mechanism of action and structure-activity relationships (SAR).

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Cancer is a disease of worldwide importance. Its incidence in the developed countries is rising, and its mortality occupies the second rank in the order of death causes. Similar tendency can be observed in the developing world: the gradual improvement in the life expectancy is also associated with an elevated cancer incidence and mortality. Accordingly, we might assume that malignancy will be soon a global problem with its entire consecutive burden. Since the early

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history, chemistry has had varying roles in the discovery and development of anticancer drugs since the beginning of cancer therapies.[1] Synthetic chemistry has been extensively used to modify drug leads, especially those of natural origin, and to solve the problem of the often scarce supply of natural products by developing semi-synthetic or synthetic strategies.

Since the 1950s, chemistry has also generated many antitumor drug leads through in vitro screening programs promoted by the National Cancer Institute (NCI) in the United States by using a range of cancer cell lines. Although DNA continues to be an essential target for anticancer chemotherapy, much recent effort has been directed to discover antitumor drugs specifically suited to target molecular aberrations which are specific to tumor cells.[2] This new generation of antitumor agents is based on research in areas such as cell signaling processes, angiogenesis and metastasis, and inhibition of enzymes that, like telomerase, are reactivated in the majority of cancer cells.[3] The aim of research project is to design and develop new compounds that interfere with target and identify potential lead compounds for anticancer drug discovery.

The proposed research work is based on in the **chemical sciences and technology** with a focus on for preparing new compound for the medicinal importance and nature of the project is interdisciplinary manner.

1. **Interdisciplinary relevance of project:**
   Progress in the development of potential drug molecules is often problematic because it is difficult to convert them into ‘‘druggable’’ compounds, that is, into molecules with adequate pharmaceutical properties. The research work proposed here on the development of antitumor agents has significant interdisciplinary relevance as it involves medicinal chemist & biological chemist for the advances in the lead discovery to clinical drug.

Justification:

The literature survey revealed that the heterocyclic chemistry of nitrogen and sulfur-containing are well established in past decades. Thiazole-containing drugs demonstrated their involvement in a variety of commercially available anti-cancer medications, such as Tiazofurin (inhibitor of IMP dehydrogenase),[4] Dasatinib (Bcr-Abl tyrosine kinase inhibitor),[5] Dabrafenib (inhibitor of enzyme B-RAF).[6] In addition, pyrazole derivatives are also known to possess several anticancer activities. Various anticancer drugs possessing the pyrazole structural motif such as Criotinib (Non-Small Cell Lung Cancer),[7] Ruxolitinib (Myelofibrosis)[8] and Darolutamide (Prostate Cancer).[9] Moreover, pyrazole bearing thaizole derivatives also identified as as a potential anticancer agents.[10]

In the edge of this project, we proposed to synthesize a new class of compounds amassing the thiazole and the pyrazole moieties in one entity that may result in upgraded biological activity because of the synergistic impact of the two rings. Based on the above reports, The present

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proposal describe the lead modification approach applying bioisoterism and ring transformation approach for drug design where novel fictionalization of pyrazole bearing thaizole nucleus by incorporating substituted aromatic & heterocyclic ring systems are sought to improve the anticancer activity of these class of compounds. Further, the biological evaluation of the proposed new agents may come up with new mode of actions which will be important for several reasons: (1) The expression level or activity of the identified target(s) might have predictive value for determining which types of tumour would be most susceptible to the compound, (2) understanding the function(s) of the proteins targeted by new derivatives could be helpful for assessing the potential toxicity to normal cells, and (3) knowledge about the target protein(s) will facilitate analysis of the drug binding site that could suggest modifications to increase potency or specificity.

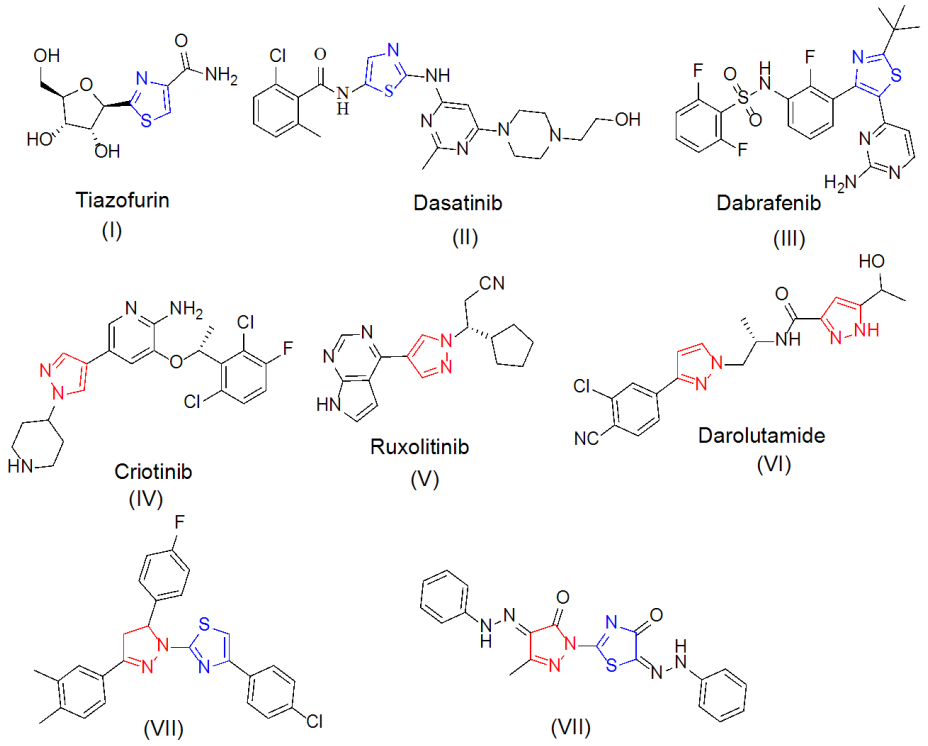

Figure-1 Reported anticancer agents : Thaizole derivatives (I-III), Pyrazole derivatives (IV-VI), Thaizonyl-pyrazole hybrids (VII-VIII)

Early investigation of target molecule:

We have synthesized few compounds for early invistiagation in this project we have synthesized

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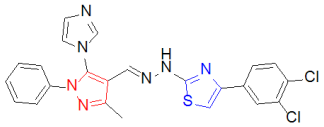
few compounds and screened in NCI-60 cancer cell lines. From that compound (**A**) was found to be cytotoxic in many cancer cell lines.



Compound A

Compound	Mean growth, %	Range of growth, %	Most sensitive cell line / Cancer type	Growth Percent, %	Growth inhibition o sensitive cell lines
A	31.99	-69.35 – 83.70	CCRF-CEM/L	26.12	73.88
			K-562/L	18.71	81.29
			A549/ATCC/nscL	-8.24	Cytotoxic
			HOP-62/nscL	10.82	89.18
			HOP-92/nscL	-22.94	Cytotoxic
			NCI-H23/nscL	12.49	87.51
			NCI-H460/nscL	3.50	96.5
			HCT-116/CC	0.90	99.1
			HCT-15/CC	23.79	76.21
			HT29/CC	17.12	82.88
			SNB-75/CNS	-2.39	Cytotoxic
			LOX IMVI/M	20.10	79.9
			MALME-3M/M	22.54	77.46
			SK-MEL-5/M	26.47	73.53
			OVCAR-3/OC	-69.35	Cytotoxic
			OVCAR-4/OC	-22.05	Cytotoxic
			OVCAR-8/OC	20.03	79.97
			NCI/ADR-RES/OC	-9.80	Cytotoxic
			786-0/RC	20.67	79.33
			CAKI-1/RC	24.87	75.13
			RXF 393/RC	-1.62	Cytotoxic
			TK-10/RC	2.74	97.26
			PC-3	28.80	71.20
			DU-145	2.44	97.56
			MCF7	17.12	82.88
			MDA-MB-231/ATCC	6.68	93.32
			T-47D	28.67	71.33

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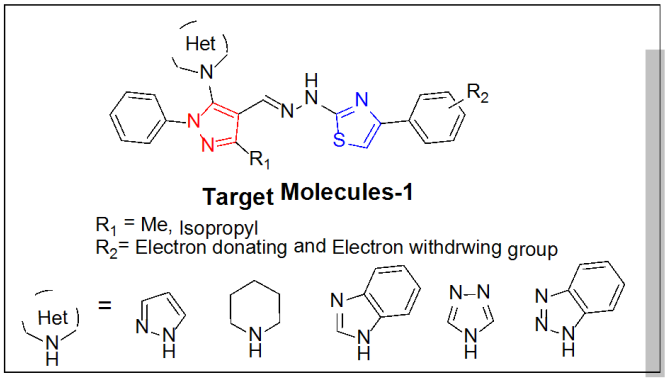
			MDA-MB-468	-8.71	Cytotoxic	

Target Molecules:

Based on the early investigation results, we have proposed target molecules as under:



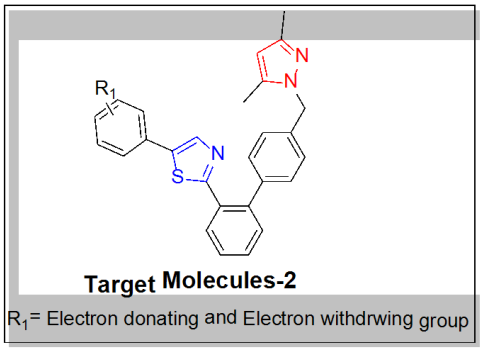


Figure 2 Design of the proposed new derivatives of pyrazole bearing thaizole derivatives

References:

1. Neidle, S., and Thurston, D. E. (**2005**). *Nat. Rev. Cancer.* 5, 285.
2. Longley, D. B., Harkin, D. P., and Johnston, P. G. (**2003**). *Nat. Rev. Cancer* 3, 330.
3. Nam, N.-H., and Parang, K. (**2003**). *Curr. Drug Targets*. 4, 159.
4. Cappellacci L, Grifantini M, Barzi A, et al. (**1995**). *J Med Chem.* 38, 3829–3837.
5. Li X, He Y, Ruiz CH, Koenig M, Cameron MD. (**2009**). *Drug Metab Dispos.* 37, 1242–1250.
6. Hu-Lieskovan S, Mok S, Homet Moreno B, et al. (**2015**) *Sci Transl Med.* 18(279), 41–279.17.
7. Bang Y. J. (**2011**). *Therapeutic advances in medical oncology*, 3(6), 279–291.

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8. Arana Yi C, Tam CS, Verstovsek S. (**2015**). *Future Oncol*. 11(5), 19–33.
9. Bastos, D. A., & Antonarakis, E. S. (**2019**). *OncoTargets and therapy,* 12, 8769–8777.
10. Sayed, A. R., Gomha, S. M., Abdelrazek, F. M., Farghaly, M. S.,Hassan, S. A., Metz, P., (**2019**), *BMC Chemistry*, 13:116 (1-13).

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The development of anticancer agents has been a focal area of research globally, with particular emphasis on heterocyclic compounds due to their diverse biological activities. Pyrazole and thiazole derivatives are two classes of nitrogen- and sulfur-containing heterocycles that have garnered significant attention in medicinal chemistry. Pyrazole derivatives such as Ruxolitinib and Darolutamide, and thiazole-based drugs like Dasatinib and Dabrafenib, are already established as potent anticancer agents targeting specific molecular pathways in cancer cells.

Current research focuses on hybrid molecules that combine multiple pharmacophores to enhance efficacy through synergistic effects. Hybrid molecules containing both pyrazole and thiazole scaffolds are emerging as promising candidates for anticancer drug discovery. Recent studies indicate that these hybrids can target kinases, enzymes, and signaling pathways unique to tumor cells, while minimizing toxicity to healthy cells.

Despite this progress, many challenges remain, including limited bioavailability, resistance development, and side effects. Researchers are addressing these issues by employing green synthetic methods, computational drug design tools like molecular docking, and in-depth biological evaluations. However, there is still a need for novel compounds with improved specificity and potency. The proposed study aims to contribute to this growing field by developing new pyrazole-thiazole hybrids with enhanced anticancer properties, filling critical gaps in current research.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To design & synthesize new anticancer agents based on pyrazole bearing thiazole scaffolds by incorporating substituted aromatic & heterocyclic ring systems To synthesize target molecules by using greener synthetic routes.
2. To evaluate in vitro anticancer activity against most potent cancer cell lines. To evaluate the biological activity of the generated array of compounds and propose their SAR (Structure-Activity Relationship) as anticancer agents.
3. To assess the possible binding mode with the target kinase/enzyme using molecular docking analysis (Autodock & MOE).

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6. Significance of the proposed study: (300 words)

- As the proposed project is directly approached towards high possibilities of finding some good scientific results about thaizole-pyrazole hybrid molecules for potential anticancer agents. we also hope to identify some lead chemical entities for the activity. These results would be a real intellectual property, and we hope to share the same by appropriate medium *viz.* (i) Patent Application, and/or (ii) Research Publication.
  Timely consultation regarding possibility of patenting the new results would be taken as and when required.

Project broader Impacts:

- The main impacts of this project are the integration of existing knowledge and research findings pertinent to an issue. The aim of design and synthesis is to increase the generality and applicability of those findings and to develop new potential candidate for anticancer treatment.
- The expression level or activity of the identified target(s) might have predictive value for determining which types of tumor would be most susceptible to the compound.
- Chemical biology of the project will be useful academic and industrial research to improve the health and quality of life of our society.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, known for its thriving pharmaceutical and chemical industries, has emerged as a hub for drug discovery and development. The proposed study on the synthesis, characterization, and anticancer evaluation of pyrazole-thiazole derivatives aligns with the state's vision of becoming a leader in innovative pharmaceutical research. With a high prevalence of cancer cases across India, including Gujarat, there is a pressing need for the development of novel anticancer agents that can address the unique genetic and environmental factors influencing the disease in the region.

The interdisciplinary nature of this research combining synthetic organic chemistry, biological evaluation, and molecular modeling supports the growing demand for locally developed, cost-effective cancer therapies. The focus on green synthetic methods is particularly relevant, as Gujarat places increasing emphasis on sustainable industrial practices to minimize environmental impact.

Moreover, the study has the potential to strengthen academic-industry collaborations in Gujarat, leveraging the expertise of local universities, research institutions, and pharmaceutical companies. The outcomes, such as patents, publications, and potential drug candidates, could significantly enhance the state's scientific reputation and contribute to its economic growth. Ultimately, this project promises to benefit Gujarat's population by advancing affordable and effective treatments for cancer, improving public health outcomes in the region.

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8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

- Gujarat is a hub of pharmaceutical industries. Through this project, we hope to have a lead molecules or some combination of molecule which could be improvised to determine their potential for the new anticancer agents.
- It will help to design and develop new compounds that interfere with target and identify potential lead compound for anticancerdrug discovery.
- Development of synthetic methodology based on economical and greener routes will be useful in academic and industrial research for further development of potential compounds
- Patent or publications of most potent compounds.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	
2.	Agriculture	
3.	Health and wellness	√
4.	Nutrition	
5.	Development of Industrial Problem Solutions	
6.	Resources management and sustainable development	
7.	High Impact Teaching	
8.	Imparting corporate responsibility, ethics, accountability and values in society	
9.	Social entrepreneurship	
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The general synthetic strategy for the targeted pyrazole bearing thaizole derivatives is depicted in

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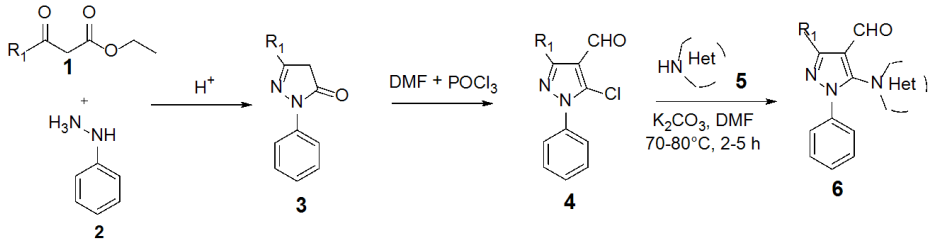
the **Scheme-1** to **Scheme-3**.

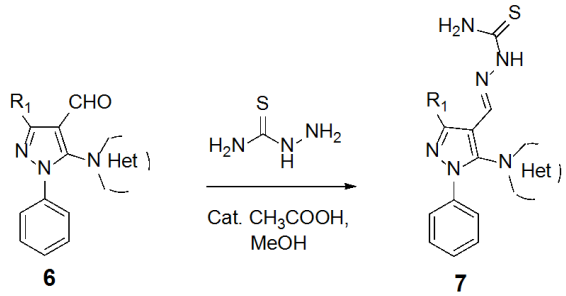
First, the requisite pyrazole intermediates will be synthesized by following the **scheme 1**. The synthesis of the pyrazolone (**3**) will be achieved from the condensation of -keto esters (**1**) with phenylhydrazine (**2**) in the presence of acid catalyst. The formylation of intermediate (**3**) by using Vilsmeier–Haack reaction give intermediate (**4**) which on reaction with various secondary amines (**5**) yielded intermediate (**6**).

Scheme 1: Synthesis of requisite intermediate (**6**).



Preparation of second intermediate will be prepared by following **scheme-2.** Intermediate (**6**) will be reacted thiosemicarbazide in the presence of catalytic acetic acid and methanol leading to the formation of intermediate (**7**).

Scheme 2: Synthesis of requisite thiosemicarbazide intermediate (**7**).



Having requisite intermediates in hand, the synthesis of targeted compounds (**9**) will be achieved as per **Scheme 3**. The intermediate compound (**7**) will be reacted with substituted phenacyl bromide (**8**) in alcohol furnished desired pyrazole bearing thiazole derivatives.

Scheme 3: Synthesis of targeted pyrazole bearing thiazole derivative (**9**).

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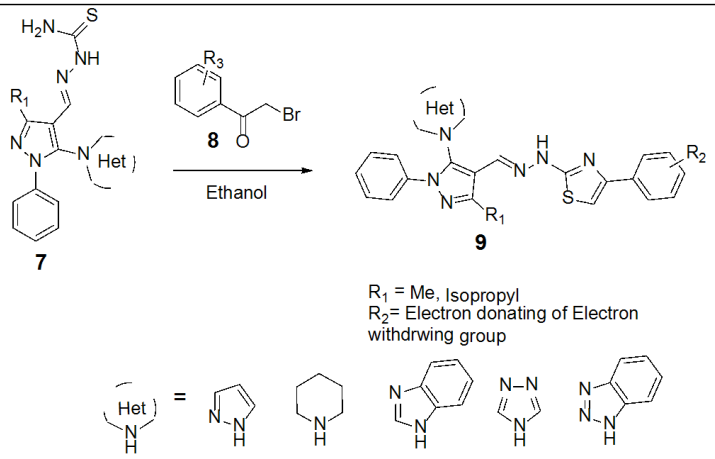

Biological Evaluation:

After having generated an array of compounds via above mentioned protocols, it will be next evaluated for the antitumor activity. This will be carried out either collaborating with the biological research groups or by hiring services. It will includes,

1. In *vitro* anticancer activity of selected compounds

2. Molecular docking studies for most potent molecules to established possible mechanism.

3. In *vitro* profiling of the selected most potent compound to study the possible molecular mechanism for anticancer activity.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

- Design and syntheses of required intermediates
- Synthesis and purification of desired compounds as proposed in the reaction scheme.
- Characterization and *in vitro*anticancer activities of proposed compounds
- Patent or Publications on outcomes of the proposed project will be carried out in reputed international and national journals

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature review, Purchase & procurement of chemicals, Laboratory setup, trial & development studies.	July	2022	March	2023
2.	Synthesis, purification & structure establishments of Scheme-1and Scheme-2.	April	2023	May	2024
3.	Synthesis, purification & structure establishments of Scheme-3 and Evaluation of in vitro anticancer studies and SAR establishment	June	2024	May	2026
4.	Data management and Conclusion findings, Report Preparation, MS Preparation, Financial UC preparation, Conclusion	June	2026	May	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	Based on the current market scenario	-	**6,50,000/-**
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	-	-	**60,000/-**

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3.	Contingency	-	-	**40,000/-**
4.	Stationery and Printing (With justification)	Printing papers and other stationary items	-	**40,000/-**
5.	Any other special requirement	Characterization and Biological activity	-	**3,50,000/-**
6.	Overhead	-	-	**60,000/-**
	TOTAL		-	**12,00,000/-**

b. Detailed Budget with Justification and Timeline of usages of Funds

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals& Equipment**	**5,50,000**	June-2022 to Dec-2024	The amount will be used to acquire chemical for the synthesis of desired compounds
2.	**B. Glassware**	**1,00,000**	June-2022 to Dec-2024	The amount will be used to acquire glassware for the synthesis of desired compounds
3.	**C. Any other consumable items**	-	-	-
4.	**Travel**		June 2024-March – 2026	It will be utilized to present the result at various national and international conferences
	a) Biological activity	**60,000**		
	b) Conference paper			
5.	**Contingency**	**40,000**		The amount will be used to cover miscellaneous expenditures
6.	**Stationery and printing**	**40,000**	As per the requirement During 5 year	To acquire Stationery items and printing for the project analysis
	a) A4 size papers	10,000		
	b) Stationary items	25,000		
7	Any other special requirement (Characterization and Biological activity)	**3,50,000**		Compound characterization and biological evaluation (NMR, Mass, IR, LCMS and XRD analysis)
8	Overhead	**60,000**		
	Grand Total	**12,00,000/-**		

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Research Project Proposal
June - 2022

1.	Title of the proposal	Energy Management for Midsize Industries	
2.	Name of Principle Investigator	Ankit B. Lehru	
3.	Designation & Department	□ Designation	Assistant Professor
		□ Faculty	Engineering and Technology
		□ Department	Electrical Engineering
4.	Contact details (e-mail, mobile number, Ext. no.)	□ Mobile Number (WhatsApp Number)	9601626303
		□ Email	ankit.lehru@atmiyauni.ac.in
		□ Departmental Extension number	1052

Application form

Part -A

(General Information)

1.	Title of the proposal	Energy Management for Midsize Industries	
2.	Broad area of proposal	Energy Audit	
3.	Sub Area of proposal	Electrical Engineering	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Ankit B. Lehru	Assistant Professor	9601626303 ankit.lehru@atmiyauni.ac.in

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			Ext. No:1052
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Dhaval Y. Raval	Assistant Professor	7383261271 Dhaval.raval@atmiyauni.ac.in Ext. No:1052
6.	Whether the proposal is transdisciplinary?	Yes	
7.	Date of Birth of PI (DD/MM/YYYY)	22-02-1988	
8.	Date of joining the Department of PI (DD/MM/YYYY)	10-08-2015	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	-	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D. (Pursuing)	Electrical Engineering	Atmiya University	-	-
ii.	Post Graduation	Electrical Engineering	G.T.U	2015	8.33
iii.	Under Graduation	Electrical Engineering	Saurashtra University	2009	60.22
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-
2.	Have you previously received any Fellowship from any funding agency?	☐ YES		☐ NO	

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3.	If yes, please indicate whether it was a (✓tick appropriate)	☐ Short-term fellowship (viz Project fellow, Project assistant, etc.)			
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)			
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)			
4.	If yes, mention the details of fellowship and tenure				
5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
6.	Total Experience	Teaching Experience: (14 Year)			
		Research Experience: 0			
7.	No. of Publication (Research articles - UGC Approved only)	National: 0			
		International: 02			
8.	No. of Publication (Book Chapters)	0			
	Books Published	0			
(Please enclose the list of papers and books published and/or accepted during last five years)					

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Energy Management for Midsize Industries

2. Abstract (Provide a summary of your research proposal in 300 words)

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Midsize industries are vital contributors to global economic growth but often struggle with optimizing energy usage due to limited resources and expertise. This research aims to develop a comprehensive energy management framework that leverages advanced technologies such as IoT, AI, and renewable energy systems to enhance efficiency, reduce costs, and promote environmental sustainability. By analyzing energy consumption patterns, identifying inefficiencies, and evaluating technological interventions, the study will propose a scalable and cost-effective model tailored to the unique needs of these industries. A mixed-methods approach, including data collection from case studies, energy audits, and stakeholder interviews, will inform the development of the framework. Expected outcomes include improved operational efficiency, lower energy costs, and reduced carbon footprints, contributing to sustainable industrial practices and supporting policymakers and industry leaders globally.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

1 Midsize industries are vital contributors to global economic growth but often struggle with optimizing energy usage due to limited resources and expertise. This research aims to develop a comprehensive energy management framework that leverages advanced technologies such as IoT, AI, and renewable energy systems to enhance efficiency, reduce costs, and promote environmental sustainability. By analyzing energy consumption patterns, identifying inefficiencies, and evaluating technological interventions, the study will propose a scalable and cost-effective model tailored to the unique needs of these industries. A mixed-methods approach, including data collection from case studies, energy audits, and stakeholder interviews, will inform the development of the framework. Expected outcomes include improved operational efficiency, lower energy costs, and reduced carbon footprints, contributing to sustainable industrial practices and supporting policymakers and industry leaders globally.

Specific Research Activities:

Energy Consumption Analysis:

Conduct detailed energy audits across diverse midsize industries to identify patterns, peak usage times, and inefficiencies. This activity will involve collecting historical data and performing real-time monitoring of energy consumption.

Technology Assessment:

Evaluate the applicability of advanced technologies such as IoT sensors, AI-based analytics, and

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renewable energy systems in addressing the identified inefficiencies. This includes pilot implementations to test feasibility and performance.

Stakeholder Engagement:

Organize interviews and focus groups with industry managers, technical staff, and energy experts to gather insights on practical challenges and opportunities for energy optimization.

Model Development:

Create a scalable energy management framework incorporating the findings from audits and technology assessments. The model will prioritize cost-effectiveness, ease of implementation, and adaptability across various sectors.

Simulation and Validation:

Use advanced simulation tools to model energy usage scenarios and predict the outcomes of implementing the proposed framework. Validate the model through real-world case studies.

Economic and Environmental Impact Analysis:

Assess the financial and environmental benefits of the proposed framework by calculating potential cost savings, reductions in greenhouse gas emissions, and ROI for industries adopting the model.

Dissemination of Findings:

Publish the research outcomes in academic journals and industry reports. Conduct workshops and webinars to share the framework with policymakers, industry leaders, and other stakeholders.

Importance of the Proposed Study:

The proposed study is critical for addressing the energy challenges faced by midsize industries, which often lack the resources and expertise of larger enterprises. Energy costs are a significant portion of operational expenses for these industries, and inefficiencies can lead to substantial financial losses. By optimizing energy management, the research offers a pathway to reduce costs, improve competitiveness, and enhance long-term sustainability.

The incorporation of advanced technologies such as IoT, AI, and renewable energy systems is particularly relevant in the current era of digital transformation and environmental consciousness. IoT sensors enable real-time monitoring of energy usage, allowing industries to identify inefficiencies as they occur. AI-driven analytics provide actionable insights, enabling predictive maintenance and smarter energy allocation. Renewable energy systems, such as solar panels and wind turbines, can reduce dependence on non-renewable energy sources, further lowering operational costs and minimizing carbon footprints.

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Moreover, the scalability and adaptability of the proposed framework ensure its relevance across diverse industrial sectors. The study's focus on practical implementation and cost-effectiveness addresses the barriers often faced by midsize industries in adopting energy-efficient practices. The inclusion of stakeholder perspectives ensures the framework aligns with real-world needs and challenges, increasing its chances of successful adoption.

From an environmental perspective, the study contributes to global efforts to combat climate change by promoting sustainable industrial practices. Reducing energy wastage and integrating renewable energy sources can significantly lower greenhouse gas emissions, helping industries align with international sustainability goals such as the Paris Agreement.

Economically, the proposed research has the potential to transform midsize industries by reducing energy expenses and enhancing productivity. The cost savings achieved through optimized energy management can be reinvested in business expansion, innovation, and workforce development, driving economic growth at both the micro and macro levels.

Furthermore, the research addresses a gap in the existing literature by focusing specifically on the needs of midsize industries, which are often overlooked in favor of larger corporations or smaller enterprises. The insights gained from this study can inform policymakers and energy regulators, enabling the development of targeted policies and incentives that support energy efficiency in this crucial sector.

In conclusion, the proposed study combines technological innovation, economic pragmatism, and environmental stewardship to deliver a transformative energy management solution for midsize industries. By addressing the unique challenges and opportunities of these industries, the research not only enhances their operational efficiency but also contributes to broader societal goals of sustainability and economic resilience. The findings will serve as a valuable resource for industry leaders, policymakers, and researchers, fostering a more sustainable and competitive industrial landscape globally.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research Proposal: Energy Management for Midsize Industries

Midsize industries are vital contributors to global economic growth but often struggle with optimizing energy usage due to limited resources and expertise. This research aims to develop a comprehensive energy management framework that leverages advanced technologies such as IoT, AI, and renewable energy systems to enhance efficiency, reduce costs, and promote environmental sustainability. By analyzing energy consumption patterns, identifying inefficiencies, and evaluating technological interventions, the study will propose a scalable and cost-effective model tailored to the unique needs of these industries. A mixed-methods approach, including data collection from case studies, energy audits, and stakeholder interviews, will inform the development of the framework. Expected outcomes include

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improved operational efficiency, lower energy costs, and reduced carbon footprints, contributing to sustainable industrial practices and supporting policymakers and industry leaders globally.

Specific Research Activities

Energy Consumption Analysis:

Conduct detailed energy audits across diverse midsize industries to identify patterns, peak usage times, and inefficiencies. This activity will involve collecting historical data and performing real-time monitoring of energy consumption.

Technology Assessment:

Evaluate the applicability of advanced technologies such as IoT sensors, AI-based analytics, and renewable energy systems in addressing the identified inefficiencies. This includes pilot implementations to test feasibility and performance.

Stakeholder Engagement:

Organize interviews and focus groups with industry managers, technical staff, and energy experts to gather insights on practical challenges and opportunities for energy optimization.

Model Development:

Create a scalable energy management framework incorporating the findings from audits and technology assessments. The model will prioritize cost-effectiveness, ease of implementation, and adaptability across various sectors.

Simulation and Validation:

Use advanced simulation tools to model energy usage scenarios and predict the outcomes of implementing the proposed framework. Validate the model through real-world case studies.

Economic and Environmental Impact Analysis:

Assess the financial and environmental benefits of the proposed framework by calculating potential cost savings, reductions in greenhouse gas emissions, and ROI for industries adopting the model.

Dissemination of Findings:

Publish the research outcomes in academic journals and industry reports. Conduct workshops and webinars to share the framework with policymakers, industry leaders, and other stakeholders.

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The proposed study is critical for addressing the energy challenges faced by midsize industries, which often lack the resources and expertise of larger enterprises. Energy costs are a significant portion of operational expenses for these industries, and inefficiencies can lead to substantial financial losses. By optimizing energy management, the research offers a pathway to reduce costs, improve competitiveness, and enhance long-term sustainability.

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Moreover, the scalability and adaptability of the proposed framework ensure its relevance across diverse industrial sectors. The study's focus on practical implementation and cost-effectiveness addresses the barriers often faced by midsize industries in adopting energy-efficient practices. The inclusion of stakeholder perspectives ensures the framework aligns with real-world needs and challenges, increasing its chances of successful adoption.

From an environmental perspective, the study contributes to global efforts to combat climate change by promoting sustainable industrial practices. Reducing energy wastage and integrating renewable energy sources can significantly lower greenhouse gas emissions, helping industries align with international sustainability goals such as the Paris Agreement. Economically, the proposed research has the potential to transform midsize industries by reducing energy expenses and enhancing productivity. The cost savings achieved through optimized energy management can be reinvested in business expansion, innovation, and workforce development, driving economic growth at both the micro and macro levels.

Furthermore, the research addresses a gap in the existing literature by focusing specifically on the needs of midsize industries, which are often overlooked in favor of larger corporations or smaller enterprises. The insights gained from this study can inform policymakers and energy regulators, enabling the development of targeted policies and incentives that support energy efficiency in this crucial sector.

In conclusion, the proposed study combines technological innovation, economic pragmatism, and environmental stewardship to deliver a transformative energy management solution for midsize industries. By addressing the unique challenges and opportunities of these industries, the research not only enhances their operational efficiency but also contributes to broader societal goals of sustainability and economic resilience. The findings will serve as a valuable resource for industry leaders, policymakers, and researchers, fostering a more sustainable and competitive industrial landscape globally.

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Critical Evaluation of Research Status:

Current research in energy management predominantly focuses on large corporations and small enterprises, leaving a significant gap in addressing the unique challenges of midsize industries. While studies have explored the potential of IoT, AI, and renewable energy technologies, their integration into tailored frameworks for midsize industries remains underexplored. Existing literature often highlights energy efficiency solutions without considering the financial and technical constraints specific to this sector. Furthermore, the emphasis on theoretical models frequently neglects practical implementation strategies, which are crucial for real-world adoption. This research seeks to bridge these gaps by providing a pragmatic, scalable framework that incorporates advanced technologies and aligns with the operational realities of midsize industries. By focusing on both economic and environmental outcomes, the study addresses the dual imperatives of cost reduction and sustainability, making a significant contribution to the field of energy management.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Evaluate energy consumption patterns and identify inefficiencies in midsize industries.
2. Assess strategies for reducing energy costs, including energy-efficient technologies and process optimization.
3. Develop a tailored energy management framework for midsize industries.
4. Investigate the impact of energy-efficient technologies on energy consumption and costs.
5. Analyze regulatory compliance, policies, and incentives related to energy usage.
6. Evaluate the sustainability and environmental benefits of improved energy management practices.

6. Significance of the proposed study: (300 words)

The significance of the proposed study on "Energy Management for Midsize Industries" lies in its potential to address critical challenges related to energy consumption, cost management, and sustainability within this sector. Midsize industries are a vital part of many economies, but they often face unique energy-related challenges due to limited resources, lack of expertise, and high operational costs. By focusing on energy management, this study can provide valuable insights into how these industries can optimize their energy use, reduce expenses, and improve their overall operational efficiency.

Energy costs represent a significant portion of the operational expenses for midsize industries. Without effective energy management strategies, these businesses are vulnerable to rising energy prices, which can impact their competitiveness and profitability. By identifying inefficiencies and exploring cost-effective energy-saving technologies, the study can help companies reduce their energy consumption and operational costs, leading to increased

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financial sustainability.

Moreover, this research will also explore the adoption of energy-efficient technologies and renewable energy solutions, providing midsize industries with practical, scalable options to transition towards greener operations. This is not only beneficial from a cost-saving perspective but also aligns with global sustainability goals and regulations aimed at reducing carbon footprints and environmental impact.

Additionally, the study will examine the role of regulatory frameworks and government incentives, helping industries understand how to leverage these policies for improved energy performance. This can lead to better compliance with environmental regulations while maximizing available financial incentives.

Ultimately, the proposed study will contribute to the development of a comprehensive energy management framework tailored to the needs of midsize industries, facilitating their growth, sustainability, and long-term competitive advantage in a rapidly evolving energy landscape.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on Energy Management for Midsize Industries holds significant relevance to Gujarat due to the following factors:

Diverse Industrial Sector: Gujarat has a wide range of midsize industries, including manufacturing, textiles, chemicals, and engineering, which contribute significantly to the state's economic growth.

Energy Costs: Rising energy costs are a key challenge for midsize industries in Gujarat, impacting their operational expenses and profitability.

Regulatory Pressures: Industries are facing increasing regulatory pressures to reduce their carbon footprints and comply with environmental standards, necessitating efficient energy management.

Energy Optimization: The study will help identify inefficiencies in energy use, providing midsize industries with actionable strategies to reduce consumption and costs.

Sustainability Goals: Gujarat is focused on achieving sustainability targets, and improving energy management in industries is a critical part of this vision.

Renewable Energy Adoption: The study will explore the adoption of renewable energy sources,

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aligning with Gujarat's commitment to clean energy and reducing dependence on fossil fuels.

Energy-Efficient Technologies: The research will evaluate energy-efficient technologies that can help industries cut costs and improve productivity.

Government Policies and Incentives: The study will assess the role of state government policies and incentives related to energy efficiency, helping industries navigate these programs effectively.

Competitive Advantage: By improving energy management, industries can gain a competitive advantage in the market through reduced operating costs and enhanced environmental responsibility.

Job Creation: Efficient energy management can lead to new business opportunities and job creation in sectors related to renewable energy, energy-efficient technologies, and sustainability services.

Industrial Growth: Gujarat's industrial sector can experience sustainable growth by implementing the findings of the study, which will support long-term development and stability.

Global Market Positioning: With effective energy management, Gujarat's industries can position themselves better in the global market by demonstrating commitment to sustainability and cost-effectiveness.

Carbon Footprint Reduction: The study will help industries reduce their carbon footprints, contributing to Gujarat's efforts to meet international climate commitments.

Energy Security: By promoting energy efficiency and diversification of energy sources, the study can help Gujarat's industries achieve greater energy security and resilience.

Knowledge Sharing: The research will facilitate knowledge sharing among industries in Gujarat, leading to the development of best practices for energy management and sustainability across the state.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

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The expected benefits of the proposed research project on Energy Management for Midsize Industries, particularly for Gujarat, are substantial at the societal level:

1. Reduced Energy Consumption: The study's findings can lead to a reduction in overall energy consumption across Gujarat's midsize industries, resulting in significant cost savings for businesses and reducing the strain on the state's energy resources.
2. Lower Carbon Emissions: By adopting energy-efficient technologies and practices, the research will contribute to lowering the carbon emissions of industries, helping Gujarat achieve its environmental sustainability goals.
3. Improved Industrial Competitiveness: Industries that implement the findings of the study will be able to reduce their operational costs, which can make Gujarat's industrial sector more competitive on both national and global scales.
4. Job Creation in Clean Energy: The transition to energy-efficient technologies and renewable energy will stimulate job creation in clean energy sectors, including solar, wind, and energy management services, benefiting the local workforce.
5. Energy Security: The study's focus on efficient energy management and renewable energy adoption will help improve Gujarat's energy security by diversifying energy sources and reducing dependence on external energy supplies.
6. Enhanced Sustainability Practices: Industries in Gujarat will be better equipped to adopt sustainable practices, reducing waste, optimizing resource use, and aligning with global environmental standards.
7. Policy Improvements: Findings from the study can influence state-level policies, encouraging the government to implement more effective energy efficiency programs and incentives that benefit businesses and the environment.
8. Public Health Benefits: By reducing carbon emissions and pollution, the study will contribute to better air quality and public health in Gujarat, particularly in industrial zones.
9. Economic Growth: The adoption of energy-efficient practices and renewable energy technologies can lead to more sustainable industrial growth, contributing to the overall economic development of Gujarat.
10. Increased Awareness and Knowledge Sharing: The research will raise awareness of energy management practices and provide valuable insights for businesses across Gujarat, fostering a culture of sustainability and innovation within the industrial community.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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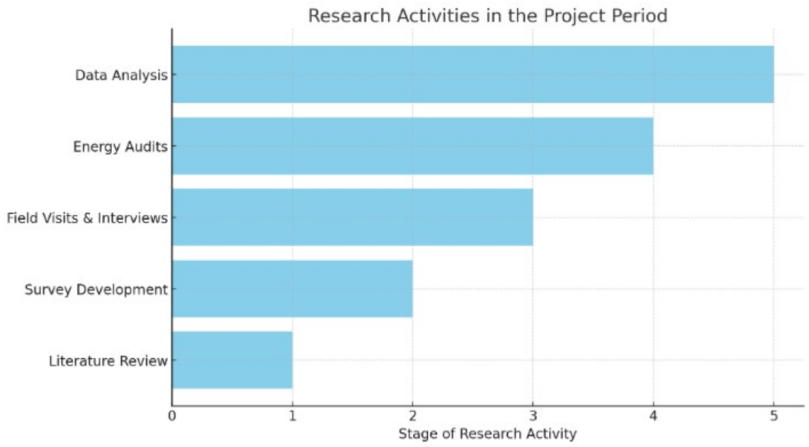

1. Literature Review: The first step will involve reviewing existing research and industry reports on energy management practices in midsize industries, focusing on energy-efficient technologies, renewable energy adoption, and regulatory frameworks. This will help establish the research framework and identify knowledge gaps.
2. Survey Development: A structured survey will be designed to assess the energy usage patterns, energy management practices, and challenges faced by midsize industries in Gujarat. The survey will target key decision-makers, such as energy managers, facility operators, and senior management.
3. Field Visits and Interviews: Conducting interviews with industry stakeholders will provide qualitative insights into the energy challenges faced by industries, along with potential solutions and opportunities for improvement.
4. Energy Audits: Select midsize industries will undergo energy audits to assess their current energy usage and identify areas for improvement. This will provide real-world data to validate the effectiveness of proposed energy-saving measures.
5. Data Analysis: Data gathered through surveys, interviews, and energy audits will be analyzed using statistical techniques to identify key trends, inefficiencies, and correlations between energy management practices and cost savings.

Hypothesis

- Primary Hypothesis: Midsize industries in Gujarat that adopt energy-efficient technologies and optimize their energy management practices will experience

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significant reductions in energy costs and improvements in overall operational efficiency.

- Secondary Hypothesis: The adoption of renewable energy sources, coupled with government incentives and policies, will further enhance the financial and environmental benefits for midsize industries in Gujarat.

Sampling Plan

- Target Population: Midsize industries across various sectors (manufacturing, textiles, chemicals, etc.) in Gujarat.
- Sample Size: A sample of 50-100 industries will be selected based on size, type, and energy consumption patterns, ensuring a representative cross-section of the industrial sector.
- Sampling Method: Stratified random sampling will be used to select industries based on sector and energy usage characteristics.

Data Collection

- Surveys: A structured questionnaire will be administered to industry representatives to gather quantitative data on energy consumption, cost-saving measures, and technology adoption.
- Interviews: Semi-structured interviews will be conducted with industry experts, energy managers, and government officials to collect qualitative data.
- Energy Audits: A select group of industries will participate in energy audits to provide detailed consumption and efficiency data.

Data Analysis

- Quantitative Analysis: Statistical tools (e.g., regression analysis, correlation analysis) will be used to analyze survey and audit data, identifying patterns and relationships between energy management practices and cost reductions.
- Qualitative Analysis: Interview transcripts will be analyzed using thematic analysis to identify common challenges, solutions, and industry perspectives on energy management.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Year 1: Pre-Audit Preparation (Study Phase)

Activities:

- Gather historical energy usage data (e.g., bills, peak demand periods) and review existing equipment, infrastructure, and operations.
- Identify key personnel, including energy managers, for collaboration.

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Year 2: Walkthrough Assessment

Activities:

- Conduct a detailed walkthrough of the facility to assess energy-intensive areas such as lighting, HVAC systems, production processes, insulation, and equipment.
- Identify potential inefficiencies, such as outdated machinery or poor insulation.

Year 3: Data Collection and Analysis

Activities:

- Measure energy usage with tools like power meters to analyze real-time consumption.
- Evaluate peak demand times, load profiles, and areas with high energy losses. This helps pinpoint inefficiencies.

Year 4: Identify Energy-Saving Opportunities

Activities:

- Propose actionable recommendations for improvement, including energy-efficient lighting, upgraded insulation, improved HVAC systems, and optimized production processes. Consider renewable energy options if applicable.
- Compile a detailed audit report, outlining findings, recommendations, cost estimates, potential savings, and ROI. Prioritize actions based on impact and feasibility.

Year 5: Final Evaluation, Reporting, and Implementation and Monitoring

Activities:

- Final Data Analysis: Complete the final analysis of all engine testing, performance metrics, and environmental impact.
- Technology Transfer: Investigate opportunities for technology transfer, including potential collaborations with industries or government bodies for commercial adoption.
- Commercialization Feasibility: Explore commercial scalability of bio-oil diesel blends, including possible pilot projects and funding opportunities.
- Develop an implementation plan, set benchmarks, and track energy usage post-implementation to ensure ongoing savings.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Pre-Audit Preparation	June	2022	May	2023

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	(Study Phase)				
2.	Walkthrough Assessment	June	2023	May	2024
3.	Data Collection and Analysis	June	2024	May	2025
4.	Identify Energy-Saving Opportunities	June	2025	May	2026
5.	Final Evaluation, Reporting, and Implementation and Monitoring	June	2026	May	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Harmonic Distortion Meter	1,50,000	1	1,50,000
2.	Travelling	50,000	-	50,000
3.	Contingency	30,000	-	30,000
4.	Thermal Imaging Camera	1,40,000	-	1,40,000
	TOTAL			3,70,000

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	Harmonic Distortion Meter	1,50,000	June 2023	For power quality and performance analysis
2	Travelling	50,000	During entire project	For Conduct detail audit at different SMEs
3	Contingency	30,000	During entire project	-

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4	Thermal Imaging Camera	1,40,000	June 2023-May 2024	Identifies hot spots in electrical panels, wiring, and equipment. It is crucial for spotting potential faults or overloads.
	Grand Total	3,70,000		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	SNEAKSphere – An E-commerce website	
2.	**Broad area of proposal**	E-commerce website	
3.	**Sub Area of proposal**	Shoes Website	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Ankitkumar Keshavlal Kalariya	**Assistant professor-SS**	9979998422
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	24-08-2011	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	19-12-2016	
9.	**Whether the PI is registered for Ph.D. on the same topic**	(Yes/No/N.A.) Yes	
10.	**If yes then name of university**	Atmiya University	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Disease Detection in Wheat Leaf with Organic Remedy Suggestions Using the YOLO Algorithm	Atmiya university	Pursuing	NA
ii.	Post Graduation	COMPUTER SCIENCE AND ENGINEERING	RAJIV GANDHI PRODYOGIKI VISHWAVIDYALAYA, BHOPAL (M.P.)	2015	*First Class*
iii.	Under Graduation	Computer Engineering	Saurashtra University	2010	Distinction
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐YES	√NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	-	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

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6.	Total Experience		Teaching Experience: (14 Year + 4 Months)		
			Research Experience: (.....Year + ... Months)		
7.	No. of Publication (Research articles - UGC Approved only)		National:2		
			International:7		
8.	No. of Publication (Book Chapters)		1		
	Books Published		2		
(Please enclose the list of papers and books published and/or accepted during last five years)					

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

SNEAKSphere – An E-commerce website

2. Abstract (Provide a summary of your research proposal in 300 words)

In today's fast-paced world of online shopping, sneakers have emerged as more than just footwear. They are a statement of style, a symbol of personal identity, and a passion that transcends generations. The global sneaker market has witnessed unprecedented growth, yet amidst this thriving industry, a critical need remained unaddressed - a dedicated online platform that caters to the unique demands of sneaker enthusiasts. SNEAKSphere was born out of this necessity. The problem was crystal clear: despite the surging popularity of sneakers, there was a noticeable absence of an all-encompassing e-commerce platform solely focused on sneakers. Consumers lacked a centralized destination where they could explore a wide range of sneaker styles, brands, and releases, while also enjoying a seamless shopping experience. This void represented an opportunity to create a distinctive online space that not only fills this gap but elevates the sneaker shopping experience to new heights

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Our project, titled "SNEAKSphere – An E-commerce website" aims to address a significant gap in sneakersfootwear market. In today's digital world, e-commerce has become a powerful driver of economic growth and consumer behaviour, transforming how people shop and how businesses operate. Among the myriad of industries benefiting from this shift, the sneaker market has emerged as a unique cultural and economic phenomenon. SNEAKSphere, an innovative e-commerce platform dedicated to sneaker enthusiasts and collectors, aims to cater to this niche by offering a curated, trustworthy, and community-driven online shopping experience. This introduction explores the critical research activities undertaken for SNEAKSphere's development and discusses the project's broader significance in reshaping the sneaker and e-commerce industries.

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The development of SNEAKSphere begins with extensive market research to understand the needs, preferences, and challenges faced by sneaker consumers. This includes identifying target demographics, analyzing pricing expectations, and studying the growing demand for limited-edition and sustainable sneaker options. Surveys, focus groups, and data analysis are key methods used to gather insights into consumer behavior. Complementing this is a detailed competitor analysis, which evaluates existing sneaker platforms such as StockX, GOAT, and e-commerce giants like Amazon. By benchmarking performance metrics such as product diversity, customer experience, pricing models, and marketing strategies, SNEAKSphere can identify gaps in the market and develop solutions to address them.

To ensure the platform is user-centric, significant research is devoted to design and usability. The goal is to create a visually appealing, intuitive, and responsive website tailored to sneaker enthusiasts. Employing user experience (UX) research techniques such as wireframe reviews, usability testing, and A/B testing ensures that SNEAKSphere is not just functional but also delightful to use. Additionally, a technological feasibility study forms a critical component of the research, focusing on integrating advanced technologies. Artificial intelligence (AI) will power personalized product recommendations and adaptive interfaces, while blockchain technology will provide secure authentication for limited-edition sneakers, ensuring buyers receive genuine products.

Another vital aspect of the research involves optimizing supply chain and logistics. Effective procurement, warehousing, and delivery processes are essential to the success of any e-commerce platform. By collaborating with logistics partners and employing predictive analytics, SNEAKSphere aims to ensure cost-effective, efficient operations that meet consumer expectations for speed and reliability. Alongside this, the platform prioritizes sustainability by promoting eco-friendly sneaker brands, reducing packaging waste, and minimizing its overall carbon footprint. This aligns SNEAKSphere with the growing consumer demand for ethical and environmentally responsible practices in business.

Marketing research is another cornerstone of SNEAKSphere's development. The platform will leverage innovative strategies such as influencer partnerships, targeted social media campaigns, and loyalty programs to build a strong and engaged user base. Pilot campaigns and data-driven decision-making will help refine these strategies, ensuring they resonate with the sneaker community. In addition to marketing, SNEAKSphere distinguishes itself by emphasizing community engagement. The platform plans to include features like forums, sneaker release calendars, and virtual events to foster a sense of belonging among its users. This social element not only enhances user retention but also reflects the deeply rooted cultural significance of sneakers.

The importance of SNEAKSphere extends beyond creating a profitable e-commerce platform. First, it addresses the unmet needs of a growing market segment. Sneakers, once functional footwear, have evolved into a $70 billion global market driven by fashion, culture, and innovation. The demand for curated platforms like SNEAKSphere reflects a need for specialized services that cater to this community. Secondly, the platform bridges a significant trust gap in the sneaker resale market, where counterfeit products remain a pervasive issue. By using blockchain for authentication, SNEAKSphere ensures transparency and builds trust between buyers and sellers, solving a critical pain point for consumers.

Moreover, SNEAKSphere's focus on user experience sets it apart from generic e-commerce platforms. AI-powered personalization, dynamic pricing, and an adaptive interface create a seamless shopping experience that resonates with consumers' individual preferences. Beyond functionality, SNEAKSphere serves as a community-driven platform, offering users a space to connect, share, and celebrate their love for sneakers. This sense of community fosters loyalty and transforms the platform from a transactional website into a cultural hub.

The project's economic implications are equally significant. SNEAKSphere supports small and medium-scale sneaker brands and resellers by providing a global platform for visibility and sales. This not only benefits local economies but also encourages entrepreneurship within the sneaker ecosystem. Additionally, the platform's commitment to sustainability demonstrates the viability of eco-conscious practices in e-commerce. By promoting

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sustainable brands and recycling initiatives, SNEAKSphere sets an example for businesses to align profitability with environmental responsibility.

SNEAKSphere also highlights the potential of niche-focused e-commerce platforms. Unlike generalized marketplaces, platforms catering to specific interests, such as sneakers, address unique consumer needs more effectively. This approach can inspire other industries to develop tailored solutions for their audiences, proving the scalability and relevance of specialized e-commerce. Furthermore, SNEAKSphere advances technological integration in the e-commerce space. Its use of AI, blockchain, and predictive analytics showcases how emerging technologies can enhance both operational efficiency and customer satisfaction.

In conclusion, SNEAKSphere represents a groundbreaking approach to e-commerce, merging cutting-edge technology, sustainability, and cultural relevance to meet the demands of the global sneaker market. Through rigorous research activities, the project aims to deliver a platform that not only caters to the practical needs of sneaker enthusiasts but also fosters community, drives innovation, and promotes environmental consciousness. By addressing critical challenges such as authenticity, user experience, and niche market engagement, SNEAKSphere sets a new benchmark for e-commerce platforms and offers a glimpse into the future of specialized online retail.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The field of e-commerce, particularly niche-focused platforms like SNEAKSphere, has seen significant advancements in recent years. The global sneaker industry has shifted from being purely functional to a cultural phenomenon, with platforms like StockX, GOAT, and Stadium Goods leading the market. Current research emphasizes creating trust and transparency, particularly in combating counterfeit products through technologies like blockchain. These platforms have successfully integrated verification systems, but their high fees and limited community engagement present opportunities for innovation.

Artificial intelligence (AI) is another area where research has made strides, enabling personalized recommendations and predictive analytics for inventory management. However, many platforms still struggle to balance technological sophistication with user-friendliness. Sustainability in e-commerce is gaining traction, with growing consumer demand for eco-friendly practices, yet few platforms actively prioritize this aspect.

Community building remains underexplored, as most e-commerce sites focus on transactions rather than fostering engagement through forums, social spaces, or exclusive events. Additionally, research into logistics optimization and scalability for niche platforms like sneaker-focused e-commerce remains limited.

In summary, while significant progress has been made in technologies like AI and blockchain, there is still untapped potential in sustainability, community building, and cost-effective logistics, which SNEAKSphere aims to address innovatively.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

Product Catalog : SNEAKSphere will offer an extensive catalog of sneakers, spanning various brands, models, styles, and price ranges. Users can browse and purchase sneakers with confidence, knowing they have access to a diverse selection.

User-Friendly Interface : The website will feature an intuitive and user-friendly interface, ensuring that customers can easily find, view, and purchase sneakers. Advanced search and filtering options will simplify the shopping process.

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Mobile Optimization: The website will be optimized for mobile devices to accommodate users who prefer shopping on smartphones and tablets.

Scheduled Delivery: Customer can schedule their delivery time , date and address.

6. Significance of the proposed study: (300 words)

The proposed study for SNEAKSphere holds significant relevance in addressing the unique demands of the sneaker industry while contributing to advancements in e-commerce. The sneaker market, now valued at over $70 billion, has evolved into a cultural and economic phenomenon, driven by limited-edition releases, celebrity collaborations, and the rise of athleisure fashion. However, the industry faces persistent challenges such as counterfeit products, lack of community-centric platforms, and limited sustainability practices. SNEAKSphere aims to tackle these issues, making this study critical for industry innovation.

One of the most pressing challenges in the sneaker market is trust. Counterfeit sneakers undermine consumer confidence, especially in resale markets. By integrating blockchain technology for product authentication, SNEAKSphere provides a reliable solution, setting a new standard for transparency and trust in online retail. This study will explore how blockchain can enhance customer satisfaction and improve platform credibility.

Moreover, the study is significant for its focus on sustainability. As environmental consciousness grows, e-commerce platforms are expected to align with eco-friendly practices. SNEAKSphere plans to promote sustainable sneaker brands, minimize packaging waste, and encourage recycling initiatives. This approach not only addresses consumer preferences but also contributes to reducing the industry's carbon footprint.

Additionally, SNEAKSphere emphasizes community building, a relatively unexplored aspect in e-commerce. By creating forums, sneaker release calendars, and virtual events, the platform aims to foster engagement, transforming transactional relationships into loyal communities.

Finally, the study provides valuable insights into the development of niche e-commerce platforms, showcasing how tailored solutions can outperform generalized marketplaces. Through a combination of advanced technologies, sustainability, and community engagement, SNEAKSphere aims to redefine the sneaker shopping experience, offering a blueprint for future innovations in specialized online retail.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study for SNEAKSphere is highly relevant to Gujarat, a state renowned for its entrepreneurial spirit, thriving textile and apparel industry, and growing technology-driven economy. Gujarat's well-established manufacturing base, particularly in footwear and allied industries, positions it as a key player in the global supply chain. By focusing on sneakers, a high-demand product category, SNEAKSphere offers an opportunity to showcase Gujarat's capabilities in producing and distributing quality footwear to a global audience.

Moreover, Gujarat's emerging IT and e-commerce ecosystem provide a robust foundation for the technological innovations planned for SNEAKSphere, such as AI-driven personalization and blockchain-based authentication. With cities like Ahmedabad and Gandhinagar developing as technology hubs, this project could further strengthen the state's reputation as a leader in digital solutions.

The platform's emphasis on sustainability aligns with Gujarat's growing focus on eco-friendly initiatives, such as promoting green businesses and reducing industrial waste. SNEAKSphere's plans to collaborate with sustainable sneaker brands and adopt environmentally conscious practices resonate with the state's vision for responsible growth.

Finally, the study can stimulate economic opportunities in Gujarat by empowering local entrepreneurs and small

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businesses to tap into the sneaker market through global e-commerce. SNEAKSphere has the potential to make Gujarat a pivotal player in the niche e-commerce domain, fostering innovation, employment, and sustainable practices.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research for SNEAKSphere is expected to deliver numerous societal benefits, particularly to Gujarat, by driving innovation, economic growth, and sustainable practices. Gujarat's dynamic industrial ecosystem and entrepreneurial culture make it an ideal beneficiary of the outcomes of this project.

One significant benefit is the creation of economic opportunities. By providing a platform that supports local sneaker manufacturers and small-scale entrepreneurs, SNEAKSphere can boost Gujarat's footwear industry. Local businesses will gain access to a global e-commerce platform, enabling them to showcase their products, increase sales, and compete on an international scale. This can lead to job creation and economic empowerment, particularly in Gujarat's industrial clusters.

The study's emphasis on sustainability aligns with Gujarat's environmental goals. SNEAKSphere will promote sustainable sneaker brands and practices, such as recycling initiatives and eco-friendly packaging. These measures can reduce waste, lower the carbon footprint, and encourage green manufacturing, setting an example for other industries in the state to follow. This focus on sustainability will enhance Gujarat's reputation as a forward-thinking and environmentally conscious state.

Technological innovation is another key area of benefit. The adoption of advanced technologies like AI for personalized shopping and blockchain for authentication will position Gujarat as a leader in tech-driven solutions. Local tech talent and startups in cities like Ahmedabad and Gandhinagar can contribute to and benefit from these developments, fostering a robust ecosystem of innovation.

On a societal level, SNEAKSphere aims to build a community around shared interests in sneakers. This can inspire cultural engagement and connect Gujarat's youth with global trends, fostering creativity and collaboration.

In conclusion, the proposed research has the potential to transform Gujarat's economy, align with sustainability goals, and enhance technological and cultural engagement, delivering long-term benefits to society.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	✓
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓

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6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	✓
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, and data analysis. (300- 400 words)

The development of SNEAKSphere requires a structured and comprehensive research methodology to ensure the platform addresses market needs effectively and achieves its goals. The methodology involves a series of systematic activities, including hypothesis formulation, sampling, data collection, and data analysis, to guide the project to completion.

Hypothesis

The central hypothesis of the study is: *"A niche e-commerce platform integrating advanced technology, sustainability, and community-building can significantly enhance consumer trust, engagement, and satisfaction in the sneaker market."*

Specific Research Activities

1. Market Research: Conduct surveys and focus groups to identify consumer preferences, trends, and pain points in the sneaker market.
2. Competitor Analysis: Analyze existing platforms like StockX and GOAT to understand their strengths and weaknesses.
3. Technological Feasibility: Assess the integration of AI for personalization, blockchain for authentication, and predictive analytics for inventory management.
4. Sustainability Practices: Research eco-friendly brands and packaging solutions to incorporate into the platform.
5. Community Engagement Features: Study successful community-based platforms to design features like forums and virtual events.

Sampling Plan

A combination of purposive and stratified sampling will be employed. The study will target:

- Consumers: Individuals aged 18-40, with an interest in sneakers or online shopping.
- Resellers and Manufacturers: Small and medium-scale businesses in Gujarat's footwear and related industries.
- Technology Experts: Professionals in AI, blockchain, and e-commerce logistics.

A sample size of 500 respondents (400 consumers and 100 industry stakeholders) will ensure diverse and representative data.

Data Collection

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Data will be collected using mixed methods, including:

- Quantitative Methods: Online surveys and structured questionnaires to gather measurable insights.
- Qualitative Methods: Focus group discussions, in-depth interviews, and observational studies to capture nuanced consumer behaviors and preferences.
- Secondary Data: Analysis of industry reports, market trends, and competitor case studies.

Data Analysis

The collected data will be analyzed using advanced tools and statistical techniques:

- Quantitative Analysis: Descriptive and inferential statistics to identify trends and validate the hypothesis.
- Qualitative Analysis: Thematic analysis of interviews and focus groups to derive actionable insights.
- Technology Evaluation: Feasibility studies to determine the effectiveness of AI and blockchain solutions.

This structured methodology ensures that the research comprehensively addresses the requirements for SNEAKSphere's development, providing actionable insights to build a platform that meets consumer needs and advances the sneaker e-commerce market.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The proposed plan of action for developing SNEAKSphere is divided into six key phases to ensure a systematic approach to research and implementation:

1. Market Analysis and Requirement Gathering:
   Conduct extensive surveys, focus groups, and competitor analysis to identify consumer preferences, market trends, and existing gaps in the sneaker e-commerce space. Gather insights on pricing, product authenticity, and sustainability expectations.
2. Platform Design and Development:
   Create a user-centric design emphasizing simplicity, responsiveness, and cultural relevance for sneaker enthusiasts. Integrate advanced technologies, including AI for personalized recommendations and blockchain for product authentication, to enhance trust and user experience.
3. Sustainability Integration:
   Collaborate with eco-friendly brands and design sustainable practices, such as recyclable packaging and a marketplace for pre-loved sneakers, to align with consumer demands for environmental responsibility.
4. Community Building Features:
   Develop engagement tools like forums, sneaker release calendars, and virtual events to foster a sense of belonging and loyalty among users.
5. Pilot Testing and Feedback:
   Launch a prototype platform for a select group of users, collect feedback, and refine features to meet user expectations effectively.
6. Marketing and Full-Scale Launch:
   Implement targeted marketing campaigns, influencer collaborations, and loyalty programs to attract and retain customers. Launch the platform statewide and scale operations based on user demand.

This phased approach ensures SNEAKSphere's successful development and long-term impact in the sneaker and e-commerce markets.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Market Research and Requirement Gathering	July	2024	June	2024

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2.	Platform Design and Development	July	2025	June	2025
3.	Sustainability Practices Integration	July	2026	June	2024
4.	Community Building Feature Development	July	2027	December	2022
5.	Pilot Testing and Feedback Collection	January	2028	December	2023
6	Marketing Campaigns and Full-Scale Launch	January	2029	June	2029

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Demain, Device	-	-	260000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	-	-	10000
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	3000
4.	Stationery and Printing (With justification)	-	-	10000
5.	Any other special requirement	-	-	7000
6.	Overhead (10% of recurring)	-	-	10000
	TOTAL			**300000**

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Application form

Part -A
(General Information)

1.	**Title of the proposal**	Streamlined Synthesis of Substituted Pyridone Derivatives: A One-Pot Approach with Enhanced Antimicrobial and Antifungal Properties	
2.	**Broad area of proposal**	Chemistry	
3.	**Sub Area of proposal**	Organic chemistry	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Archana Cholera	Associate Professor-Chemistry	9904254934

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5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	NA	**NA**	**NA**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	13/02/1978	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	26-6-2000	
9.	**Whether the PI is registered for Ph.D. on the same topic**	NA	
10.	**If yes then name of university**		

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	**Educational Qualification**				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	Ph. D.	Chemistry	Saurashtra University	2019	-
ii.	Post Graduation	Organic Chemistry	Saurashtra University	2000	
iii.	Under Graduation	Chemistry	Saurashtra University	1998	

2.	**Have you previously received any Fellowship from any funding agency?**	YES	✓ NO
3.	**If yes, please indicate whether it was a (✓ tick appropriate)**	short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	**If yes, mention the details of fellowship and tenure**		

5.	**Details of on-going and completed research funded projects (if any)**				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	**Total Experience**	Teaching Experience: (22 Years)
		Research Experience: (7 Years)
7.	**No. of Publication (Research articles - UGC Approved only)**	National : 1
		International : 1
8.	**No. of Publication (Book Chapters)**	
	Books Published	

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Part - C

PROJECT PROPOSAL

1. Title

Streamlined Synthesis of Substituted Pyridone Derivatives: A One-Pot Approach with Enhanced Antimicrobial and Antifungal Properties

2. Abstract

Abstract

The synthesis of substituted pyridone derivatives has garnered significant attention due to their remarkable biological activities, including antimicrobial and antifungal properties. However, traditional multi-step synthetic methods often face challenges such as low yields, harsh reaction conditions, and time-intensive procedures. This research proposal focuses on the development of a streamlined, one-pot synthetic approach to efficiently produce substituted pyridone derivatives with enhanced pharmacological potential.

Our proposed methodology involves the strategic use of readily available starting materials and eco-friendly catalysts to construct the pyridone framework in a single reaction vessel. By integrating key reaction steps such as condensation, cyclization, and functional group modification into a unified process, this approach minimizes reaction time, reduces waste, and improves overall efficiency. The optimization of reaction conditions, including temperature, solvent selection, and catalyst loading, will be systematically explored to maximize product yield and purity.

The synthesized pyridone derivatives will be structurally characterized using advanced spectroscopic techniques such as NMR, FT-IR, and mass spectrometry. Their antimicrobial and antifungal properties will be evaluated through in vitro assays against a range of pathogenic microorganisms, including bacterial and fungal strains. Comparative studies will be conducted to identify structural features that contribute to enhanced bioactivity, with the aim of elucidating structure-activity relationships (SAR).

This research not only seeks to address the synthetic bottlenecks associated with pyridone derivatives but also aims to expand their potential as versatile pharmacophores in drug development. The findings are expected to contribute significantly to the fields of medicinal and synthetic organic chemistry, providing a sustainable and scalable route for the production of biologically potent molecules.

This innovative one-pot approach aligns with green chemistry principles, offering an efficient, eco-friendly, and cost-effective solution to meet the growing demand for novel antimicrobial and antifungal agents.

3. Introduction:

The development of efficient and sustainable methods for synthesizing bioactive compounds remains a cornerstone of modern organic and medicinal chemistry. Pyridone derivatives,

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characterized by their versatile chemical structure and extensive range of biological activities, have emerged as critical scaffolds in drug discovery and development. These compounds exhibit potent antimicrobial, antifungal, anti-inflammatory, and anticancer properties, making them valuable pharmacophores in the design of therapeutic agents. Despite their immense potential, the traditional multi-step synthesis of pyridone derivatives often suffers from significant challenges, including low yields, prolonged reaction times, harsh reaction conditions, and the generation of toxic by-products. Addressing these issues, this research proposal seeks to develop a streamlined, one-pot synthetic approach to substituted pyridone derivatives, emphasizing efficiency, environmental sustainability, and enhanced biological activity.

Importance of the Proposed Study

The emergence of multidrug-resistant microbial and fungal strains poses a serious global health challenge, necessitating the urgent development of new and effective antimicrobial agents. Pyridone derivatives, due to their diverse functional groups and tunable properties, offer immense potential to address this need. However, the existing synthetic strategies are often incompatible with large-scale production or green chemistry principles, limiting their application in drug development. The proposed research addresses these critical gaps by focusing on the following key aspects:

1. **Development of a One-Pot Synthetic Strategy**: Traditional methods for synthesizing pyridone derivatives typically involve multiple reaction steps, each requiring isolation and purification of intermediates. This not only increases the time and cost of synthesis but also generates significant chemical waste. A one-pot approach integrates multiple reactions into a single operational step, reducing the overall environmental footprint while improving efficiency and scalability.
2. **Eco-Friendly and Sustainable Approach**: In line with green chemistry principles, this study aims to employ environmentally benign reagents and catalysts. The proposed method seeks to minimize the use of hazardous solvents and reduce energy consumption by optimizing reaction conditions.
3. **Enhanced Antimicrobial and Antifungal Activity**: By systematically exploring substitutions on the pyridone core, this research aims to identify derivatives with superior antimicrobial and antifungal properties. The study will also investigate structure-activity relationships (SAR) to elucidate the molecular features responsible for enhanced bioactivity.
4. **Potential for Broad-Spectrum Applications**: Beyond antimicrobial and antifungal applications, pyridone derivatives have shown promise in other therapeutic areas, including anti-inflammatory and anticancer therapies. The insights gained from this study may pave the way for their application in a wider range of medicinal contexts.

Research Activities to be Pursued

The project will focus on the following specific research activities during its duration:

1. **Design and Planning of One-Pot Synthetic Routes**:

   ✓ Selection of suitable starting materials and reagents for the synthesis of substituted pyridone derivatives.
   ✓ Identification and incorporation of catalysts (preferably eco-friendly catalysts) to facilitate efficient cyclization and functionalization reactions.

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✓Optimization of reaction parameters, including temperature, time, solvent selection, and reagent proportions, to maximize yield and purity.

2. **Optimization and Scalability of Reaction Conditions**:

✓Conducting small-scale reactions to systematically optimize the proposed one-pot approach.
✓Exploring scalability by transitioning optimized reactions to larger batches, assessing reproducibility and consistency.
✓Evaluating the environmental impact of the process, including waste generation and energy consumption.

3. **Structural Characterization of Synthesized Derivatives**:

✓Employing advanced spectroscopic techniques such as nuclear magnetic resonance (NMR), Fourier-transform infrared spectroscopy (FT-IR), and mass spectrometry to confirm the chemical structure of synthesized compounds.
✓Utilizing X-ray crystallography for detailed structural analysis of selected derivatives.

4. **Biological Activity Evaluation**:

✓Testing the synthesized derivatives for antimicrobial and antifungal activity using standard in vitro assays.
✓Screening against a range of microbial pathogens (Gram-positive, Gram-negative bacteria) and fungal strains to determine spectrum of activity.
✓Calculating minimum inhibitory concentration (MIC) values to quantify bioactivity.

5. **Structure-Activity Relationship (SAR) Studies**:

✓Systematically varying substituents on the pyridone core to identify structural features critical for biological activity.
✓Correlating bioactivity data with chemical structure to elucidate SAR.
✓Designing new derivatives based on SAR findings to further enhance activity.

6. **Comparative Analysis with Existing Methods**:

✓Benchmarking the one-pot synthetic approach against traditional multi-step methods in terms of yield, efficiency, environmental impact, and scalability.
✓Comparing the antimicrobial and antifungal activity of synthesized derivatives with commercially available drugs to assess their therapeutic potential.

Significance of the Proposed Study

This research holds immense potential to contribute to the fields of synthetic organic chemistry, medicinal chemistry, and pharmaceutical sciences. The streamlined one-pot synthesis of pyridone derivatives represents a significant advancement in the efficient and sustainable production of bioactive compounds. By reducing reaction complexity and environmental impact, this approach aligns with the growing demand for green chemistry solutions in drug development.

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Furthermore, the emphasis on enhancing the antimicrobial and antifungal properties of pyridone derivatives addresses a pressing global health issue—the rising prevalence of drug-resistant infections. The insights gained from SAR studies will not only aid in the rational design of more potent derivatives but also provide a deeper understanding of the molecular basis of their bioactivity.

In conclusion, the proposed study offers a comprehensive framework for the development of novel pyridone derivatives with improved pharmacological profiles. By integrating synthetic efficiency, environmental sustainability, and biological efficacy, this research is poised to make a significant impact on both scientific advancement and public health. The findings are expected to serve as a foundation for future studies and applications, ultimately contributing to the discovery of next-generation therapeutic agents.

4. Status of Current Research in the proposed field:

The synthesis of substituted pyridone derivatives has been a subject of significant interest due to their broad spectrum of biological activities, including antimicrobial and antifungal properties. Traditionally, the synthesis of these compounds has relied on multi-step procedures, involving condensation, cyclization, and subsequent functional group modifications. While these methods are well-established, they often require harsh reaction conditions, expensive or toxic reagents, and produce substantial chemical waste, limiting their scalability and environmental compatibility.

Recent advancements have focused on streamlining these processes through catalytic methods and innovative reaction designs. Transition-metal catalysts, such as palladium and copper, have been employed to facilitate cyclization reactions, while microwave-assisted synthesis has emerged as a promising technique for reducing reaction times. However, these methods still face challenges, such as limited substrate scope, complex catalyst recovery, and high operational costs.

In the context of biological activity, studies have demonstrated that subtle structural modifications in the pyridone core significantly influence antimicrobial and antifungal efficacy. Despite promising results, systematic structure-activity relationship (SAR) studies remain incomplete, leaving critical gaps in understanding the optimal design of bioactive pyridone derivatives.

Overall, while progress has been made in synthetic methodologies and bioactivity studies, the development of a one-pot, eco-friendly approach with comprehensive SAR exploration remains an unmet need, offering a compelling avenue for innovation in this field.

5. Objectives of the proposed study:

1. To develop a one-pot synthetic methodology for substituted pyridone derivatives, integrating multiple reaction steps into a single, streamlined process.
2. To optimize reaction conditions, including catalyst selection, temperature, solvent, and reagent ratios, for improved yield, purity, and scalability.
3. To explore the use of eco-friendly catalysts and solvents in alignment with green

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chemistry principles, minimizing environmental impact and chemical waste.
4. To conduct a comprehensive structural characterization of synthesized pyridone derivatives using advanced spectroscopic techniques, such as NMR, FT-IR, and mass spectrometry.
5. To evaluate the antimicrobial and antifungal properties of the synthesized derivatives through in vitro assays, determining their efficacy against a broad range of microbial and fungal strains.
6. To perform structure-activity relationship (SAR) studies to identify key structural features contributing to enhanced bioactivity and to guide the design of more potent derivatives.

6. Significance of the proposed study:

The proposed study addresses critical challenges in the synthesis of substituted pyridone derivatives, presenting a streamlined, one-pot approach that aligns with the principles of green chemistry. By reducing the reliance on multi-step processes, this research offers an innovative solution to the inefficiencies of traditional synthesis methods, including high costs, prolonged reaction times, and significant environmental impact. The development of a sustainable, eco-friendly synthetic pathway holds immense potential for scalable production and industrial applications.

The antimicrobial and antifungal properties of pyridone derivatives are of particular relevance in combating the growing threat of drug-resistant pathogens. With infectious diseases causing significant morbidity and mortality worldwide, the discovery of potent and effective therapeutic agents is of paramount importance. This study aims to produce pyridone derivatives with enhanced bioactivity, filling the gap in the availability of novel antimicrobial agents. By conducting structure-activity relationship (SAR) studies, the research will identify critical molecular features that contribute to bioactivity, aiding in the rational design of next-generation therapeutic compounds.

Additionally, the proposed study contributes to the advancement of synthetic and medicinal chemistry, fostering innovation in drug discovery. The one-pot methodology not only enhances efficiency but also sets a benchmark for sustainable practices in pharmaceutical synthesis. The findings are expected to have a broad impact, paving the way for future research and the development of versatile bioactive compounds with applications in various therapeutic areas.

7. Relevance of the proposed study to Gujarat:

Gujarat, recognized as the "Pharma Hub of India," plays a pivotal role in the country's pharmaceutical and chemical industries. The proposed study's focus on developing a streamlined, eco-friendly synthesis of substituted pyridone derivatives aligns with the state's emphasis on innovation, sustainability, and industrial growth. The one-pot synthetic approach can enhance the efficiency of drug production processes, contributing to Gujarat's leadership in pharmaceutical manufacturing.

The state is home to numerous pharmaceutical companies and research institutions actively involved in the development of antimicrobial and antifungal agents. The growing prevalence of drug-resistant pathogens presents a significant challenge to healthcare systems, including those

in Gujarat. The proposed research can address this issue by providing novel, potent therapeutic agents that meet the needs of the local and global markets.

Additionally, Gujarat's commitment to green industrial practices makes the proposed eco-friendly methodology particularly relevant. By minimizing chemical waste and energy consumption, this research aligns with the state's environmental policies and sustainability goals.

By fostering collaboration between academic researchers and the pharmaceutical industry in Gujarat, the study can bridge gaps between basic research and industrial application. Ultimately, the outcomes of this research hold promise for advancing Gujarat's contributions to healthcare innovation and sustainable industrial practices.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat:

Gujarat, often referred to as the "Pharma Hub of India," plays a pivotal role in the country's pharmaceutical and chemical industries. With a significant share in drug manufacturing and exports, the state is a leading contributor to healthcare solutions globally. However, the growing threat of antimicrobial resistance (AMR) poses a challenge to the industry, requiring the development of novel and effective antimicrobial agents. The proposed study aligns with this need by focusing on the synthesis of Pyridone derivatives with potential antimicrobial activity, directly contributing to Gujarat's pharmaceutical advancements. Furthermore, Gujarat is committed to sustainable industrial practices, particularly in chemical manufacturing. The integration of green chemistry principles in this study—such as eco-friendly synthesis and minimal waste generation—resonates with the state's efforts to promote environmentally conscious practices. Industries in Gujarat can benefit from adopting such sustainable methods, enhancing their competitiveness and compliance with international standards. Moreover, the outcomes of this research can boost academic and industrial collaboration in Gujarat, fostering innovation in drug discovery and sustainable chemistry. By addressing both health and environmental challenges, the proposed study has the potential to solidify Gujarat's position as a leader in the development of next-generation pharmaceuticals.

9. The proposal can be broadly classified into any of the below mentioned focus areas:

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	
2.	Agriculture	
3.	Health and wellness	
4.	Nutrition	
5.	Development of Industrial Problem Solutions	

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6.	Resources management and sustainable development	
7.	High Impact Teaching	
8.	Imparting corporate responsibility, ethics, accountability and values in society	
9.	Social entrepreneurship	
10.	Others (if any)	✓

10. Methodology:

Hypothesis

The one-pot synthesis of substituted pyridone derivatives using an eco-friendly approach will lead to the development of cost-effective and efficient compounds with enhanced antimicrobial and antifungal properties, making them promising candidates for therapeutic applications.

Specific Research Activities

1. **Optimization of Synthesis Protocol**

   ✓A one-pot synthetic strategy will be developed using β-keto acids, amines, and electrophilic reagents as substrates.
   ✓The reaction conditions (temperature, solvent, catalyst type and concentration, and reaction time) will be optimized to maximize yield, purity, and efficiency.
   ✓Green chemistry principles, such as the use of recyclable solvents and catalysts, will be prioritized to ensure the process is environmentally sustainable.

2. **Structural Characterization**

   ✓The synthesized pyridone derivatives will be characterized using Nuclear Magnetic Resonance (NMR) spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, and High-Resolution Mass Spectrometry (HRMS) to confirm the molecular structure and purity of the compounds.

3. **Antimicrobial and Antifungal Testing**

   ✓The synthesized pyridone derivatives will be screened for antimicrobial activity against a range of Gram-positive (Staphylococcus aureus) and Gram-negative (Escherichia coli, Pseudomonas aeruginosa) bacteria.
   ✓Antifungal activity will be tested against Candida albicans and Aspergillus niger.
   ✓Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) values will be determined using standard microdilution techniques.

4. **Structure-Activity Relationship (SAR) Studies**

   ✓The effects of different substituents on the antimicrobial and antifungal activity will be

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analyzed to identify key structural features that contribute to efficacy.

- ✓SAR analysis will guide the design of more potent derivatives by correlating specific structural modifications with biological activity.

5. **Comparative Efficacy**

- ✓The antimicrobial and antifungal activity of the synthesized compounds will be compared to that of standard antibiotics (e.g., ampicillin for bacteria and ketoconazole for fungi) to identify promising candidates for further development.

Sampling Plan

- ✓A variety of β-keto acids and amines with different functional groups will be chosen to create a broad range of substituted pyridone derivatives. This will provide structural diversity for testing.
- ✓The microbial strains selected for testing will include both clinical isolates and well-established standard strains to ensure that the synthesized compounds have broad-spectrum activity.

Data Collection

- **Chemical Data**: Reaction yields, structural data from NMR, FTIR, and HRMS, and purity levels will be documented to assess the efficiency of the synthesis protocol.
- **Biological Data**: Inhibition zones, MIC, and MBC values obtained from antimicrobial and antifungal assays will be recorded to evaluate the biological activity of the compounds.

Data Analysis

- **Chemical Data**: The efficiency and reproducibility of the synthesis will be analyzed by evaluating the yield and purity of the synthesized compounds.
- **Biological Data**: Statistical analysis (e.g., ANOVA) will be conducted to determine the significance of antimicrobial and antifungal activity differences between the compounds. SAR trends will be identified to correlate structural features with biological activity.
- **Comparative Studies**: The relative efficacy of the synthesized pyridone derivatives will be compared with the activity of standard antibiotics to assess their potential as therapeutic agents.

This comprehensive methodology ensures the development of substituted pyridone derivatives with enhanced antimicrobial and antifungal properties, achieved through a streamlined, eco-friendly synthesis route.

Proposed Scheme :

Scheme-: Synthesis of carboxamide and cyano bearing pyridone derivatives

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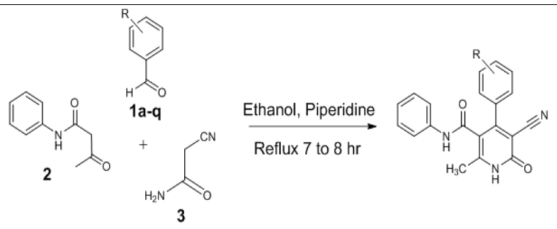

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11. Suggested plan of action:

The proposed study will be executed in three phases to ensure systematic progress:

Phase 1: Synthesis Optimization

Develop and optimize a one-pot synthesis protocol for Pyridone derivatives.

Focus on green chemistry principles by employing recyclable catalysts and eco-friendly solvents.

Conduct trial reactions with various substrates to maximize yield, selectivity, and scalability.

Phase 2: Characterization and Screening

Characterize the synthesized compounds using NMR, FTIR, and mass spectrometry to confirm their structure and purity.

Perform in vitro antimicrobial testing against a panel of Gram-positive and Gram-negative bacteria and fungal species.

Determine MIC and MBC values to quantify antimicrobial potency.

Phase 3: Analysis and Optimization

Conduct structure-activity relationship (SAR) studies to identify key structural features contributing to biological activity.

Compare the antimicrobial efficacy of synthesized compounds with standard antibiotics to

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identify potential lead candidates.
Refine the synthetic methodology or structural designs based on findings for improved biological activity and sustainability.
This phased approach ensures a balance between chemical innovation and biological evaluation, delivering a streamlined, impactful process for the development of novel antimicrobial and antifungal agents with practical applications.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature review and formulation of hypothesis	June	2022	July	2022
2.	Development and optimization of synthesis	August	2022	October	2023
3.	Structural characterization of synthesized compounds	November	2023	January	2024
4.	Antimicrobial evaluation and data collection	February	2024	May	2024
5.	Data analysis, SAR studies, and report preparation	June	2024	June	2025

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables			
2.	a. Chemicals,	15,000	12	1,80,000
3.	b. Glassware,	8,125	8	65,000
4.	c. Electric items	3,000	10	30,000
	d. Other items (specify)			
5.	Travelling (*viz.* sample collection, should be Minimum and with justification)	10,000	4	40,000
6.	Contingency	3,000	1	3,000

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	(Upto maximum for Rs. 3000/-)			
7.	Stationery and Printing (With justification)	2,000	6	12,000
8.	Any other special requirement			
9.	Overhead (10% of recurring)			
	TOTAL	**3,30,000**		

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a) Reactants for triazine synthesis	1,00,000	June to December	Required in bulk to optimize one-pot synthesis for various derivatives.
	b) Solvents for reactions	50,000	June to December	Essential for eco-friendly synthesis; aligns with green chemistry principles.
	c) Analytical-grade reagents	30,000	January to May	Needed for purification and characterization of compounds.
2.	**B. Glassware**			
	a) Reaction vessels	30,000	June to August	For precise and safe execution of synthesis protocols.
	b) Measuring apparatus	20,000	June to August	Required for accurate measurements of reactants and reagents.
	c) Storage containers	15,000	Ongoing	For safe storage of chemicals and synthesized compounds.
3.	**C. Any other consumable items (like wires/ electric items etc)**			

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	a) Electric items (wires, adapters, etc.)	15,000	June to August	Needed for setting up and maintaining laboratory equipment.
	b) Filters and membranes	15,000	Ongoing	For purification of products and separation of impurities.
4.	**Travel**	No. of Times in a month		
	a) Travel to collect biological samples	20,000	September and January	Essential for acquiring samples for antimicrobial testing.
	b) Visit to collaborative institutions	20,000	October and February	To access advanced facilities for testing and characterization.
5.	**Contingency**	3,000	Ongoing	Covers unforeseen expenses during the research period.
6.	**Stationery and printing**			
	a) Printing experimental protocols	5,000	Ongoing	Essential for sharing protocols with team members and collaborators.
	b) Printing final reports and manuscripts	7,000	April to May	For preparing final submissions and publication materials.
	Grand Total	3,30,000		

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Research Project Proposal
June-2022

1.	Title of the proposal	Improvement of mechanical properties of dry lean concrete by using different materials	
2.	Name of Principle Investigator	Mr. Ashraf M. Mathakiya	
3.	Designation & Department	Designation	Assistant Professor
		Faculty	Engineering and Technology
		Department	Civil Engineering
4.	Contact details (e-mail, mobile number, Ext. no.)	Mobile Number (WhatsApp Number)	9974078377
		Email	ashraf.mathakiya@atmiyauni.ac.in
		Departmental Extension number	1065

Application form

Part -A
(General Information)

1.	Title of the proposal	Improvement of mechanical properties of dry lean concrete by using different materials
2.	Broad area of proposal	Engineering
3.	Sub Area of proposal	Highway Engineering
4.	Details of Principal Investigator (PI)	

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	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Mr. Ashraf M. Mathakiya	Assistant Professor, Civil Engineering Department	Email: ashraf.mathakiya@atmiyauni.ac.in Mo. No. : 9974078377 Ext. no. : 1071
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	-	-	-
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	25/11/1992	
8.	Date of joining the Department of PI (DD/MM/YYYY)	20/06/2016	
9.	Whether the PI is registered for Ph.D. on the same topic	N.A.	
10.	If yes then name of university	-	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

Part -B
(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	-	-	-
ii.	Post Graduation	Civil (Transportation	GTU	2016	78.70

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		Engineering)			
iii.	Under Graduation	Civil Engineering	GTU	2014	73.00
iv.	CSIR/UGG-NET/ SLET/GATE	-			

2.	Have you previously received any Fellowship from any funding agency?		NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐short-term fellowship (viz Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	-	

5. Details of on-going and completed research funded projects (if any)

Sr. No.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-

6.	Total Experience	Teaching Experience: (8 Year + 6 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: -
		International: -
8.	No. of Publication (Book Chapters)	-
	Books Published	-

(Please enclose the list of papers and books published and/or accepted during last five years)

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

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Improvement of mechanical properties of dry lean concrete by using different materials

2. Abstract (Provide a summary of your research proposal in 300 words)

The mechanical properties of dry lean concrete (DLC) play a crucial role in its performance as a subbase material in pavement construction. However, due to its low cement content and high water demand, DLC often exhibits limited strength and durability. This research proposal aims to investigate methods for improving the mechanical properties of DLC by incorporating various materials and admixtures.

The study will explore the use of supplementary cementitious materials (SCMs) such as fly ash, ground granulated blast-furnace slag (GGBS), and silica fume to enhance binding characteristics and durability. Additionally, the effect of incorporating chemical additives such as superplasticizers and water-reducing agents on DLC's compressive strength, tensile strength, and modulus of elasticity will be assessed.

The research methodology will involve material characterization, mix design optimization, and extensive laboratory testing, including compressive strength, flexural strength, and durability analysis under simulated environmental conditions. The outcomes of this study are expected to contribute to the development of cost-effective and sustainable DLC mixes with superior mechanical properties, thereby enhancing the longevity and performance of pavements. These findings will offer practical solutions for civil engineering applications and align with global efforts toward sustainable infrastructure development.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Dry lean concrete (DLC) is a low-cement, low-water-content concrete mix commonly used as a subbase layer in rigid pavement construction. Its primary function is to provide a stable foundation for the pavement while distributing traffic loads effectively. Due to its economic benefits and simplicity in construction, DLC has become a popular choice in large-scale projects. However, the mechanical properties of DLC, such as compressive strength, tensile strength, and durability, are often suboptimal due to its lean composition. This poses challenges in ensuring the long-term performance and structural integrity of pavements, particularly in regions subjected to heavy traffic loads or harsh environmental conditions.

The mechanical properties of DLC are critical for its performance. Compressive strength ensures the ability of the material to withstand loads without failure, while tensile and flexural strength contribute to its resistance to cracking and deformation. Inadequate strength or durability in DLC can lead to premature failure, increased maintenance costs, and reduced pavement lifespan. Hence, improving the mechanical properties of DLC is essential to address these issues and ensure the development of sustainable and efficient pavement systems.

One promising approach to enhancing the mechanical performance of DLC involves modifying its composition by incorporating alternative materials. These include supplementary cementitious materials (SCMs) such as fly ash, ground granulated blast-furnace slag (GGBS), and silica fume. These materials have pozzolanic properties that improve the binding characteristics and microstructure of the concrete matrix, leading to better strength and durability. Additionally, the use of recycled aggregates can promote sustainability by reducing dependence on natural

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resources and minimizing construction waste.

Another avenue for improvement lies in the incorporation of fibers and chemical admixtures. Natural or synthetic fibers, such as polypropylene, steel, or basalt fibers, can enhance tensile strength and crack resistance by providing reinforcement at the micro-level. Chemical admixtures, such as superplasticizers and water-reducing agents, can optimize workability and water-cement ratios, enabling better compaction and hydration of the mix.

The potential benefits of modifying DLC go beyond mechanical properties. Improved material performance can lead to longer-lasting pavements, reduced maintenance costs, and increased sustainability by minimizing the environmental impact of cement production. Additionally, incorporating industrial byproducts, recycled materials, and fibers aligns with global efforts to promote sustainable development in construction practices.

Despite these advantages, the integration of alternative materials into DLC requires a comprehensive understanding of their effects on the mechanical and durability properties of the mix. Factors such as optimal dosage, compatibility with existing materials, and cost implications must be carefully evaluated. Furthermore, extensive testing is required to ensure that the modified DLC meets the stringent performance criteria for subbase applications.

This research proposes a systematic investigation into the improvement of DLC's mechanical properties through the incorporation of various materials. The study will focus on evaluating the effects of SCMs, fibers, and chemical admixtures on key mechanical parameters, such as compressive strength, tensile strength, modulus of elasticity, and durability. Additionally, advanced techniques such as microstructural analysis will be employed to understand the underlying mechanisms contributing to performance enhancement.

The findings of this research are expected to provide practical insights into optimizing DLC mixes for subbase applications. By addressing the limitations of conventional DLC, the study aims to contribute to the development of cost-effective, durable, and sustainable pavement solutions. This aligns with the broader goals of improving infrastructure resilience, reducing carbon emissions, and promoting resource efficiency in the construction industry.

In summary, the improvement of mechanical properties of DLC through the use of alternative materials and admixtures presents a promising avenue for addressing the challenges associated with conventional mixes. This research will not only enhance the performance of DLC but also contribute to the advancement of sustainable construction practices, making it a valuable endeavor in the field of civil engineering.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research on improving the mechanical properties of dry lean concrete (DLC) has gained significant traction in recent years due to its critical role in pavement construction. Several studies have explored the incorporation of supplementary cementitious materials (SCMs) such as fly ash, ground granulated blast-furnace slag (GGBS), and silica fume, which enhance strength and durability by refining the microstructure and promoting pozzolanic reactions. Similarly, the use of recycled aggregates has been investigated for its potential to improve sustainability while maintaining adequate mechanical performance.

The addition of fibers, such as polypropylene and steel fibers, has been shown to enhance tensile

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strength and crack resistance, addressing the brittle nature of conventional DLC. Furthermore, chemical admixtures like superplasticizers and water reducers have demonstrated effectiveness in optimizing workability and hydration. Despite these advancements, challenges remain in determining the optimal material combinations, dosages, and compatibility with DLC's lean mix design.

Recent studies have also emphasized the need for advanced characterization techniques, such as scanning electron microscopy (SEM) and X-ray diffraction (XRD), to better understand the microstructural changes influencing mechanical properties. However, research on field performance under varying environmental and traffic conditions remains limited, necessitating further investigation to ensure practical applicability and long-term reliability.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To perform physical properties of material
2. To Enhance Mechanical Properties of DLC
3. To Optimize Mix Design
4. To Improve Durability

6. Significance of the proposed study: (300 words)

The proposed study holds significant importance in addressing the limitations of conventional dry lean concrete (DLC) and contributing to advancements in sustainable and durable pavement construction. DLC is a critical component of pavement subbase layers, providing load distribution and structural support. However, its lean composition often results in suboptimal mechanical properties, such as low strength and poor durability, which can lead to premature pavement failure and increased maintenance costs.

This research aims to improve DLC's mechanical properties through the incorporation of supplementary cementitious materials (SCMs), fibers, and chemical admixtures. By enhancing its compressive strength, tensile strength, and durability, the study will contribute to the development of DLC mixes capable of withstanding higher traffic loads and harsh environmental conditions. Optimized DLC designs will improve pavement performance and extend service life, ultimately reducing maintenance costs and disruptions.

Overall, this study will address critical challenges in DLC applications, offering practical and sustainable solutions for improving pavement systems. It is expected to have far-reaching impacts on cost-effectiveness, durability, and environmental sustainability in construction practices.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study is highly relevant to Gujarat, a state with extensive infrastructure development and rapidly growing transportation networks. Gujarat's strategic location as a hub for industrial and economic activities demands durable and efficient road infrastructure to support heavy traffic loads and ensure smooth connectivity. Dry lean concrete (DLC) is a commonly used subbase material for pavements in Gujarat due to its cost-effectiveness. However, its inherent limitations, such as low strength and durability, pose challenges for

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sustaining the long-term performance of pavements under the region's demanding conditions.

Gujarat's diverse environmental conditions, ranging from arid to coastal regions, expose pavements to temperature variations, salinity, and moisture-related stresses, accelerating deterioration. Enhancing the mechanical properties and durability of DLC through the use of alternative materials is essential to mitigate these challenges. Additionally, the integration of industrial byproducts such as fly ash and slag, readily available in Gujarat due to its robust industrial base, can promote sustainable construction practices and reduce waste.

This study aligns with Gujarat's commitment to infrastructure development and sustainable practices. The findings can contribute to the creation of durable and eco-friendly roadways, ensuring long-term economic benefits while supporting the state's vision of becoming a leader in sustainable infrastructure development.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research project has the potential to deliver significant societal benefits, particularly for the state of Gujarat, by addressing key challenges in infrastructure development and promoting sustainable construction practices.

One of the primary benefits is the improvement of road quality and longevity. By enhancing the mechanical properties and durability of dry lean concrete (DLC), the research will contribute to more robust and long-lasting pavements. This will reduce the frequency of repairs and maintenance, ensuring smoother transportation networks and minimizing disruptions for the public and businesses. Improved road quality will support Gujarat's growing industrial and trade activities by providing reliable connectivity, fostering economic growth.

The adoption of sustainable construction materials, such as industrial byproducts (e.g., fly ash, GGBS) and recycled aggregates, will also have environmental benefits. It will help reduce the extraction of natural resources, minimize construction waste, and lower greenhouse gas emissions associated with cement production. These measures align with Gujarat's initiatives for promoting eco-friendly development and can serve as a model for other states.

Furthermore, the cost savings achieved through optimized DLC mixes will benefit government agencies and taxpayers by lowering infrastructure construction and maintenance expenses. Efficient and durable road systems will also enhance public safety and convenience, improving the overall quality of life for Gujarat's residents.

Additionally, the findings can boost local industries by creating demand for industrial byproducts, contributing to the circular economy. By incorporating innovative and sustainable practices, the research will help Gujarat maintain its reputation as a leader in infrastructure development while addressing global challenges like climate change and resource depletion.

Overall, the societal impact of this research lies in its ability to deliver cost-effective, durable, and environmentally sustainable infrastructure solutions that support Gujarat's growth and enhance the well-being of its citizens.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	✓
2.	Agriculture	
3.	Health and wellness	
4.	Nutrition	
5.	Development of Industrial Problem Solutions	
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	
8.	Imparting corporate responsibility, ethics, accountability and values in society	
9.	Social entrepreneurship	
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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Hypothesis

The incorporation of supplementary cementitious materials (SCMs) and chemical admixtures into dry lean concrete (DLC) enhances its mechanical properties, durability, and sustainability without significantly increasing costs.

Research Activities

1. Literature Review:
   Conduct an extensive review of existing studies on DLC and the use of alternative materials to identify knowledge gaps and establish the basis for mix design modifications.
2. Material Selection and Characterization:
   Identify and source materials such as fly ash, ground granulated blast-furnace slag (GGBS), silica fume, and chemical admixtures (e.g., superplasticizers). Perform material characterization using standard tests to assess properties like fineness, specific gravity, and chemical composition.
3. Mix Design Optimization:
   Develop a range of DLC mix designs by systematically varying the proportions of cement, aggregates, SCMs, fibers, and admixtures. Adopt established guidelines, such as Indian Roads Congress (IRC) specifications, to create practical and feasible mix designs.
4. Experimental Testing:
   Conduct laboratory tests to evaluate the mechanical and durability properties of the optimized DLC mixes, including:
   - Compressive Strength: Using cubes and cylindrical samples.
   - Flexural and Tensile Strength: Using beams and splitting tensile tests.
   - Durability Tests: Evaluating resistance to cracking, freeze-thaw cycles, and abrasion.

Sampling Plan

Design a systematic sampling plan to prepare specimens for various tests. Each mix design will be replicated multiple times to ensure statistical reliability. Samples will be tested at different curing intervals (e.g., 7, 28, and 56 days) to monitor strength and durability development over time.

Data Collection

Collect data on material properties, test results. Document all observations and results systematically for analysis.

Data Analysis

Use statistical tools to compare the performance of different mix designs, evaluating the effects of individual materials and combinations. Perform regression analysis to identify optimal material proportions and establish predictive models for DLC performance. Results will be interpreted to validate the hypothesis and develop practical recommendations.

This methodology ensures a systematic and comprehensive approach to addressing the research objectives and deriving actionable insights.

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11. Suggested plan of action: Define the suggested plan of action in 200 words)

As per above description

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Procurement of Instrument	June	2022	July	2024
2.	Study Different Elements	July	2024	September	2025
3.	Experimental study	September	2025	December	2025
4.	Cost Analysis	December	2025	January	2026
5.	Publication	January	2026	March	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	a. Fly ash, cement, aggregate, sand, GGBS, plasticizer chemical b. Flexural strength test machine c. Durability test setup d. Mixture	-	1	Rs. 82000/- Rs. 150000/- Rs. 100000/- Rs. 50000/-
2.	Travelling (viz. sample collection, should be Minimum and with justification)	-	-	Rs. 20000/-
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	Rs. 3000/-
4.	Publication	-	-	Rs. 30,000/-
5.	Surveys at different location	-	-	Rs. 20,000/-
6.	Overhead (10% of recurring)	-	-	Rs. 45000/-
	TOTAL	-	-	Rs. 500000/-

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

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S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	A. Materials			
a.	Fly ash, cement, aggregate, sand, GGBS, plasticizer chemical	Rs. 82000/-	Up to July-2022-24	
b.	Flexural strength testmachine	Rs. 150000/-	Up to July-2022-24	
c.	Durability test setup	Rs. 100000/-	Up to July-2022-24	
d.	Mixture	Rs. 50000/-		
2.	Travelling (viz. sample collection, should be Minimum and with justification)	Rs. 20000/-	-	Reputed scopus /WosS/ UGC care publication
3.	Contingency (Upto maximum for Rs. 3000/-)	Rs. 3000/-	-	If required
4.	Publication	Rs. 30,000/-	-	Reputed scopus /WosS/ UGC care publication
5.	Surveys at different location	Rs. 20,000/-	-	Surveys and other visits
6.	Overhead (10% of recurring)	Rs. 45000/-	-	If required
	TOTAL	Rs. 500000/-	-	

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Yoga for Sustainable Living	
2.	**Broad area of proposal**	*Life Science*	
3.	**Sub Area of proposal**	Yoga	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Mrs. Bhumika S. Zalavadia	Asst. Professor, Computer Engineering Department	bhumika.zalavadia@atmiyauni.ac.in, 9909736800, 1508
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Mr. Indrajit J. Jadeja	Asst. Professor, Computer Engineering Department	indrajitsinh.jadeja@atmiyauni.ac.in, 9725503943, 1503
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**	10/03/1980	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01/03/2012	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.				
ii.	Post Graduation		Karnataka State Open University	2011	78
iii.	Under Graduation		Sardar Patel University, Vallabh Vidyanagar	2001	64
iv.	CSIR/UGG-NET/ SLET/GATE				

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☐ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (13 Years + 09 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 01
		International: 10

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8.	No. of Publication (Book Chapters)	
	Books Published	08
(Please enclose the list of papers and books published and/or accepted during last five years)		

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PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Yoga for Sustainable Living

2. Abstract (Provide a summary of your research proposal in 300 words)

Today, the biggest challenge that the world is facing is unsustainability in different areas of life. In 2015, UN defined seventeen Sustainable Development Goals, to be achieved by 2030. Today, the humans must have to realize the meaning of Yog - Existence is Coexistence. It means, ability to realize the fact that Existence is Coexistence, means every individual object/act of this universe is connected with the rest of the world. Sustainability refers to the ability to be maintained at certain state which leads to the overall balanced state of entire world. It is required at physical, social, economical, environmental, emotional and spiritual levels to have balanced state where every human can live happy life and can reach the ultimate goal of life - Mokṣa. Indian scriptures had given the ways of sustainable living. Eight stages in Yogsūtra by Maharṣi Patañjali is the sequential process to realize our connection with the rest of world. Lord Krishna in Bhagavad Gītā says about Gyān Yog, Karm Yog and Bhakti Yog, which ultimately leads to the attainment of sustainability living. Vedâs talked about four Puruṣārtha – Dharma - right way of living, Arth - to fulfill basic requirement of life, Kāma - desire/pleasure, Mokṣa - liberation from everything. Moksha sustains Dharma, Dharma sustains Arth and Kāma. The concern of Dharma and Mokṣa is to create sustainable Arth and Kāma. This project will focus on how human can realize Yog - connection with rest of the world and live by ancient Indian ways of sustainable living.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The project will mainly focus on ancient Indian ways of achieving sustainability at different levels of life. It will help to identify and explore the facts that how we can achieve the sustainability in scientific way and keep the society, nation and the entire world in a balanced state. This project will focus on exploring different ancient Indian practices related with Ahār - what we eat - for physical sustainability, Achār – our conduct with the external world - for social, economical and environmental sustainability, Vichāra – our thoughts - for emotional and spiritual sustainability, Vihāra – rest or recreation activities – for physical and emotional sustainability. This project will scientifically generate the outputs in the form of surveys, feedbacks, experiments, models etc. to demonstrate how sustainability at different levels of life is connected with and dependent on each other; it will prove that it is not possible to achieve the sustainability at one level completely without getting it at all other levels. As Existence is Coexistence, the human acts at one level immediately affect at rest of the world and may lead the entire world in either balanced or unbalance state. It will help in creating some real-life models of sustainable living.

Different types of activities like surveys, feedbacks, experiments, development of models etc. will be done in the association with education institutions and different areas of society like industries, government organizations, NGOs, social workers etc. to conclude the result of ideas given in the ancient Indian scriptures for getting balanced life.

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4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research in the field of "Yoga for Sustainable Living" has been expanding, focusing on the integration of yoga practices with principles of sustainability, both at the individual and societal levels. This interdisciplinary field explores how yoga, with its emphasis on mindfulness, ethical living, and interconnectedness, can contribute to ecological well-being and promote sustainable lifestyles. Studies have found that yoga practices can enhance awareness of environmental issues, foster compassion for all living beings, and encourage practices like minimalism, resource conservation, and reduced consumption. Additionally, yoga's emphasis on mental clarity and stress reduction is seen as crucial for making mindful choices that support sustainability. Researchers have also examined the role of yoga in promoting sustainable mental health, emotional resilience, and community well-being. Yoga's holistic approach to health—balancing body, mind, and spirit—aligns with sustainable living by encouraging harmony with oneself and nature. Moreover, several studies suggest that yoga, through its ethical principles (such as Ahimsa or non-violence), can inspire individuals to engage in more eco-conscious behaviors, from adopting plant-based diets to supporting ethical businesses. However, the field is still emerging, and more research is needed to comprehensively assess how yoga can support global sustainability goals in tangible ways.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To explore and promote rich ancient Indian practices for sustainability already described in our Indian scriptures.
2. To create awareness about the relevance of ancient Indian practices for sustainability in current modern era in current generation.
3. To support and contribute in the direction of achieving Sustainable Development Goals defined by UN.

6. Significance of the proposed study: (300 words)

A project proposal on "Yoga for Sustainable Living" is significant as it bridges the ancient wisdom of yoga with the urgent need for sustainable living practices in today's world. Yoga promotes holistic well-being by fostering physical health, mental clarity, and emotional balance, which are essential for individuals to lead mindful and intentional lives. By integrating principles like mindfulness and moderation into daily practices, yoga encourages sustainable consumption, reduced waste, and environmentally conscious choices. These practices align with the philosophy of Ahimsa (non-harming), emphasizing a harmonious relationship with nature and reducing the ecological footprint.

Furthermore, yoga cultivates a deeper connection with the environment by fostering awareness of the interdependence between human actions and the planet's health. Through workshops, retreats, and community initiatives, the project can inspire participants to adopt eco-friendly habits such as minimizing single-use plastics, conserving energy, and embracing plant-based diets. This alignment of yoga practices with sustainability principles directly supports the United Nations Sustainable Development Goals (SDGs), including Good Health and Well-being (Goal 3), Responsible Consumption and Production (Goal 12), and Climate Action (Goal 13).

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The project also has the potential to create social impact by fostering a sense of collective responsibility and inspiring communities to adopt sustainable practices. By integrating yoga into sustainability education, individuals can develop a lifestyle that balances personal well-being with ecological integrity. Moreover, as a universal practice transcending cultural and geographical boundaries, yoga can serve as a platform to promote global awareness and action for sustainability. A project on "Yoga for Sustainable Living" thus holds transformative potential, combining personal health with environmental stewardship to address contemporary challenges and pave the way for a sustainable future.

7. Relevance of the proposed study to Gujarat: (200 words)

The project proposal on "Yoga for Sustainable Living" holds significant relevance for Gujarat, a state known for its rapid industrial growth, rich cultural heritage, and commitment to sustainable development. Gujarat faces environmental challenges such as pollution, water scarcity, and the need for efficient waste management, making it imperative to adopt sustainable practices. Yoga, with its emphasis on holistic well-being and mindfulness, can inspire individuals and communities to lead environmentally conscious lives. By integrating yoga's principles, such as moderation and harmony with nature, the project can promote habits like responsible consumption, water conservation, and waste reduction.

Gujarat's vibrant cities, including Ahmedabad and Surat, can benefit from yoga-based initiatives to combat lifestyle-related health issues while fostering awareness of environmental sustainability. The project aligns with Gujarat's efforts to achieve the United Nations Sustainable Development Goals (SDGs), particularly in areas such as health, climate action, and responsible consumption. Additionally, incorporating yoga into educational and community programs can help create a culture of sustainability, resonating with the state's tradition of balancing progress with ecological sensitivity. As a universal practice, yoga also bridges diverse communities, making it a powerful tool to inspire collective action for a sustainable future in Gujarat, ensuring well-being for both its people and the environment.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings of the project "Yoga for Sustainable Living" could bring transformative benefits to the society of Gujarat, addressing critical challenges while fostering a healthier and more sustainable way of life. By integrating yoga's principles of mindfulness and balance into everyday practices, the project has the potential to improve public health across the state. In urban centers like Ahmedabad, Surat, and Vadodara, where lifestyle-related diseases are rising, yoga can promote physical fitness, mental clarity, and stress reduction, leading to healthier communities and decreased healthcare burdens. Additionally, the project can inspire environmental consciousness, encouraging practices such as responsible consumption, energy conservation, and waste reduction—key to addressing Gujarat's environmental issues like pollution and water scarcity. Through educational initiatives and community workshops, the findings could empower individuals to adopt sustainable living practices, making sustainability an integral part of their lives. This aligns with Gujarat's developmental priorities and supports global efforts toward the UN Sustainable Development Goals, such as good health, responsible consumption, and climate action. Moreover, the project could strengthen the cultural values of simplicity and harmony deeply embedded in Gujarat's traditions, uniting diverse communities in a shared commitment to ecological stewardship. Ultimately, the project findings promise a healthier, more conscious society, driving Gujarat toward a sustainable future.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The project "Yoga for Sustainable Living" involves specific research activities designed to explore the link between yoga practices and sustainable living behaviors, providing valuable insights for societal benefits in Gujarat. The hypothesis posits that integrating yoga into daily life can significantly enhance personal well-being and foster environmentally responsible behaviors, contributing to sustainable living. To test this hypothesis, a stratified sampling plan will be employed, targeting diverse groups across Gujarat, including students, professionals, homemakers, and senior citizens, from both urban and rural settings. A representative sample of 500 participants will be divided into two groups: yoga practitioners and non-practitioners, enabling comparative analysis. Data collection will follow a mixed-methods approach to capture quantitative and qualitative dimensions of the research. Surveys and structured questionnaires will gather information on participants' health indicators, consumption patterns, waste management habits, and environmental awareness. In addition, interviews and focus groups will provide qualitative insights into perceptions of yoga and its influence on sustainable

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practices. Observational studies will track changes in behaviors, such as resource usage and health metrics, while case studies will document specific success stories. For data analysis, statistical tools like t-tests and regression analysis will assess correlations between yoga practices and sustainable behaviors, highlighting differences between the two groups. Qualitative data from interviews and focus groups will undergo thematic analysis to identify patterns in participant experiences and motivations. Longitudinal data tracking behavioral metrics will provide measurable outcomes, such as reduced resource usage or improved health. This comprehensive approach ensures a robust understanding of the relationship between yoga and sustainability. The findings are expected to offer actionable insights for policymakers, educators, and communities in Gujarat, showcasing yoga's potential to promote holistic well-being and environmental stewardship, aligning with the state's cultural values and developmental goals for a sustainable future.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The suggested plan of action for the project "Yoga for Sustainable Living" focuses on systematically integrating research, awareness, and implementation activities to achieve its objectives. Initially, a detailed project blueprint will be developed, including timelines, resource allocation, and stakeholder involvement. Awareness campaigns will be launched across Gujarat to highlight the benefits of yoga for personal well-being and sustainable living, targeting schools, workplaces, and community centers. Following this, a research phase will be conducted, starting with participant recruitment using a stratified sampling method to ensure representation across demographics. Data will be collected through surveys, interviews, and observational studies, focusing on participants' health, consumption patterns, and environmental practices. Concurrently, yoga workshops and sustainability training sessions will be organized to provide participants with practical tools and knowledge.

The project will then implement interventions, such as promoting mindful consumption, waste reduction, and eco-friendly practices, while tracking behavioral changes over time. Data analysis will combine statistical methods and thematic insights to evaluate the impact of yoga on sustainable living. Finally, the findings will be disseminated through reports, seminars, and policy recommendations, aiming to scale successful practices across Gujarat. This plan ensures a structured approach to understanding and promoting the role of yoga in fostering a sustainable, healthier society.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review	June	2022	December	2022
2.	Selection of 500 Participants	January	2023	February	2023
3.	Practicing Yoga	March	2023	May	2024
4.	Data Collection	June	2024	December	2024
5.	Data Analysis	January	2025	December	2025
6.	Comparative Study and Report Preparation	January	2026	May	2027

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13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify) 1. E-resources and Books 2. Participation and Publications in Conferences 3. Data Generation and Analysis of Surveys			10,85,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			2,00,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3,000
4.	Stationery and Printing (With justification)			12,000
5.	Any other special requirement			
6.	Overhead (10% of recurring)			
	TOTAL			**13,00,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
	b)			
	c)			
2.	**B. Glassware**			
	a)			
	b)			

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	c)			
3.	**C. Any other consumable items (like wires/ electric items etc)**			
	a)			
	b)			
4.	**Travel**	No. of Times in a month		
	a) Participation and Publications in Conferences	1 (75,000)	June-2022 to May-2027	
	b) Data Collection	1 (1,25,000)	June-2022 to May-2027	
5.	**Contingency**	3,000	June-2022 to May-2027	
6.	**Stationery and printing**			
	a) Stationary	5,000	Junuary-2026 to May-2027	
	b) Report and Supporting Document Printing	7,000	January-2026 to May-2027	
7.	Other items (specify) 1. E-resources and Books 2. Participation and Publications in Conferences 3. Data Generation and Analysis of Surveys	10,85,000	June-2022 to May-2027	
	Grand Total	13,00,000		

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Part -A

(General Information)

1.	**Title of the proposal**	Exploring Best Practices and Innovations in Recommendation Systems Development and Deployment	
2.	**Broad area of proposal**	Computer Science	
3.	**Sub Area of proposal**	Data Science and Machine Learning	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Divyesh Prafulbhai Gohel	Assistant Professor Computer Science	divyesh.gohel@atmiyauni.ac.in 9714580007 1116
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Dr. Hitendra Nanjibhai Donga	Professor Computer Science	hitendra.donga@atmiyauni.ac.in 9925022399 5011
	Dr. Jaydeep Ramniklal Ramani	Assistant Professor Computer Science	7383441783 Jaydeep.ramani@atmiyauni.ac.in 1113
	Mr. Jitendra Laljibhai Timrai	Assistant Professor Computer Science	9228881926 Jitendra.timrai@atmiyauni.ac.in 1117
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	17/06/1990	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01-06-2020	
9.	**Whether the PI is registered for Ph.D. on the same topic**	YES	

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10.	If yes then name of university	Saurashtra University

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Computer Science	Saurashtra University	2023	-
ii.	Post Graduation	M.C.A.	Gujarat Technological University	2013	82.20
iii.	Under Graduation	B.C.A.	Saurashtra University	2010	57.23
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	✓NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	NA	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (10 Year + 5 Months)
		Research Experience: (2 Year + 6 Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 5
		International: 4

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8.	No. of Publication (Book Chapters)	1
	Books Published	-
(Please enclose the list of papers and books published and/or accepted during the last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Exploring Best Practices and Innovations in Recommendation Systems Development and Deployment

2. Abstract (Provide a summary of your research proposal in 300 words)

This research explores best practices and innovations in the development and deployment of recommendation systems. These systems play a crucial role in providing personalized experiences across industries like e-commerce and entertainment. The study will review key algorithms, such as collaborative filtering and deep learning-based approaches, while addressing challenges like data sparsity, scalability, and real-time processing. It will also examine issues in system deployment, focusing on privacy, fairness, and user experience. The research aims to provide a comprehensive framework that combines proven methods and emerging innovations, helping organizations enhance the accuracy and impact of their recommendation systems.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Introduction:

This research focuses on exploring best practices and innovations in the development and deployment of recommendation systems, which are vital in providing personalized experiences in industries like e-commerce and entertainment. The primary objective is to analyze current methodologies and identify emerging approaches to improve the efficiency, scalability, and accuracy of these systems.

Research Activities:

1. **Algorithm Analysis:** Review of traditional algorithms (collaborative filtering, content-based) and modern methods (deep learning, reinforcement learning).
2. **Challenge Identification:** Address issues like data sparsity, scalability, and real-time processing.
3. **Deployment Optimization:** Study the deployment phase, focusing on industry-specific optimization and performance requirements.

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4. **Ethics and Fairness:** Explore solutions to ensure privacy, fairness, and transparency in recommendation systems.
5. **Case Studies:** Examine real-world applications to understand successes and challenges.
6. **Emerging Innovations:** Focus on techniques like explainable AI, hybrid systems, and integrating multi-modal data to improve recommendations.

Importance of the Study:
Recommendation systems are key to driving user engagement and satisfaction. This research is important as it will provide a comprehensive framework that combines established methods with emerging technologies, helping organizations develop more efficient and ethical recommendation systems. By addressing challenges and focusing on innovations, this study will contribute to both academic understanding and practical deployment across industries, ensuring these systems remain effective and trustworthy.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Recommendation systems have advanced significantly with the use of traditional methods like collaborative filtering and content-based techniques, as well as modern approaches such as deep learning and hybrid models. However, challenges remain, including data sparsity, bias, and privacy concerns. Emerging trends focus on explainable AI and integrating multi-modal data to improve accuracy and transparency. Despite progress, there is still a need for more standardized frameworks to address fairness, scalability, and ethical deployment across industries. Ongoing research aims to optimize these systems for diverse applications and enhance user experience.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

- Compare traditional and modern recommendation algorithms.
- Address challenges like data sparsity.
- Explore innovations in explainable AI and multi-modal data.
- Investigate privacy, fairness, and transparency issues.
- Provide guidelines for optimizing recommendation systems.
- Develop a framework for effective system deployment.

6. Significance of the proposed study: (300 words)

This study is significant as it aims to enhance the effectiveness of recommendation systems, which are crucial for personalizing user experiences across industries like e-commerce and entertainment. By analyzing both traditional and modern recommendation algorithms, the

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research will contribute to improving the accuracy, scalability, and real-time performance of these systems.

One of the key contributions of this study is addressing ongoing challenges, such as data sparsity, cold-start problems, and the need for large-scale real-time data processing. By exploring innovations like explainable AI and multi-modal data integration, the research aims to improve transparency, user trust, and recommendation quality.

Additionally, the study will emphasize ethical considerations, such as privacy, fairness, and bias in recommendation systems. As these systems are increasingly used in critical applications, ensuring they operate in a transparent and unbiased manner is essential for their broader acceptance and success.

Furthermore, the research will provide practical guidelines and a comprehensive framework for deploying recommendation systems across various industries. This will help organizations optimize system performance, improve user engagement, and ensure that recommendations are relevant and ethical.

Overall, this study will make a significant contribution to both academic research and industry practices, offering insights that can improve the design, implementation, and ethical standards of recommendation systems.

7. Relevance of the proposed study to Gujarat: (200 words)

This study is relevant to Gujarat's growing tech ecosystem, especially in sectors like e-commerce, education, and tourism, where personalized recommendations are crucial. By improving recommendation systems, the research can enhance customer engagement and support business growth. Additionally, it aligns with Gujarat's focus on ethical tech development, addressing issues like privacy and fairness. The findings can also benefit local academic institutions and tech companies, strengthening Gujarat's position as a leader in AI and innovation.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

This research will enhance user experiences in e-commerce, education, and entertainment, benefiting consumers and businesses in Gujarat. It will promote responsible AI development by addressing privacy and fairness, increasing public trust. The study will also help local industries, particularly SMEs, improve efficiency through better recommendation systems. Additionally, it will contribute to education by integrating advanced AI concepts into Gujarat's universities, fostering a skilled workforce. Overall, the research will support Gujarat's technological growth, economic development, and ethical AI practices.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

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Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	✓

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Methodology:
The research will evaluate traditional and modern recommendation algorithms (collaborative filtering, deep learning) to improve performance, scalability, and fairness. Ethical issues like privacy and bias will also be analyzed.

Sampling Plan:
Case studies from e-commerce sectors will be selected.

Data Collection:
Data will be gathered through analysis of existing datasets.

Data Analysis:
Statistical comparisons will assess algorithm performance, while thematic analysis will evaluate ethical concerns. The findings will guide the development of an optimized recommendation system framework.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The research will proceed in the following phases:

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1. **Literature Review:** Review existing recommendation algorithms, challenges, and ethical concerns to identify gaps.
2. **Algorithm Evaluation:** Test traditional and modern recommendation algorithms for accuracy, scalability, and transparency.
3. **Data Collection:** Gather data from case studies, surveys.
4. **Challenge and Ethical Analysis:** Analyze issues like data sparsity, bias, privacy, and fairness.
5. **Propose Solutions:** Develop improved methodologies and frameworks based on findings.
6. **Reporting and Recommendations:** Summarize results, propose practical recommendations, and suggest future research directions.

This phased approach ensures comprehensive analysis and effective recommendations for the optimization and ethical deployment of recommendation systems.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review	June	2022	Dec	2022
2.	Algorithm Evaluation	Jan	2023	Dec	2023
3.	Data Collection	Jan	2024	Dec	2024
4.	Challenge and Ethical Analysis	Jan	2025	Dec	2025
5.	Propose Solutions	Jan	2026	Dec	2026
6.	Reporting & Recommendations	Jan	2027	June	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	-	-	-
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	10	1000 Km	100000

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3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	3000
4.	Stationery and Printing (With justification)	-	-	25000
5.	Any other special requirement			372000
6.	Overhead (10% of recurring)	-	-	
	TOTAL			**5,00,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
2.	**B. Glassware**			
	a)			
3.	**C. Any other consumable items (like wires/ electric items etc)**			
	a)	Laptop 200000		
	b)	Printer 15000		
4.	**Travel**			
	a) Data Collection and Other	100000		
5.	**Contingency**	3000		
6.	**Stationery and printing**			
	a) Printing	25000		
7.	**Other**	157000		
	Grand Total	**500000**		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	A Comparative Study on Buying Behavior of Rural and Urban Consumer on Mobile Phone in Gujarat	
2.	**Broad area of proposal**	Marketing	
3.	**Sub Area of proposal**	Buying Behaviour/ Rural Marketing	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Chirag V. Erda	Associate Professor, Department of Management	Chirag.erda@atmiyauni.ac.in Mobile No. 9638934965 Ext. No. 1304
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	19/02/1980	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	02/07/2009	
9.	**Whether the PI is registered for Ph.D. on the same topic**	N.A.	
10.	**If yes then name of university**	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	Ph. D.	Management	Gujarat University	2016	NA
ii.	Post Graduation	1) Marketing 2) Commerce	1) Gujarat University 2) IGNOU	1) 2002 2) 2011	1) 2.96 GPA (Higher Second Class) 2) 68.67%
iii.	Under Graduation	Management	Gujarat University	2000	61.20%
iv.	CSIR/UGG-NET/ SLET/GATE	UGC-NET		2013	NA

2.	Have you previously received any Fellowship from any funding agency?	θYES	√θNO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	θshort-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		θ pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		θ post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5. Details of on-going and completed research funded projects (if any)

S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (17 Years)
		Research Experience:
7.	No. of Publication (Research articles -	National:Indian

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	UGC Approved only)	International: Total 8 (3 UGC Care)
8.	No. of Publication (Book Chapters)	2
	Books Published	-
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

A Comparative Study on Buying Behavior of Rural and Urban Consumer on Mobile Phone in Gujarat

2. Abstract (Provide a summary of your research proposal in 300 words)

The Indian market has immense potential, which need to be tapped. The growth rates in rural markets have been remarkable in the recent years when compared to those of urban markets. A complex set of factors influence rural consumers' behavior. Social norms, traditions, caste and social customs have greater influence on the consumer behavior in rural areas than in urban areas.

The present study aims to examine the comparative buying decision process of rural and their urban counterparts towards the purchase of mobile phone in Gujarat. A comparative study is needed to assess the similarities and differences between buying decision process displayed by both urban and rural consumers with regards to mobile phone. Buying process assess the five stages: problem/need recognition, information search, evaluation of alternatives, purchase behavior and post purchase behavior. This study also aims to examine the role of youth in buying process of mobile phone in and will attempt to develop important marketing implications for mobile phone in Gujarat.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The complex set of factors influence rural consumer's behavior. Social norms, traditions, caste, and social customs have greater influence on the consumer behavior in rural areas than in urban areas. The seasonality of agricultural production influences the seasonality of rural consumer's demand. Given the fact that the landless laborers and daily wage earners get their income in installments, their purchasing is restricted to small quantities of products at a time,

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mostly on a daily basis or once in two or three days. (JhaMithileshwar, 2007)

Consumer decision making process is the road map of consumer's minds and is the best expression of consumer behavior. Consumer behavior may be defined as the decision process and physical activity individuals engage in when evaluating, acquiring, using or disposing of goods and services (Loudon, 2002). Consumer behavior is a multistage process and actual buying comes at a later stage. The important consumer behavior models are a): Stimulus Response Model b): Nicosia Model c): Howard – Sheth Consumer Behavior Model and d): Engel, Blackwell, Miniard Model. e): Consumer Decision Making Process by L.G.Schiffman and L.L.Kanuk

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The topic of consumer behavior regarding mobile phones in rural and urban areas has gained significant interest in recent years due to the rapid expansion of the telecommunications sector and the increasing penetration of smartphones in both segments.

Consumer Behavior Studies:

Research has highlighted differences in purchasing decisions influenced by factors like income, education, lifestyle, and exposure to technology. Urban consumers often prioritize brand, advanced features, and service quality, while rural consumers focus on affordability, durability, and basic functionalities.

Mobile Penetration in India:

Studies from India emphasize that mobile phones are essential for both rural and urban consumers, serving as tools for connectivity, education, and business. Rural markets have seen increasing adoption due to government digital initiatives and affordable models.

Digital Divide:

Researchers often explore the challenges of digital inclusion, highlighting gaps in infrastructure and purchasing power between rural and urban areas.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To examine the need/motive of rural consumers to buy mobile phone
2. To examine the sources of information of rural consumers to buy mobile phone
3. To examine the criteria of evaluation of alternatives of rural consumers to buy mobile phone

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4. To examine the purchase decision of rural consumers of mobile phone
5. To examine the post purchase behavior of rural consumers of mobile phone

6. Significance of the proposed study: (300 words)

The consumer decision process models have wide implications to the marketer. It is not wise to assume that the rural market as a whole can be served by a single product-price-promotion combination. In order to develop distinctive product promotion strategies, understanding the behavioral segments of rural markets is very important. To persuade a consumer to buy a specific brand of the product, marketer has to focus on all stages of consumer decisions and develop suitable strategies.

Indian literature on empirical studies conducted on this topic is not very extensive. Even in foreign literature, some of the decision variables are not adequately covered and some are totally ignored due to the complex nature of the subject.

Very few studies are conducted to understand how rural markets are understood by the marketers such as the proposed here.

The present study aims to examine the comparative buying behavior of rural and urban counterparts towards the purchase of mobile phone. A comparative study is needed to assess the similarities and differences between buying behavior displayed by both urban and rural consumers with regards to mobile phone. Further, it will guide various mobile manufacturing companies about modification required in present marketing strategies applied for tapping urban markets and to decide, if possible, and to what extent these strategies can be molded and applied successfully to the rural markets. To achieve these objectives an attempt is made to compare and analyze buying decision making process of rural and urban consumers on mobile phone of Gujarat.

7. Relevance of the proposed study to Gujarat: (200 words)

Understanding the buying behavior of consumers is crucial for businesses to develop effective marketing strategies and product offerings. This study focuses on comparing the buying behavior of rural and urban consumers in Gujarat, specifically concerning mobile phones. Its relevance is outlined as follows:

Market Penetration and Growth Opportunities:

- Gujarat, being one of the most economically vibrant states in India, offers a diverse market landscape. By examining the differences in buying behavior, companies can identify growth opportunities in rural and urban areas.

Consumer Preferences and Decision-Making:

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- The study highlights factors influencing consumer choices, such as brand preference, price sensitivity, features, and after-sales service. This information is valuable for tailoring products and services to meet specific regional demands.

Technology Adoption:

- With the increasing penetration of smartphones and digital technology in India, understanding how rural and urban consumers adopt and use mobile phones provides insights into digital inclusion and connectivity.

Cultural and Economic Factors:

- Rural and urban areas often differ significantly in terms of income levels, education, lifestyle, and access to information. This study sheds light on how these factors shape consumer behavior and purchasing decisions.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

This study holds significant value for various stakeholders, including businesses, policymakers, and consumers. Below are the key benefits specific to Gujarat:

Business Strategy Development: Businesses can tailor their marketing strategies to address the unique preferences of rural and urban consumers. For example, rural areas may benefit from messaging around affordability and durability, while urban consumers might be more influenced by innovation and brand image.

Policy Formulation and Infrastructure Development: Policymakers can use the findings to address disparities in mobile access and affordability between rural and urban areas, enabling digital inclusion across the state.

Economic Growth and Entrepreneurship: Increased mobile penetration and usage in rural areas can drive economic growth by empowering small businesses, farmers, and self-employed individuals with access to digital tools and markets.

Social and Cultural Impact: Mobile phones enable better connectivity between rural and urban populations, strengthening family ties and promoting social cohesion.

Academic and Research Contributions: The study adds to the body of knowledge on consumer behavior in India, providing a Gujarat-specific perspective.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

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Sr. No.	Area	(✓ tick appropriate)
1.	Environment	θ
2.	Agriculture	θ
3.	Health and wellness	θ
4.	Nutrition	θ
5.	Development of Industrial Problem Solutions	θ
6.	Resources management and sustainable development	θ
7.	High Impact Teaching	θ
8.	Imparting corporate responsibility, ethics, accountability and values in society	θ
9.	Social entrepreneurship	θ✓
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Objectives of the Study

1) To understand the Buying Decision Making Process of rural consumers for mobile phone in Gujarat.

2) To compare the buying decision process of rural and urban consumers for mobile phone in Gujarat.

3) To understand the role of youth in buying decision process of rural and urban consumers for mobile phone in Gujarat.

4) To find out marketing implications for rural consumers on mobile phone in Gujarat.

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Hypotheses of the Study

H1: There is no significant difference between rural and urban consumers regarding need/motive to buy mobile phone in Gujarat.

H2: There is no significant difference between rural and urban consumers regarding sources of information of mobile phone in Gujarat.

H3: There is no significant difference between rural and urban consumers regarding criteria of evaluation of alternatives of mobile phone in Gujarat.

H4: There is no significant difference between rural and urban consumers regarding purchase decision of mobile phone in Gujarat.

H5: There is no significant difference between rural and urban consumers regarding post purchase behavior of mobile phone in Gujarat.

Data Sources

The study includes primary data source and secondary sources. The present study started with exploring in-depth secondary sources. Afterward, the primary data was collected from Gujarat.

Research Instrument - Questionnaire

Different questions are asked regarding the buying decision process of mobile phones. As mentioned earlier there are five stages of buying decision process so different questions are asked regarding need recognition, information search, evaluation of alternatives, purchase decision and post-purchase behavior. Questions regarding personal information are kept at last.

Sampling Unit

Sampling unit for the survey is rural and urban mobile phone consumers of Gujarat.

Sample Size

Thus, sample size is very vital decision as it affects further analysis of the study. The sample size of 1000 respondents was taken for the survey, which includes 500 respondents from rural areas

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and 500 respondents from urban areas from Gujarat.

Data Analysis Plan

The present study has used number of tools for statistical analysis like ***frequency distribution, descriptive statistics, two – sample hypothesis tests (t test), One-way analysis of variance (ANOVA) and Chi-Square test.***

11. Suggested plan of action: Define the suggested plan of action in 200 words)

- To develop questionnaire for the study and do the pilot study
- To develop action plan for the primary study
- To collect the data from different rural and urban areas of Gujarat
- To analyse the data
- To present the findings

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Questionnaire	May	2022	June	2022
2.	Pilot study	July	2022	September	2022
3.	Data collection	October	2022	December	2022
4.	Data analysis	January	2023	February	2023
5.	Findings	March	2023	March	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			500,000

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2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			150,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3,000
4.	Stationery and Printing (With justification)			120,000
5.	Any other special requirement			177,000
6.	Overhead (10% of recurring)			50,000
	TOTAL			**10,00,000**

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
	b)			
	c)			
2.	**B. Glassware**			
	a)			
	b)			
	c)			
3.	**C. Any other consumable items (like wires/ electric items etc)**	500,000		
	a)			
	b)			
4.	**Travel**	No. of Times in a month		
	a) Purpose 1	75,000	July-Sept. 2022	Pilot study
	b) Purpose 2	75,000	Oct. – Dec. 2022	Data collection
5.	**Contingency**	3,000		

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6.	**Stationery and printing**	120,000		
	a) Purpose 1			
	b) Purpose 2			
7	**Any other special requirement**	177,000		
8	**Overhead**	50,000		
	Grand Total	**10,00,000**		

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Application for Research Project

Part -A

(General Information)

1.	Title of the proposal	Formulation of Liquid Biofertilizer Consortium and its Study of the Effect on Soil-borne Fungal Pathogens	
2.	Broad area of proposal	Life Science	
3.	Sub Area of proposal	Agriculture Microbiology	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Dr. Chitra Bhattacharya	Assistant Professor (Microbiology)	chitra.bhattacharya@atmiyauni.ac.in 8103792322
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Not Applicable	NA	NA
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	16-12-1987	
8.	Date of joining the Department of PI (DD/MM/YYYY)	01-06-2020	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	No	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Microbiology	MATS University, Raipur, C.G.	2020	69.5%
ii.	Post Graduation	Microbiology	Pt. Ravishankar Shukla University, Raipur, C.G.	2010	59.00%
iii.	Under Graduation	Biology	Pt. Ravishankar Shukla University, Raipur, C.G.	2008	60.38%
iv.	CSIR/UGG-NET/ SLET/GATE	Not Applicable			
v.	M.Phil.	Bioscience	Rani Durgawati Vishwavidyalaya, Jabalpur, M.P.	2011	70.31%
vi.	DCA	Computer Application	Rashtriya Shaksharta Mission, Govt. of India	2009	84.00%
2.	Have you previously received any Fellowship from any funding agency?		☐ YES	☐ NO	
3.	If yes, please indicate whether it was a (✓tick appropriate)		☐ short-term fellowship (viz Project fellow, Project assistant, etc.)		
			☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)		
			☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)		
4.	If yes, mention the details of fellowship and tenure		Not Applicable		
5.	Details of on-going and completed research funded projects (if any)				

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	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	1.	A Study of Lipase Enzyme Production and Its Industrial Application Minor Research Project – Co-PI F.No.-MS-34/202002/XII/13-14/CRO	330000/-	UGC, CRO, Bhopal	June 2014 to June 2016
	2.	Melishield Mosquito Repellent Project Mentor- Eyuva F.No.: BT/EF0017/01/22	200000/-	DBT, BIRAC	Dec. 2022 to Dec. 2023
	3.	Development of Bacto-fungal Consortium and Study of Biological Attributes in Organic Farming Practice Mini Research Project-Principal Investigator F.No.: No.SL/SMFAP/Phase 1/2021/001	66709/-	University Seed Money (URAB Committee)-Atmiya University, Rajkot	June 2021 to June 2022
	4.	Formulation of Melishield Fragment Mosquito Repellent Project Mentor	25963/-	State-level Student Start-up & Innovation Policy (SSIP), Govt. of Gujarat	April 2022 to April 2023
	5.	Formulation of Herbal Mosquito Repellent Project Mentor F.No.: BJS1_M83	25000/-	IKS Division	July 2022 to Sept. 2022

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6.	Total Experience	Teaching Experience: (…12... Year + …10… Months)
		Research Experience: (……Year + …… Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 4
		International: 2
8.	No. of Publication (Book Chapters)	4
	Books Published	1
(Please enclose the list of papers and books published and/or accepted during last five years)		

Books Published:
At LAP LAMBERT Academic Publishing, Germany, ISBN: 978-3-659-27112-0 Title- "Effect of Ageing on Biochemical Parameters in Sesame Seed" year-2014

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Book Chapter:

1. Title: "Application of Microbial Technology for Waste Removal" 2021.

Book Name: Microbial Technology for Sustainable Environment

Publisher: Springer Nature

ISBN No.: 978-981-16-3839-8 (P)

ISBN No.: 978-981-16—3840-4 (eBook)

DOI: 10.1007/978-981-16-3840-4_16

Authors: Ravi Ranjan Kumar, Chitra Bhattacharya & Nutan Prakash Vishwakarma

2. Title: Chapter 3 Design and Operation of New Microbial Product Bioprocessing System

Book Name: Microbial Products for Future Industrialization

Publisher: Springer Link,

ISBN No. – 978-981-99-1737-2

DOI: https://doi.org/10.1007/978-981-99-1737-2_3

Authors: Ravi Ranjan Kumar & Chitra Bhattacharya

3. Title: Chapter 15 Microbial Biomaterials and Their Industrial Applications

Book Name: Microbial Products for Future Industrialization

Publisher: Springer Link,

ISBN No. – 978-981-99-1737-2

DOI: https://doi.org/10.1007/978-981-99-1737-2_3

Authors: Chitra Bhattacharya & Mousumi Das

4. Title: Understanding Plant-Plant Growth Promoting Rhizobacteria (PGPR) Interactions for Inducing Plant Defences (2023)

Book Name: Novel Approaches in Science & Pharma Fraternity

Publisher: P.K. Publishers & Distributors

ISBN No. – 978-93-92239-66-3

DOI/URL: https://www.pkpublishers.com/product/novel-approaches-in-science-pharma-fraternity/

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Journal Papers: International & Nationals

S. No.	Title of Articles/ Books	Publisher/ Journal	Date of Publication
1.	Isolation and Characterization of Bacterial Isolates from Agricultural Soil at Durg District.	Indian Journal of Science and Research (UGC approved) ISSN: 0976-2876 (Print) ISSN: 2250-0138(Online) Impact Factor-1.4095	Vol.4 (1), 2014: 25-30
2.	Isolation & Characterization of Rhizobium Species and Its Effect on Growth on Monocot Plant Used as Biofertilizer	International Journal of Research (UGC approved) ISSN: 2348-6848 Impact Factor- 3.541	IJR/ Vol.2(1), Jan. 2015: 597-604
3.	Study of Lipase Producing Bacterial Strains from Oil Contaminated Soil	Journal of Basic and Applied Research ISSN:2413-7014	J. basic appl. Res. Vol. 2(4), 2016: 512-515
4.	Isolation and characterization of phosphate solubilizing bacteria from paddy field of Bhilai region	World Journal of Pharmaceutical Sciences (UGC approved) ISSN (Print): 2321-3310; ISSN (Online): 2321-3086 Impact Factor- 0.453	World J Pharm Sci. Vol. 5(11), 2017: 77-80
5.	Studies on the Optimization of Lipase Production by Aspergillus parasiticus MK178553 Isolated from the Paddy Field of Soil	Journal of Emerging Technologies and Innovative Research (JETIR) (UGC approved) ISSN:2349-5162 Impact Factor: 5.87	Journal of Emerging Technologies and Innovative Research. Vol. 5(12), 2018: 395-402
6.	Isolation, Screening and Optimization of Lipase Producing Fungal Strains from Agricultural Soil	International Journal of Pharmacy and Biological Sciences- (UGC approved) Online ISSN: 2230-7605, Print ISSN: 2321-3272	IJPBSTM (2019) 9 (2): 561-570

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Formulation of Liquid Biofertilizer Consortium and its Study of the Effect on Soil-borne Fungal Pathogens

2. Abstract (Provide a summary of your research proposal in 300 words)

Soil-borne fungal pathogens pose significant threats to agricultural productivity by causing diseases that adversely impact plant health and yield. The increasing reliance on chemical fertilizers and fungicides to combat these pathogens has raised environmental concerns, necessitating the development of sustainable alternatives. This research aims to formulate a liquid biofertilizer consortium comprising beneficial microorganisms to enhance soil health and suppress soil-borne fungal pathogens. The proposed study will isolate and characterize potential microbial strains, including nitrogen-fixing bacteria, phosphate-solubilizing bacteria, potassium-solubilizing bacteria, and antagonistic fungi. These strains will be evaluated for their compatibility, efficacy in nutrient solubilization, and antagonistic activity against key soil-borne fungal pathogens. The selected strains will then be incorporated into a liquid biofertilizer formulation, ensuring stability, shelf life, and easy application. Field and greenhouse experiments will assess the biofertilizer's impact on soil health parameters, including microbial diversity, nutrient availability, and plant growth-promoting properties. Additionally, its efficacy in reducing the incidence and severity of fungal diseases will be evaluated across different crops and soil types.

This research seeks to provide a holistic solution for sustainable agriculture by integrating biocontrol and biofertilization. The formulated liquid biofertilizer consortium is expected to reduce chemical inputs, improve crop productivity, and mitigate environmental degradation. The outcomes of this study will contribute to the advancement of eco-friendly agricultural practices and provide a scalable technology for farmers facing challenges from soil-borne fungal pathogens.

Keywords:

Plant-growth-promoting microbes, bio-control agents, soil health and condition

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

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India is often the largest agricultural field for the growth and development of crops. Due to the over- population, we are not able to fulfill the food security for all the hungry people and of the huge utilization of land fertility has been depleted. After the green revolution, farmers have extensively use chemical fertilizers lead to reduction in soil fertility and showing negative impact on the environment. So, there is a need to develop an alternative arrangement of chemical fertilizers and insecticides for the sustainable approach of agricultural field that can enhance the growth of crop and to minimize the effect of harmful pathogens from the soil. Groundnut is an important oilseed crop with leads to the 13th rank among the principal economic crops of the world and the 3rd largest producer of groundnut in the world. Following are the states of India that lead in the production of groundnut (A. L. Singh et al., 2016). Gujarat and Andhra Pradesh are half of the cultivators of groundnut in India (Shankarappa Talawar, 2004). All parts of the groundnut are susceptible to disease caused by microorganisms such as bacteria, fungi, viruses, nematodes, etc. which leads to poor quality of crop followed by loss of economy. In Gujarat among all pathogenic microorganisms' fungi are vigorously known for causing disease in groundnut resulting in yield reduction (Mayee, 1995). The fungal diseases can be classified as listed below: foliar diseases; seed and seedling diseases; stem, root, and pod diseases. Many fungal pathogens caused the seed and seedling rot diseases. The majority of rots are caused by Aspergillus niger, Rhizopus spp., Fusarium spp., and Aspergillus flavus (Subrahmanyam et al. 1992), which are most common in seeds attack, agricultural soil and seedling of many crops. Biological control has become a critical component of plant disease management and it is a practical and safe approach for various crops (Patel & Anahosur 2001). The present investigation would try to develop a microbial consortium for the seed treatment which can be an ability self-defense mechanism in the seeds against soil-borne fungal plant pathogens.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

- Soil-borne fungal pathogens, such as Fusarium spp., Rhizoctonia spp., and Pythium spp., are significant contributors to crop yield losses globally. Addressing these pathogens often involves chemical fertilizers and pesticides; however, their widespread use has raised environmental and sustainability concerns.
- Chemical Fertilizers and Pesticides

  Chemical fertilizers have played a pivotal role in enhancing crop productivity by providing essential nutrients like nitrogen, phosphorus, and potassium. However, studies reveal that excessive and unbalanced fertilizer use can disrupt soil microbiota, decrease microbial diversity, and promote pathogen proliferation. For instance, nitrogen overuse has been linked to increased susceptibility of crops to certain fungal pathogens. Similarly, chemical pesticides, while effective in disease control, often result in the development of pathogen resistance, bioaccumulation, and non-target effects on beneficial soil microorganisms.

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- Microbial Consortia as a Sustainable Alternative

  Recent advancements in microbial biotechnology emphasize the use of microbial consortia as eco-friendly and sustainable solutions to mitigate the adverse effects of soil-borne pathogens. These consortia typically include nitrogen-fixing bacteria (Rhizobium spp., Azospirillum spp.), phosphate-solubilizing bacteria (Pseudomonas spp., Bacillus spp.), potassium-solubilizing bacteria, and antagonistic fungi (Trichoderma spp.). Such consortia not only enhance nutrient availability but also exhibit antagonistic activities against pathogens through mechanisms like mycoparasitism, competition, and production of antifungal metabolites.

- Effectiveness Against Soil-Borne Pathogens

  Studies have demonstrated the ability of microbial consortia to suppress fungal pathogens, promote plant growth, and improve soil health. For example, Trichoderma in consortia disrupts fungal cell walls, while Pseudomonas produces siderophores and antibiotics that inhibit pathogen growth. These findings highlight the potential of microbial consortia to serve as both biocontrol agents and biofertilizers, reducing dependency on chemicals and fostering sustainable agricultural practices.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

- Isolation and Identification of Desire Bacterial and Fungal Strains
- Screening of plant-growth-promotion activity
- Antagonistic activity between bacto-fungal consortium against fungal plant pathogens
- To study the effect of plant growth promotion and plant defense mechanism
- To Study the effect of liquid biofertilizers on field and greenhouse experiments.
- Statistical approach to Plant growth promotion.

6. Significance of the proposed study: (300 words)

Soil-borne fungal pathogens significantly threaten global agricultural productivity, causing severe yield losses in staple and high-value crops. Current practices heavily rely on chemical fertilizers and fungicides to enhance crop growth and combat pathogens. However, these chemical inputs are often associated with detrimental effects such as soil degradation, reduced microbial diversity, environmental pollution, and human health risks. The development of an effective, sustainable alternative is, therefore, a pressing need in modern agriculture.

The formulation of a liquid biofertilizer consortium represents an innovative solution to these challenges. By integrating beneficial microorganisms, such as nitrogen-fixing bacteria, phosphate-solubilizing bacteria, potassium-solubilizing bacteria, and antagonistic fungi, a

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biofertilizer consortium can address multiple agricultural needs simultaneously. These microorganisms not only improve nutrient availability and soil fertility but also enhance the plant's natural defenses against soil-borne fungal pathogens through various mechanisms, including competition, mycoparasitism, and the production of antifungal metabolites.

Studying the effects of such a biofertilizer consortium on soil-borne fungal pathogens is crucial for understanding its biocontrol potential and optimizing its application in diverse agroecological conditions. This research will provide insights into the interactions between beneficial microbes, pathogenic fungi, and plant hosts, offering a holistic approach to integrated pest and nutrient management.

The significance of this study lies in its potential to revolutionize sustainable agriculture. A well-formulated liquid biofertilizer consortium can:

1. Reduce dependency on chemical inputs, lowering production costs for farmers.
2. Enhance soil health and fertility over time, ensuring long-term agricultural productivity.
3. Mitigate environmental pollution and promote biodiversity.
4. Address global food security challenges by providing an eco-friendly and scalable technology.

Ultimately, this research aligns with global efforts toward achieving sustainable development goals, particularly in combating climate change, ensuring food security, and promoting responsible consumption and production practices.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, a leading agricultural state in India, plays a significant role in the country's crop production, contributing extensively to the cultivation of cotton, groundnut, cumin, wheat, and various horticultural crops. Despite its agricultural prominence, the state faces several challenges, including soil degradation, erratic rainfall, and increasing prevalence of soil-borne fungal pathogens such as Fusarium oxysporum, Rhizoctonia solani, and Pythium spp., which threaten crop yield and farmer livelihoods.

The proposed study on the formulation of a liquid biofertilizer consortium and its effect on soil-borne fungal pathogens holds significant relevance for Gujarat due to the following factors:

Soil Fertility Management: Gujarat's soils, particularly in regions with intensive farming, are prone to nutrient depletion and salinity. The use of chemical fertilizers has further exacerbated soil health issues. A biofertilizer consortium tailored to local soil conditions can replenish soil fertility, enhance microbial diversity, and promote sustainable farming practices.

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Pathogen Control in Key Crops: Many crops in Gujarat are susceptible to soil-borne fungal pathogens, which cause substantial economic losses. A microbial consortium with biocontrol properties can serve as an effective, eco-friendly alternative to chemical fungicides, reducing disease incidence and enhancing crop productivity.

Water Resource Optimization: Liquid biofertilizers, being water-based, are compatible with Gujarat's extensive micro-irrigation network. This synergy enables efficient application, minimizes wastage, and supports water conservation in a state frequently affected by water scarcity.

Promotion of Organic and Sustainable Farming: Gujarat has shown interest in organic and sustainable farming initiatives. The adoption of biofertilizer technologies can align with government policies, enhance export potential, and meet the increasing consumer demand for organic produce.

Farmer Empowerment and Cost Reduction: The proposed biofertilizer consortium can reduce farmers' dependency on costly chemical inputs, leading to lower production costs and improved profitability, particularly benefiting small and marginal farmers.

By addressing these critical agricultural needs, the study has the potential to contribute to Gujarat's agricultural sustainability, bolster rural economies, and serve as a model for other regions facing similar challenges.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

Expected Societal Benefits of the Proposed Research Project for Gujarat

The proposed research on the formulation of a liquid biofertilizer consortium and its study of the effects on soil-borne fungal pathogens is anticipated to yield several societal benefits, particularly for Gujarat. As a state heavily reliant on agriculture, the successful implementation of this research can address critical challenges faced by farmers and contribute to sustainable development in the region.

Enhanced Agricultural Productivity: By mitigating soil-borne fungal diseases that severely affect key crops in Gujarat, the biofertilizer consortium is expected to improve crop health and yield. This will directly contribute to increased food security and economic stability in rural areas.

Improved Soil Health and Sustainability: The biofertilizer's ability to enrich soil with beneficial microbes and essential nutrients will help restore soil fertility and microbial diversity, counteracting the adverse effects of prolonged chemical fertilizer use. This ensures long-term agricultural sustainability.

Reduction in Chemical Dependency: A biofertilizer consortium will reduce farmers' reliance on synthetic fertilizers and fungicides, decreasing production costs and lowering the environmental

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pollution associated with chemical runoff. This shift will promote eco-friendly farming practices across the state.

Adaptation to Climate Challenges: Gujarat faces frequent water scarcity and soil salinity issues. The adoption of liquid biofertilizers, which are compatible with micro-irrigation systems, will promote efficient resource utilization and climate-resilient agriculture.

Support for Organic Farming Initiatives: The findings of the research can contribute to the expansion of organic farming in Gujarat, enhancing market opportunities for farmers and meeting the growing consumer demand for organic produce both locally and internationally.

Empowerment of Small and Marginal Farmers: Lowering input costs and increasing crop resilience will economically benefit small and marginal farmers, reducing their financial burden and improving their livelihoods.

Job Creation and Rural Development: The production, distribution, and application of biofertilizers can create new employment opportunities in rural areas, fostering local industries and contributing to regional development.

Environmental Conservation: The reduced use of chemical inputs will minimize soil and water pollution, contributing to a healthier ecosystem and promoting biodiversity in agricultural landscapes.

By addressing key agricultural and environmental challenges, this research can pave the way for a more resilient and sustainable agricultural sector in Gujarat, ensuring long-term benefits for farmers, consumers, and the broader community.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐

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6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

1. Soil Collection and Sample Preparation
    - Collect soil samples from various agricultural fields.
    - Prepare the samples by sieving and homogenizing to ensure a uniform sample for microbial isolation.
2. Isolation of Bacterial Strains
3. Serial Dilution Method, Incubation: Incubate plates at appropriate temperatures (usually 30°C for 24–48 hours) and to detection the colony Morphology:
4. Isolation of Fungal Strains
    - Direct Plating Method: Plate soil samples on Sabouraud Dextrose Agar (SDA) or potato dextrose agar (PDA) to isolate fungal strains.
    - Incubation: Incubate plates at 25°C for 5–7 days.
    - Colony Morphology and Microscopic Observation: Examine fungal growth and identify by colony characteristics and microscopic features (hyphae, spores).
5. Identification of Bacterial and Fungal Strains
    - Bacterial Identification: Use biochemical tests, such as Gram staining, catalase test, and specific enzyme tests, for preliminary identification. Further confirm using molecular methods like 16S rRNA gene sequencing.
    - Fungal Identification: Fungal strains can be identified through macroscopic (colony morphology) and microscopic (spore, conidiophore) observations. DNA sequencing of internal transcribed spacer (ITS) regions can provide confirmation.
6. Storage of Isolates
    - Store pure cultures of bacteria and fungi at -80°C for future use.

2. In Vitro Antagonistic Assay

- Dual Culture Technique: Inoculate fungal pathogens on agar plates and introduce bacterial isolates or fungal consortia at a fixed distance.
- Observations: Measure the inhibition zone formed around bacterial or fungal

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cultures. Observe for clear zones or growth inhibition after incubation.
- Microscopic Examination: Examine the interaction zone under a microscope to study the effect of the consortium on pathogen growth.

Quantitative Analysis of Inhibition
- Measure the diameter of the inhibition zone around the bacterial or fungal culture to quantify the antagonistic effect.
- Perform repeated assays to confirm consistency.

Selection of Effective Strains
- Based on the results, select the most effective bacterial and fungal strains that exhibit strong antagonism against the pathogens.

3. Study the Effect of Plant Growth Promotion and Plant Defense Mechanism

1. Preparation of Plant Growth Media
   - Select appropriate plant species (e.g., tomato, wheat, or another model plant) for testing.
   - Prepare growth media (e.g., potting soil, hydroponic solutions) for growing plants in controlled conditions.
2. Inoculation of Plants with Bacto-Fungal Consortium
   - Seed Treatment: Treat seeds with the prepared bacto-fungal consortium by soaking seeds in bacterial and fungal culture before planting.
   - Soil Inoculation: Alternatively, inoculate the soil with a mixture of the consortium after planting seeds.
3. Plant Growth Measurement
   - Growth Parameters: Measure plant height, leaf area, root length, and biomass at regular intervals (e.g., every two weeks).
   - Chlorophyll Content: Use a SPAD meter to assess chlorophyll content as an indicator of plant health and vigor.
   - Root Colonization: Evaluate the root system for microbial colonization using staining methods or microscopic observations.
4. Evaluation of Plant Defense Mechanisms
   - Enzyme Activity Assays: Measure activities of defense enzymes like peroxidase (PO), polyphenol oxidase (PPO), and chitinase in the plant tissues.
   - Gene Expression Analysis: Use RT-PCR to assess the expression of plant defense-related genes such as PR proteins, pathogenesis-related proteins, and jasmonic acid-related genes.
5. Assessment of Disease Resistance
   - Inoculate plants with fungal pathogens (same pathogens used earlier) to assess the defense response.
   - Disease Scoring: Record disease incidence and severity to determine if plants treated with the bacto-fungal consortium show reduced disease symptoms compared to control plants.

4. Statistical Approach to Plant Growth Promotion

1. Experimental Design
   - Randomized Block Design (RBD): Set up experiments with multiple replications

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to reduce variability.
- Treatment Groups: Include multiple treatment groups: control (no inoculum), bacterial-only, fungal-only, and bacto-fungal consortium.
- Replicates: Ensure sufficient replicates (e.g., 5–10 plants per treatment) for statistical power.

2. Data Collection
   - Record growth parameters (e.g., plant height, root length, biomass, chlorophyll content) and defense enzyme activities at regular intervals.
   - Collect data on disease incidence, severity, and plant yield (if applicable).
3. Data Analysis
   - Descriptive Statistics: Calculate mean, standard deviation, and standard error for each treatment group.
   - ANOVA (Analysis of Variance): Perform ANOVA to determine if there are significant differences in growth parameters and defense responses between different treatments.
   - Post-Hoc Analysis: If ANOVA shows significant differences, perform post-hoc tests (e.g., Tukey's HSD) to identify which groups differ.
   - Regression Analysis: If applicable, analyze the relationship between plant growth parameters and microbial treatments.
4. Interpretation of Results
   - Based on statistical analysis, conclude the effectiveness of the bacto-fungal consortium in promoting plant growth and enhancing disease resistance.
   - Report the findings in scientific papers, including detailed statistical results and graphical representations.

5. Greenhouse Experiments

1. Preparation:
   - Sterilize soil to eliminate native microbial and pathogen populations.
   - Select test crops prone to soil-borne fungal diseases (e.g., tomato, cucumber, or wheat).
2. Experimental Design:
   - Divide plants into treatments (biofertilizer, chemical fertilizer, control, and pathogen-only).
   - Apply biofertilizer and fungal pathogen inoculum as per experimental plan.
3. Data Collection:
   - Measure plant growth parameters (germination rate, root/shoot length, biomass).
   - Assess pathogen severity (disease incidence and lesion size).
   - Monitor soil microbial activity and nutrient availability.

6. Field Experiments

1. Site Selection and Preparation:
   - Identify fields with a history of soil-borne fungal diseases.
   - Prepare plots for treatment applications.
2. Experimental Layout:

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- Use randomized complete block design (RCBD) with treatments including biofertilizer, chemical fertilizer, integrated treatments, and controls.
- Apply biofertilizers via irrigation or foliar sprays.

3. Monitoring and Data Collection:
   - Evaluate plant growth (height, yield, and vigor).
   - Assess disease incidence and severity in treated and untreated plots.
   - Analyze soil samples for microbial diversity, nutrient content, and pathogen populations.

3. Laboratory Analysis

1. Soil and Plant Tissue Analysis:
   - Quantify nutrient uptake in plant tissues (N, P, K).
   - Assess soil enzyme activity and organic matter content.
2. Pathogen Quantification:
   - Measure fungal populations using dilution plating or qPCR.

4. Data Analysis and Interpretation

1. Statistical Analysis:
   - Use ANOVA or multivariate analysis to compare treatments.
   - Assess correlations between biofertilizer application, plant growth, and disease suppression.
2. Interpretation:
   - Determine the effectiveness of biofertilizer in promoting plant growth and controlling pathogens.
   - Identify optimal application methods and dosage.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The formulation of a liquid biofertilizer involves systematic steps to identify, isolate, characterize, and combine beneficial microorganisms into a stable and effective product. Here's a detailed plan of action:

1. Problem Identification and Objective Setting
   - Define the purpose of the biofertilizer (e.g., enhancing nutrient availability, promoting plant growth, controlling soil-borne fungal pathogens).
   - Identify target crops, soil types, and environmental conditions for application.
2. Collection of Samples
   - Source: Collect soil, rhizosphere, and compost samples from diverse agroecological regions, especially those with healthy crop growth.
   - Target Microorganisms: Focus on nitrogen-fixing bacteria, phosphate- and potassium-solubilizing bacteria, and antagonistic fungi.
3. Isolation of Beneficial Microorganisms
   - Use selective media to isolate microbial strains such as:

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- Bacteria: Rhizobium, Azospirillum, Pseudomonas, Bacillus.
- Fungi: Trichoderma, Aspergillus.

- Purify isolates for further characterization.

4. Characterization of Microbial Strains
   1. Morphological Characterization:
      - Examine cell shape, size, spore formation, and colony morphology.
   2. Biochemical Characterization:
      - Test for enzymatic activities, nutrient solubilization (e.g., phosphate, potassium), and nitrogen fixation.
   3. Molecular Characterization:
      - Use PCR and sequencing to identify strains at the species level.
   4. Functional Traits:
      - Assess antifungal activity against soil-borne pathogens using dual culture assays.
      - Measure plant growth-promoting properties like siderophore production, IAA production, and ACC deaminase activity.
5. Compatibility Testing
   - Test the compatibility of selected strains to ensure they can coexist without antagonistic effects.
6. Formulation Development
   1. Carrier Selection:
      - Use liquid carriers such as distilled water, glycerol, or molasses for nutrient supplementation.
   2. Stability and Viability:
      - Optimize formulation conditions to maintain microbial viability (e.g., pH, temperature, aeration).
      - Test for shelf life under storage conditions.
   3. Additives:
      - Include additives like bio-stimulants or polymers to enhance microbial survival and adhesion to plant roots.
7. Quality Control Testing
   - Test for microbial count, contamination, pH stability, and nutrient content.
   - Validate antagonistic properties and plant growth-promoting potential in lab conditions.
8. Greenhouse Evaluation
   - Apply the formulated biofertilizer to test crops grown in controlled conditions.
   - Assess its impact on plant growth, nutrient uptake, and pathogen suppression.
9. Field Testing
   - Conduct trials in diverse agroclimatic zones and soil types.
   - Evaluate efficacy, scalability, and cost-effectiveness in real-world conditions.
10. Final Product Standardization
    - Standardize the formulation based on results from greenhouse and field trials.

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- Ensure compliance with regulatory standards for biofertilizer production.

11. Commercialization and Dissemination
    - Develop protocols for large-scale production.
    - Train farmers and stakeholders on application techniques.
    - Promote adoption through field demonstrations and outreach programs.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Year 1: Initial Research and Preparation 1. Literature Review and Planning (Months 1–3) 2. Sample Collection and Microbial Isolation (Months 4–6) 3. Microbial Characterization (Months 7–12)	(Months 1–3)	(Months 1–3)	(Months 1–3)	(Months 1–3)
		(Months 4–6)	(Months 4–6)	(Months 4–6)	(Months 4–6)
		(Months 7–12)	(Months 7–12)	(Months 7–12)	(Months 7–12)
2.	Year 2: Formulation and Optimization 1. Development of Liquid Biofertilizer Consortium (Months 1–6) 2. Preliminary Greenhouse Trials (Months 7–12)	(Months 1–6)	(Months 1–6)	(Months 1–6)	(Months 1–6)
		(Months 7–12)	(Months 7–12)	(Months 7–12)	(Months 7–12)
3.	Year 3: Detailed Experimental Studies 1. Greenhouse Optimization (Months 1–6) 2. Field Trials - Phase 1 (Months 7–12)	(Months 1–6)	(Months 1–6)	(Months 1–6)	(Months 1–6)
		(Months 7–12)	(Months 7–12)	(Months 7–12)	(Months 7–12)
4.	Year 4: Advanced Field Studies and Data Analysis 1. Field Trials - Phase 2 (Months 1–6) 2. Comprehensive Data Collection and Analysis (Months 7–12)	(Months 1–6)	(Months 1–6)	(Months 1–6)	(Months 1–6)
		(Months 7–12)	(Months 7–12)	(Months 7–12)	(Months 7–12)

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5.	Year 5: Validation, Reporting, and Dissemination 1. Validation Studies (Months 1–6) 2. Final Data Analysis and Report Preparation (Months 7–9) 3. Dissemination and Outreach (Months 10–12)	(Months 1–6)	(Months 1–6)	(Months 1–6)	(Months 1–6)
		(Months 7–9)	(Months 7–9)	(Months 7–9)	(Months 7–9)
		(Months 10–12)	(Months 10–12)	(Months 10–12)	(Months 10–12)

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	NON-RECURRING			
	Personnel	5 years	1 (project assistant)	600000.00
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	5 years		320000.00 + 106000.00
2.	Travelling (viz. sample collection, should be Minimum and with justification)	5 years		27000.00
3.	Contingency	5 years		80000.00
4.	Stationery and Printing (With justification)			-
5.	Any other special requirement			-
6.	Overhead (10% of recurring)			-
	TOTAL	5 years		1133000.00

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Year	Personnel	Consumables	Equipment	Travel	Contingency	Total (₹)
Year 1	120000	60000	26000	5000	10000	221000
Year 2	120000	70000	20000	5000	20000	235000
Year 3	120000	60000	30000	10000	20000	240000
Year 4	120000	90000	30000	5000	10000	245000
Year 5	120000	40000	0	2000	20000	192000
Total (₹)	600000	320000	106000	27000	80000	1133000

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	Personnel			
Year-1 to 5	Recruitment of Project Assistants (1 people)	600000.00	60 months	60 months' salary amount for Project Assistant (12000/- per month consolidated)
2.	A. Chemicals			
Year-1 to 5	Necessary chemicals	220000.00	60 months	Consumables and Materials (Chemicals, media, reagents, etc.)
	B. Glassware			
Year-1 to 5	Necessary glassware	220000.00	50 months	Initial lab consumables (e.g., petri dishes, test tubes, pipettes, conical flasks, glassware)
	C. Equipment's			
Year-1 to 5	Necessary glassware	106000.00	4-8 months	Additional equipment as needed for formulation work (e.g., fermentation tanks, rotatory shaker incubator). Procurement of equipment for large-scale trials, possibly additional lab infrastructure for testing biofertilizer on a larger

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				scale.
3.	C. Any other consumable items (like wires/ electric items etc)	Not Applicable		
4.	Travel			
Year-1	1 time in every 2 months	5000	6 months	Field visits to collect soil samples and study initial pathogens
Year-2	2 times	5000	3 months	Travel for soil sampling, survey of different regions for fungal pathogen identification, and visits to collaborating institutions if necessary
Year-3	2 times	10000	4-5 months	Travel for field sampling, fungal pathogen analysis, and presentations at conferences (possibly 1 international, 1 national conference).
Year-4	3-4 times	5000	6 months	Field visits to test the effect of the biofertilizer in real-world conditions. Attendance at relevant conferences or seminars for knowledge exchange
Year-5	2-3 times	2000	6 months	Final presentation at conferences and meetings, including international dissemination of findings
5.	Contingency			
Year -1 to 5	Miscellaneous	80000.00		Office supplies, reports, meetings with collaborators, administrative work, Data analysis software, Publication costs, Final

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				project wrap-up, report submission and printing.
6.	Stationery and printing	Not Applicable		
	Grand Total (₹)	1133000.00		For the successful completion of project

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Water –Mediated systhesis of Highly Functionalize S-Triazine Derivatives	
2.	**Broad area of proposal**	Chemical Science	
3.	**Sub Area of proposal**	Organic Chemistry	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. DEVENDRA KANERIYA	ASSISTANT PROFESSOR Chemistry	9825342490 Devendra.kaneriya@atmiyauni.ac.in
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	JAY GODHANI	Ph.D. Scholer	8866336492
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	06/08/1974	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01/12/2018	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	NA	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	CHEMISTRY	SAURASTRA UNIVERSITY	2001	-
ii.	Post Graduation	CHEMISTRY	SAURASTRA UNIVERSITY	1996	61.56
iii.	Under Graduation	CHEMISTRY	SAURASTRA UNIVERSITY	1994	57.54
iv.	CSIR/UGG-NET/ SLET/GATE				

2.	Have you previously received any Fellowship from any funding agency?	NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	short-term fellowship (*viz* Project fellow, Project assistant, etc.)
		pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)
		post-doctoral fellowship (*viz* D S Kothari PDF, or any other)
4.	If yes, mention the details of fellowship and tenure	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (…….. Year + …… Months)
		Research Experience: (……Year + …… Months)

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7.	No. of Publication (Research articles - UGC Approved only)	National:
		International:
8.	No. of Publication (Book Chapters)	NA
	Books Published	NA
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Water –Mediated systhesis of Highly Functionalize S-Triazine Derivatives

2. Abstract (Provide a summary of your research proposal in 300 words)

A series of novel 1,3,5-triazine derivatives bearing various aryl amine, 2-amino pyrazine and 4-hydroxy coumarin moieties as substituents have been synthesized by an easy and conventional method using sequential nucleophilic substitution of chlorine atoms of cyanuric chloride. The reaction of cyanuric chloride with 4-hydroxy coumarin in acetone using alkaline medium at 0-5°C was afforded compound 3 in good yield. Followed by reaction 3 with 2-amino pyrazine and then various aromatic amines have afforded target compounds 6a-n in good yields. All the newly synthesized compounds were characterized by using spectroscopic analysis and then examined for their ability to inhibit the two Gram-positive bacteria (Bacillus subtilis and Staphylococcus aureus) Gram-negative bacteria (Escherichia coli and Pseudomonas aeruginosa) and one fungal species (Aspergillus niger) for biological interest.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Nitrogen containing heterocyclic compounds plays a significant role in the field of biological and medicinal among them 1,3,5-triazine skeleton is more interesting structure and has a wide variety of interesting applications in numerous fields [17]. Various derivatives of s-triazine show antimicrobial [18,19], antifungal [20], antitumor [21] and herbicidal [22] activities. Some are

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also used for the treatment of HIV infection [23]. Several workers investigated the s-triazine nucleus in the scope of potential therapeutic agents for diseases due to bacteria, malaria and cancer [24]. The above literature survey led us to consider the s-triazine nucleus as a core scaffold. It has been reported that s-triazine derivatives are used as templates for molecular imprinting [25] and for the construction of three-helix bundle protein [26].

It has been extensively reported that the presence of 4-hydroxy coumarin and pyrazine moieties in 1,3,5-triazine may enhance their biological activity [27-31]. Thus keeping in mind the tremendous biological potential of cyanuric chloride, 4-hydroxy coumarin and pyrazine derivatives motivated us to develop an easy and clean route for construction of novel triazine derivatives and examined their biological activity.

4. Status of Current Research in the proposed field:

Synthesis of 2-(Coumarinyl-4-oxy)-4,6-dichloro-s-triazine

To a stirred solution of cyanuric chloride (0.05 mol, 9.2 g) in acetone (50 ml) at 0-5°C, the solution of 4-hydroxy coumarin (0.05 mol, 8.1 g) in 10% NaHCO3 (45 ml) was added drop wise in two hours. The reaction was being monitored by TLC using acetone: toluene (10:1) as eluent. After completion of reaction, the stirring was stopped and the reaction mixture was poured in to crushed ice. The product obtained was filtered and dried. The crude product was purified by recrystallization from acetone to givethe title compound (3); yield 87%, M.p. 208-210°C.

Synthesis of 4-((4-chloro-6-(pyrazin-2-ylamino)-1,3,5-triazin-2-yl)oxy)-2H-chromen-2-one

To a stirred solution of compound 3 (1 g, 3.2 mmol) in acetone 20 ml was added K2CO3 (0.5 g, 3.2 mmol) at 0-5°C for 10 min. The solution of 2-amino pyrazine (306 mg, 3.2 mmol) in acetone 5 ml was added to above reaction mixture slowly drop wise during time period of 15 min. after completion of addition, the reaction was stirred at room temperature for 5 to 6 h. The reaction was being monitored by TLC using Toluene: Acetone (1:5) Rf: 0.21. After completion of the reaction, the reaction was poured in to crushed ice to yield the desired product. The product was filtered off and air dried to use further without purification. Yield 78%, mp 220-222°C.

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5. Objectives of the proposed study:

We have demonstrated an easy and conventional method for the synthesis of novel 4-hydroxy coumarin and 2-amino pyrazine bearing 1,3,5- triazine derivatives with good to high yields. The present process comprises easy and clean workup which gave desired product with good purity. Among all compounds, six compounds were screened against gram positive and gram negative bacteria and fungi and examined zone of inhibition. Compound 6e was found active against Gram-positive and Gram-negative bacteria. However, all compounds have moderate inhibition against fungi A. niger.

6. Significance of the proposed study:

It seems like you might be referring to a proposed study or development related to "tirazine." However, "tirazine" isn't a well-known term in pharmacology, chemistry, or other scientific fields based on my current knowledge.

Could you clarify if you're referring to a specific compound or concept, such as a drug, chemical, or technology? You might be thinking of **"triazine,"** a class of compounds, or **"terazine"**, but I need a bit more context to provide the relevant information.

7. Relevance of the proposed study to Gujarat:

Most of the currently marketed drugs consist of heterocyclic scaffolds containing nitrogen and or oxygen as heteroatoms in their structures. Several research groups have synthesized diversely substituted Triazine as anti-infective agents having anti-bacterial, anti-viral, anti-leishmanial, etc. activities. For the first time, the present review article will provide the coverage of synthetic account of Triazine as anti-infective agents along with their potential for SAR, activity potential, promising target for mode of action. The efforts have been made to provide the chemical intuitions to the reader to design new chemical entity with potential of anti-infective activity. This review will mark the impact as the valuable, comprehensive and pioneered work along with the library of synthetic strategies for the organic and medicinal chemists for further refinement of Triazine as anti-infective agents.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat:

In a nutshell, the synthesis of Triazine has been recognized as the key pharmacophore for broad-spectrum anti-infective or anti-microbial activities including anti-fungal, anti-bacterial, anti-malarial, anti-tubercular and anti-viral activities. In general, these scaffolds can be synthesized from amidoxime (obtained from reaction of nitrile and hydroxylamine) with carbonyl derivatives such as acyl chloride, ester, carboxylic acid. Mechanistically, the reaction of amidoxime with aldehyde yields the Triazine, which can be oxidized to Triazine with the stoichiometric assistance of oxidizing agents. The objective behind the present work has been set to create the spotlight around Triazine considering their synthetic strategies and usefulness as anti-parasitic activity for the benefit of medicinal chemists to design new scaffolds with potential activity of interest.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	✓
2.	Agriculture	
3.	Health and wellness	
4.	Nutrition	
5.	Development of Industrial Problem Solutions	✓
6.	Resources management and sustainable development	✓
7.	High Impact Teaching	
8.	Imparting corporate responsibility, ethics, accountability and values in society	✓
9.	Social entrepreneurship	
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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All melting points were recorded using open capillary and are uncorrected. ^{1}H-NMR spectra were obtained using a Bruker model spectrophotometer and were recorded at 400 MHz in Deuterated Dimethyl Sulfoxide (DMSO-d_6). Chemical shifts are reported in ppm relative to the residual signal of the solvent. IR spectra were recorded on a FTIR-Schimadzu. Mass spectrums were recorded using GCMS-Agilent. Chemicals and solvents were purchased from Loba Chemi, Himedia, Sigma-Aldrich and used without purification.

Synthesis of 2-(Coumarinyl-4-oxy)-4,6-dichloro-s-triazine

To a stirred solution of cyanuric chloride (0.05 mol, 9.2 g) in acetone (50 ml) at 0-5°C, the solution of 4-hydroxy coumarin (0.05 mol, 8.1 g) in 10% $NaHCO_3$ (45 ml) was added drop wise in two hours. The reaction was being monitored by TLC using acetone: toluene (10:1) as eluent. After completion of reaction, the stirring was stopped and the reaction mixture was poured in to crushed ice. The product obtained was filtered and dried. The crude product was purified by recrystallization from acetone to give the title compound

Synthesis of 4-((4-chloro-6-(pyrazin-2-ylamino)-1,3,5-triazin-2-yl)oxy)-2*H*-chromen-2-one

To a stirred solution of compound 3 (1 g, 3.2 mmol) in acetone 20 ml was added K_2CO_3 (0.5 g, 3.2 mmol) at 0-5°C for 10 min. The solution of 2-amino pyrazine (306 mg, 3.2 mmol) in acetone 5 ml was added to above reaction mixture slowly drop wise during time period of 15 min. after completion of addition, the reaction was stirred at room temperature for 5 to 6 h. The reaction was being monitored by TLC using Toluene: Acetone (1:5) R*f*: 0.21. After completion of the reaction, the reaction was poured in to crushed ice to yield the desired product. The product was filtered off and air dried to use further without purification.

General synthesis of 4-((4-(arylamino)-6-(pyrazin-2-ylamino)-1,3,5-triazin-2-yl)oxy)-2*H*-chromen-2-one 6a-n

The mixture of 4-((4-chloro-6-(pyrazin-2-ylamino)-1,3,5-triazin-2-yl)oxy)-2*H*-chromen-2-one (500 mg, 1.39 mmol), various aryl amines (1.3 mmol), catalytic amount of K_2CO_3 and THF was heated under reflux condition for 7-8 h. After completion of the reaction, it was poured in to crushed ice. The separated product was filtered, dried and crystallized out from chloroform to yield the desired products.

References:

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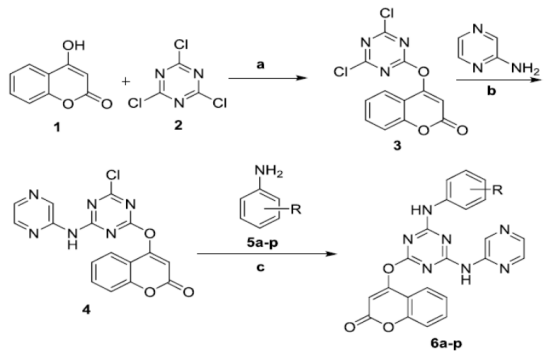
11. Suggested plan of action: Define the suggested plan of action in 200 words)



Scheme 1: Synthesis of trisubstituted novel 1,3,5-triazines
(a) Acetone, 10% $NaHCO_3$ solution, stirring at 0-5°C, 2-3 h; (b) Acetone, K_2CO_3 (1 eq.), stirring at 0-5°C to rt, 4-5 h; (c) THF, K_2CO_3 cat. reflux 7-8 h

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Synthesis of 2-(Coumarinyl-4-oxy)-4,6-dichloro-s-triazine	May	2023	September	2023
2.	Synthesis of 4-((4-chloro-6-(pyrazin-2-ylamino)-1,3,5-triazin-2-yl)oxy)-2*H*-chromen-2-one	October	2023	March	2024
3.	General synthesis of 4-((4-(arylamino)-6-(pyrazin-2-ylamino)-1,3,5-triazin-2-yl)oxy)-2*H*-chromen-2-one 6a-n	April	2024	December	2024
4.	synthesis & characterization of Substituted derivative	January	2025	August	2025
5.	Microbial activity of s-triazine	September	2025	April	2026

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Total Amount
1.	Consumables a. Chemicals,	2,95,000

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	b. Glassware, c. Electric items d. Other items (specify)	
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	10000
3.	Contingency (Upto maximum for Rs. 3000/-)	3000
4.	Stationery and Printing (With justification)	5000
5.	Any other special requirement	12000
6.	Overhead	
	TOTAL	**3,25,000**

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Part -A

(General Information)

1.	**Title of the proposal**	Comparison of Different Biomass Sources for ABE Yield in Fermentation Processes	
2.	**Broad area of proposal**	Bioenergy	
3.	**Sub Area of proposal**	Biomass	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dhaval A. Tank	Assistant Professor & Industrial Chemistry	7405464010 dhaval.tank@atmiyauni.ac.in
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Ravi S. Tank	HoD & Industrial Chemistry	9825114015 ravi.tank@atmiyauni.ac.in,
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	06/01/1989	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01/06/2020	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

Part -B

(Educational Qualification and Previous Research Experience of PI)

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1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.				
ii.	Post Graduation	Chemical Engineering	Nirma University	2012	7.17/10 (CPI)
iii.	Under Graduation	Biotechnology	Saurashtra University	2010	60.53%
iv.	CSIR/UGG-NET/ SLET/GATE				

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☐✓ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (4 years + 7 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles -	National:-

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	UGC Approved only)	**International:-**
8.	**No. of Publication (Book Chapters)**	-
	Books Published	
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Comparison of Different Biomass Sources for ABE Yield in Fermentation Processes

2. Abstract (Provide a summary of your research proposal in 300 words)

This research aims to evaluate and compare various biomass sources for their efficiency and suitability in producing acetone, butanol, and ethanol (ABE) through fermentation processes. The study will focus on identifying key factors affecting yield, including biomass composition, pretreatment methods, and microbial strains used. The outcome will provide insights into optimizing ABE fermentation for industrial applications, emphasizing sustainability and cost-effectiveness.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Acetone, butanol, and ethanol (ABE) are valuable chemicals used in various industrial applications, including solvents, biofuels, and pharmaceuticals. Fermentation-based production of ABE has gained attention due to its potential as a sustainable alternative to petrochemical-derived products. Biomass is a key feedstock in ABE fermentation, and its type and quality significantly influence the yield and economic feasibility of the process.

This study proposes to compare different biomass sources—including lignocellulosic residues, agricultural waste, and energy crops—to identify the most efficient and sustainable feedstock for ABE production. By addressing the challenges in biomass pretreatment and fermentation optimization, this research aims to contribute to the advancement of bio-based chemical production

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4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Status of Current Research: Comparison of Different Biomass Sources for ABE Yield in Fermentation Processes

Research on ABE fermentation has expanded significantly, particularly in optimizing feedstock utilization to enhance yield and reduce costs. Studies have examined lignocellulosic biomass sources like corn stover, wheat straw, and switchgrass, focusing on their chemical composition and potential as feedstocks. Agricultural residues, including sugarcane bagasse and fruit peels, have also been explored due to their abundance and low cost.

Pretreatment technologies are a critical area of focus. Physical methods such as milling and steam explosion, chemical processes including acid and alkaline hydrolysis, and enzymatic approaches have all been investigated to improve the release of fermentable sugars. While effective, the high costs and environmental concerns associated with some pretreatment methods remain barriers to large-scale implementation.

Microbial strain development is another significant aspect of current research. Efforts have centered on engineering Clostridium acetobutylicum and related species to improve their tolerance to ABE products, enhance substrate utilization, and reduce byproduct formation. Advances in synthetic biology and metabolic engineering have enabled the creation of robust strains capable of achieving higher butanol yields, a key economic driver in ABE production.

Comparative studies on biomass sources have highlighted the variability in ABE yields due to differences in feedstock composition and pretreatment efficacy. However, these studies often lack standardization in experimental design, making direct comparisons challenging. Furthermore, economic and environmental assessments are increasingly incorporated into research to evaluate the feasibility of different biomass sources.

Despite significant progress, gaps remain in systematically comparing diverse biomass sources under uniform conditions to identify the most promising candidates for industrial ABE production. This underscores the need for comprehensive studies that integrate feedstock selection, pretreatment optimization, and microbial strain performance.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To evaluate the composition and characteristics of various biomass sources.
2. To investigate the effect of pretreatment methods on biomass conversion efficiency.
3. To compare ABE yields using different microbial strains and fermentation conditions.
4. To assess the economic and environmental impact of using different biomass sources.

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6. Significance of the proposed study: (300 words)

This research holds broad significance for advancing sustainable and efficient bio-based chemical production. By systematically comparing various biomass sources, the study aims to provide a robust framework for selecting feedstocks that balance economic feasibility with environmental responsibility. The integration of advanced pretreatment techniques and optimized microbial strains will pave the way for higher yields and reduced production costs, making ABE fermentation a viable alternative to petrochemical processes. Furthermore, the outcomes of this study will contribute to global efforts in reducing reliance on fossil fuels and mitigating climate change, aligning with the principles of a circular economy and green chemistry.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, a state known for its thriving agricultural and industrial sectors, is uniquely positioned to benefit from this research. The state generates a significant amount of agricultural residues, including cotton stalks, sugarcane bagasse, and groundnut shells, which are potential feedstocks for ABE fermentation. Leveraging these biomass resources can help Gujarat establish itself as a hub for bio-based chemical production, reducing waste and promoting sustainable practices.

Additionally, Gujarat's well-established chemical and petrochemical industries provide an ideal ecosystem for integrating ABE production into existing infrastructure. The development of cost-effective and sustainable ABE fermentation processes can complement the state's efforts to diversify its industrial portfolio and reduce its carbon footprint. Furthermore, this research aligns with Gujarat's vision for sustainable development and its commitment to fostering innovation in green technologies.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research holds the potential to deliver several societal benefits to the state of Gujarat:

Waste Utilization and Environmental Sustainability: By converting agricultural residues into valuable chemicals, the study addresses the problem of waste management, reducing environmental pollution from biomass burning.

Economic Growth: Promoting bio-based chemical production can create new economic opportunities, particularly in rural areas where agricultural residues are abundant. This could lead

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to job creation and enhanced income for farmers and local communities.

Reduction in Fossil Fuel Dependence: The development of sustainable ABE production processes can help reduce reliance on imported fossil fuels, supporting Gujarat's energy security and contributing to national self-reliance.

Support for Green Industries: The findings can help establish Gujarat as a leader in green industrial processes, aligning with the state's ambitions for sustainable industrial development.

Health and Quality of Life: By mitigating air pollution caused by open biomass burning, the research contributes to improved public health and better living conditions for Gujarat's residents.

Policy and Educational Impact: The research findings can inform state policies on waste management, bioenergy, and sustainable development, while also fostering educational initiatives and skill development in green technologies.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	✓☐
2.	Agriculture	✓☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓☐
6.	Resources management and sustainable development	✓☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐

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9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

1. Biomass Selection and Characterization

- Identify and collect samples of lignocellulosic residues (e.g., corn stover, wheat straw), agricultural waste (e.g., fruit peels, sugarcane bagasse), and energy crops (e.g., switchgrass, miscanthus).
- Analyze chemical composition, including cellulose, hemicellulose, lignin, and moisture content.

2. Pretreatment Methods

- Employ physical (milling, steam explosion), chemical (acid or alkaline hydrolysis), and enzymatic pretreatments to enhance biomass digestibility.
- Evaluate the efficiency of each method in releasing fermentable sugars.

3. Fermentation Experiments

- Use Clostridium acetobutylicum and other ABE-producing microbial strains.
- Conduct batch and fed-batch fermentation experiments under controlled conditions.
- Measure ABE yield, sugar utilization, and byproduct formation.

4. Data Analysis and Comparison

- Compare ABE yields across biomass sources and pretreatment methods.
- Perform statistical analysis to identify significant factors influencing yield.
- Conduct life cycle assessment (LCA) to evaluate the environmental impact.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

1. Literature Review and Initial Assessment

- Conduct a comprehensive review of existing studies on ABE fermentation and biomass sources.
- Identify knowledge gaps and define criteria for selecting biomass feedstocks.
- Procure necessary laboratory equipment and secure required permissions for research

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activities.

2. Biomass Selection and Characterization

- Collect samples of potential biomass sources (e.g., agricultural residues, lignocellulosic materials, energy crops).
- Analyze chemical composition, including cellulose, hemicellulose, lignin, and moisture content, to assess suitability for fermentation.

3. Pretreatment Optimization

- Test various pretreatment methods (physical, chemical, enzymatic) to enhance fermentable sugar release.
- Measure the efficiency of each method and optimize process parameters.
- Evaluate environmental and economic implications of pretreatment methods.

4. Fermentation Trials

- Conduct batch and fed-batch fermentation experiments using ABE-producing microbial strains.
- Test fermentation efficiency for each pretreated biomass type under controlled conditions.
- Measure key outputs: ABE yield, sugar utilization, and byproduct formation.

5. Data Analysis and Optimization

- Analyze experimental data to identify the most effective biomass-preparation-fermentation combinations.
- Use statistical tools to determine significant factors influencing ABE yield.
- Conduct a preliminary cost-benefit analysis of the proposed fermentation process.

6. Life Cycle Assessment (LCA)

- Evaluate the environmental impact of using different biomass sources.
- Analyze parameters such as energy input/output, greenhouse gas emissions, and resource utilization.

7. Report Writing and Dissemination

- Compile results into a detailed research report with actionable recommendations for stakeholders.
- Publish findings in peer-reviewed journals and present them at relevant conferences.
- Engage with industry stakeholders and policymakers to discuss potential industrial-scale applications.

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review and Initial Assessment	June	2022	August	2022
2.	Biomass Selection and Characterization	September	2022	November	2022
3.	Pretreatment Optimization	December	2022	July	2023
4.	Fermentation Trials	August	2023	December	2023
5.	Data Analysis and Optimization	January	2024	September	2024
6.	Life Cycle Assessment (LCA)	October	2024	March	2025
7.	Report Writing and Dissemination	April	2025	July	2025

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	Variable		600000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	Variable		200000
3.	Contingency (Upto maximum for Rs. 3000/-)	Variable		50,000
4.	Stationery and Printing (With justification)	Variable		30000
5.	Any other special requirement	Variable		200000

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6.	Overhead (10% of recurring)	-		-
	TOTAL	-		**1080000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**	200000	6 months	Chemicals required for fermentation, media preparation, and analysis.
2.	**B. Glassware**	200000	6 months	Glassware for culturing biomass, fermentation vessels, and sample collection.
3.	**C. Any other consumable items (like wires/ electric items etc)**	200000	6 months	Items for electrical setups, sensors for fermentation monitoring, and cables.
4.	**Travel**	200000	6 months	Field visits to biomass sources, academic conferences, or external collaborations.
5.	**Contingency**	50000	6 months	Unexpected costs such as equipment malfunction or material shortages.
6.	**Stationery and printing**	30000	Throughout project	For report printing, presentations, and documentation of research results.
7.	Any other special requirement	200000	As needed	Specific requirements such as specialized equipment for biomass characterization or fermentation enhancement.
8.	Overhead (10% Recurring)	-	-	-
	Grand Total	10,80,000		10,80,000

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Application form

Part -A

(General Information)

1.	Title of the proposal	The Enduring Legacy of Ancient Indian Sports and Martial Arts from Historical Roots to Modern Practices	
2.	Broad area of proposal	Life Science	
3.	Sub Area of proposal	Sports	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Mr. Indrajitsinh Jadeja	Head of Department Diploma Mechanical Engineering	9725503943
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
		n/a	n/a
6.	Whether the proposal is transdisciplinary?	Yes	
7.	Date of Birth of PI (DD/MM/YYYY)	21/09/1986	
8.	Date of joining the Department of PI (DD/MM/YYYY)	13/09/2010	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	n/a	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

Part -B

(Educational Qualification and Previous Research Experience of PI)

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1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.				
ii.	Post Graduation	CAD/CAM	Gujarat Technological University	2014	
iii.	Under Graduation	Production Engineering	Saurashtra University	2007	
iv.	CSIR/UGG-NET/ SLET/GATE				

2.	Have you previously received any Fellowship from any funding agency?	☐YES	✓NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐short-term fellowship (viz Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (17 Year + 0 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 5
		International: 2
8.	No. of Publication (Book Chapters)	

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	Books Published	1
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

The Enduring Legacy of Ancient Indian Sports and Martial Arts from Historical Roots to Modern Practices

2. Abstract (Provide a summary of your research proposal in 300 words)

This research aims to explore the rich tradition of sports and martial arts in ancient India, examining their origins, cultural significance, and evolution. The study will also investigate the enduring legacy of these practices and their influence on contemporary sports and physical education in India. By analyzing historical texts, archaeological findings, and cultural narratives, this research seeks to provide a comprehensive understanding of the ancient Indian sporting ethos and its relevance in the modern world. Ancient Indian sports and rituals were deeply interwoven, reflecting the civilization's holistic approach to life. Ancient sports like Mallakhamb, Kalaripayattu, Kushti (Pehlwani) Vajra Mushti, Yoga, Silambam, Pachisi having their diverse range in physical fitness, strategic thinking, and holistic well-being. Many of these sports are popular in Medieval and Ancient period of India. These sports not only provided entertainment but also played crucial roles in community bonding, physical training, and the development of mental discipline. Understanding and promoting these traditional sports can offer valuable insights into India's historical practices and their relevance in contemporary times. They underscored the importance of physical and mental well-being, ethical conduct, and cultural continuity. The legacy of these traditions continues to influence modern Indian sports and cultural practices, highlighting their enduring significance.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The Project aim to bridging the gap between the Ancient Indian Sports & Martial arts to the Modern era sports. Ancient Indian sports and martial arts were not merely physical activities but integral aspects of the cultural, spiritual, and educational systems. This proposal outlines a study to investigate the origins, development, and cultural impact of these practices. It aims to highlight how ancient sports and martial arts have shaped modern Indian sports and continue to influence global fitness and martial arts practices. Sports have played a crucial role in human societies since ancient times, serving as a means of physical exercise, entertainment, and social

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cohesion. This proposal outlines a study to investigate the historical roots of sports in ancient civilizations, their cultural and social significance, and their evolution into modern forms. The research will highlight the ways in which ancient sports have influenced contemporary athletic practices and contributed to the development of modern sports culture. By the completion of the project following questions will be answered.

1. What were the primary sports and martial arts practiced in ancient India, and what were their origins?
2. How were these activities integrated into the cultural, religious, and social fabric of ancient Indian society?
3. In what ways have ancient Indian sports and martial arts influenced modern sports and physical education in India?
4. How have ancient Indian martial arts contributed to global martial arts and fitness practices?

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research on ancient Indian sports and martial arts in India is gaining momentum. Scholars are investigating historical texts, archaeological evidence, and oral traditions to understand the origins and evolution of these practices. Research focuses on disciplines like Kalaripayattu, Malla Yuddha, and Kusti, exploring their historical roots, philosophical underpinnings, and socio-cultural significance. Efforts are underway to document and preserve these traditions through workshops, training programs, and academic initiatives. However, further research is needed to comprehensively understand the impact of these ancient practices on modern Indian society and their potential for contemporary applications in health, education, and cultural development.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To trace the historical origins and development of key sports and martial arts in ancient India.
2. To explore the cultural, religious, and social significance of these activities in ancient Indian society.
3. To analyze the transition and adaptation of ancient sports and martial arts into modern practices.
4. To assess the impact of ancient Indian sports and martial arts on contemporary physical education and global fitness trends.

6. Significance of the proposed study: (300 words)

Educational Integration: Incorporating ancient sports into educational curricula enhances

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cultural literacy and provides diverse physical education experience. Innovation and Modern Adaptations: Understanding the evolution of ancient sports can inspire modern innovations in sports technology and training methods. Societal Impact: Reviving and celebrating ancient sports can foster a sense of national identity and pride, connecting modern societies with their historical roots. Global Impact: Ancient Indian sports, such as yoga, have gained global recognition, enhanced India's cultural influence and promoting cultural diplomacy. Academic Contributions: Researching ancient sports contributes new knowledge to academic fields, enriching the study of history, culture, and physical education.

7. Relevance of the proposed study to Gujarat: (200 words)

Research into ancient Indian sports and martial arts offers significant benefits for Gujarat. By reviving traditional practices like Kusti and indigenous games, the state can preserve its rich cultural heritage and attract tourists. These disciplines promote physical and mental well-being, combating sedentary lifestyles. Furthermore, they provide opportunities for skill development and employment. By fostering community and instilling values in youth, this research contributes to a more vibrant and healthy society.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

Research into ancient Indian sports and martial arts can provide significant benefits to the state of Gujarat. Firstly, it can contribute to the preservation and revitalization of Gujarat's rich cultural heritage. By reviving traditional sports like Kusti and indigenous games, the state can reconnect with its past and strengthen its cultural identity. This can also attract tourists interested in experiencing authentic cultural experiences, boosting tourism revenue. Secondly, this research can have a positive impact on the health and well-being of Gujarat's citizens. Promoting the practice of these sports can encourage physical activity, combat sedentary lifestyles, and improve overall health. Many of these disciplines also emphasize mental discipline, focus, and stress reduction, contributing to better mental well-being. Finally, this research can have economic and social benefits. Training programs in traditional sports and martial arts can provide valuable skills and employment opportunities for youth in the state. Developing infrastructure and organizing events around these sports can attract athletes and sports enthusiasts from around the world, further boosting the local economy. Moreover, these activities can foster a sense of community and shared cultural identity among people of all ages, contributing to a more vibrant and cohesive society.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	✓

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4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

1. Intern Selection
    a. Intern selection will be completed on the base of Relevant Fields of Study, Research and Analytical Skills, Interest and Passion, Skills and Competencies, Digital Literacy and data analysis skill.
2. Literature Review
    a. Examination of ancient texts, such as the writings of Homer, Herodotus, and Pliny, for references to sports.
    b. Review of archaeological findings and historical records from ancient civilizations, including Greece, Rome, Egypt, and India.
3. Historical Analysis
    a. Study of historical documents, inscriptions, and artworks depicting ancient sports.
    b. Analysis of the evolution of sports from ancient to modern times through historical narratives and records.
4. Cultural Study
    a. Exploration of traditional festivals, rituals, and cultural practices that included sports.
    b. Interviews with historians, cultural scholars, and practitioners of traditional sports.
5. Field Research
    a. Observation and documentation of traditional sports still practiced in cultural communities.
    b. Engagement with sports academies and institutions to understand the integration of ancient sports techniques into modern training.

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6. Demographic & Geographic Survey
    a. Develop a survey plan that include target audience, design the questionnaires, Data collection and data analysis.
    b. Prepare a report on interpretation of research that includes findings, visualization, conclusion & Feedback.
7. Detailed Analysis Report
    a. Prepare a detailed analysis report that shows the following insights key points.
        i. Awareness
        ii. Cultural Significance
        iii. Modern Influence
        iv. Health Benefits
        v. Global Recognition
    b. Comparison of ancient sports with their modern counterparts.
    c. Analysis of the transformation and adaptation processes over the time.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Literature Review: A comprehensive review of relevant historical texts, archaeological findings, and scholarly articles will provide a foundation for understanding the evolution of these practices in India and Gujarat specifically.

Field Research: Conduct ethnographic research in villages and urban areas to observe and document the continued practice of traditional sports and martial arts. Interview practitioners, gurus, and community members to understand their cultural significance and social impact.

Data Collection and Analysis: Design and administer surveys to assess public awareness, interest, and participation in these sports. Collect and analyze data on the socio-economic and demographic factors influencing their practice.

Historical Analysis: Study historical documents, inscriptions, and artworks to trace the origins and evolution of these sports in Gujarat. Analyze how they have adapted and transformed over time.

Cultural Study: Explore the cultural context of these sports, including their connections to festivals, rituals, and social norms. Investigate how they contribute to the cultural identity of Gujarat.

Dissemination of Findings: Publish research findings in academic journals, organize workshops and seminars, and collaborate with local communities to promote the revival and preservation of these valuable traditions.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year

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1.	Foundation & Literature Review	April	2022	May	2022
2.	Field Research & Data Collection	June	2022	July	2022
3.	Data Analysis & Historical Research	August	2022	September	2022
4.	Cultural & Historical Analysis	October	2022	November	2022
5.	Report Writing & Dissemination	December	2022	January	2023
6	Dissemination & Project Closure	February	2023	March	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Salaries (Interns)	10000	10	₹ 12,00,000
2.	Travel and Conferences	5,000	20 visits	₹ 1,00,000
3.	Equipment/Facilities (E-resources Books)	25,000	1	₹ 25,000
4.	Contingency	-	-	₹ 75,000
	TOTAL			₹ 14,00,000

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	Personnel Costs	12,00,000	1-12	To fund salaries for research assistants, a project coordinator, and expert consultations.
2.	Travel & Logistics	1,00,000	2-6, 9-10	To cover travel, accommodation, and transportation for field research and conference

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				participation.
3.	Equipment & Facilities	25,000	1-3	To purchase necessary equipment (laptops, software) for data collection and analysis.
8.	Contingency	75,000	1-12	To address unforeseen expenses and ensure project flexibility.
	Grand Total	14,00,000		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Crystal Engineering: A cutting-edge approach for ameliorating biopharmaceutical performance of selected antibiotics	
2.	**Broad area of proposal**	*Pharmacy*	
3.	**Sub Area of proposal**	Crystal Engineering	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Kevin Garala	Associate Professor, Pharmacy	kevin.garala@atmiyaui.ac.in, 9974664666, 1713
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Dr. Parag Rabara **Ms. Reena Ughreja**	Associate Professor, Assistant Professor, Pharmacy	parag.rabara@atmiyauni.ac.in, 9904524080 reena.ughreja@atmiyauni.ac.in, 9409323414, Ext No.,1713
6.	**Whether the proposal is transdisciplinary?**	~~Yes~~ / No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	19/06/1985	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	15/04/2009	
9.	**Whether the PI is registered for Ph.D. on the same topic**	NO	
10.	**If yes then name of university**	NA	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	Ph. D.	Pharmacy	Saurashtra University, Rajkot, Gujarat, India	2015	-
ii.	Post Graduation	Pharmaceutics	Shivaji University, Kolhapur, Maharashtra, India	2008	66.27%
iii.	Under Graduation	-	North Maharashtra University, Jalgaon, Maharashtra, India	2006	64.12%
iv.	~~CSIR/UGC-NET/ SLET/~~GATE	Pharmacy	IIT, Kharakpur	2006	Score - 356

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☐V NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	NA	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	**Title**	**Project Cost**	**Sponsoring Agency**	**Duration (Start – End – MM/YYYY)**

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6.	Total Experience	Teaching Experience: (13 Year + 2 Months)
		Research Experience: (……-…Year + ……-… Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 03
		International: 17
8.	No. of Publication (Book Chapters)	-
	Books Published	1
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Crystal Engineering: A cutting-edge approach for ameliorating biopharmaceutical performance of selected antibiotics

2. Abstract (Provide a summary of your research proposal in 300 words)

In recent decades, the developing era of crystal engineering and its capacity to generate novel multicomponent adducts has expansively been utilized in the pharmaceutical field to address active pharmaceutical ingredients (API). They can lead to ameliorate the biopharmaceutical characteristics such as solubility, dissolution rate, thermodynamic stability, tabletability, compactability, chemical and thermal stability, flowability, manufacturability, and pharmacokinetics properties without compromising their structural integrity and pharmacological activities of the APIs. Therefore in the proposed project, crystal engineering has emerged as a cutting-edge approach for overcoming the stumbling APIs of the two antibiotics (Linezolid and Lomefloxacin) by designing of multi-component adducts (eutectic mixture/co-crystal/co-amorphous solids). The prepared adducts will be prepared by various solid-state or solution based methods followed by various characterization techniques such as Differential Scanning Calorimeter (DSC), Hot Stage Microscopy (HSM), single and powder X-ray diffraction, solid-state Nuclear Magnetic Resonance (ss NMR), Fourier-Transform Infrared spectroscopy (FT-IR), Raman Spectroscopy, Scanning Electron Microscopy (SEM) and Density Function Theory (DFT). The pharmaceutical relevant parameters like apparent solubility, dissolution, packability, compressibility, compactibility and stability of the prepared multicomponents will be performed and compared with pure APIs. The optimized samples will

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be subjected for the in-vitro antibiotic efficacy and in-vivo performance of the selected APIs and also compared with the original APIs. The optimized adducts finally will be formulated as directly compressible tablets having multicomponent-based dosage form.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

There are many dosage forms of drugs available for the application of active pharmaceutical ingredients (APIs). Most of the drugs are marketed and sold in oral solids mainly tablets and capsules. Moreover, out of the various existing forms of an API, selecting the best solid form, in the early development stages is essential to save time and cost associated with the drug development process and the empathy of which is a crystalline form. Hence, crystalline forms of APIs play a vital role in drug discovery and development in terms of optimization of bioavailability, filing intellectual property rights, and developing suitable manufacturing methods. Unfortunately, majority of already existing APIs and new drug molecules have a setback of low solubility and dissolution which consequently affects their oral administration.

Moreover, drug molecules even with favourable pharmacological characteristics face various challenges during the development and scale-up due to their undesirable mechanical parameters such as flowability, manufacturability, packability, compressibility, and so on. In context to this, successful development of robust formulation requires the comprehensive knowledge of APIs and making use of this knowledge to formulate a tailor-made formulation by manipulating the aforementioned parameters of the original APIs. In recent decades, multi-component crystalline systems mainly co-crystals, eutectic mixtures, and co-amorphous solids are the current research interest of crystal engineers and pharmaceutical scientists due to their excellent and unique pharmaceutical properties. In this regard, crystal engineering implementing the principle of supramolecular chemistry offers unique advantages and has expansively been utilized in the pharmaceutical field to generate novel multi-component adducts (co-crystal/eutectic/co-amorphous) of old APIs. They can lead to manipulating the pharmaceutical relevant properties such as solubility, dissolution rate, thermodynamic stability, tabletability, compactability, chemical and thermal stability, flowability, manufacturability, and pharmacokinetics properties without compromising the structural integrity and pharmacological activities of the APIs. In this way, it is aimed to design the novel progress of researches in the multi-component solids in understanding the structure-property relationship through crystal engineering approach and also would open up the possibilities in the development of the desired multi-component based product on pharmaceutical important.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Formulating APIs, having poor mechanical characteristics, into multi-component solids (MCSs) is a tailor-made technique to ameliorate solid-state properties for new drug development and product redesign. Research on multicomponent adducts, namely cocrystal, eutectics, and co-amorphous, has piqued the curiosity of crystal engineers and formulation scientists and is now an integral element of the pre-formulation development of drug products. Although MCSs

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research has grown rapidly in the last two decades, effective clinical translation of MCSs is still limited. Several researchers discussed the growing field of MCSs of APIs involving co-crystal, eutectic composition, and co-amorphous solids with ameliorating the physicochemical and processing characteristics of the selected APIs via crystal engineering approach. This study will helpful for the development of desirable solid forms based on pharmaceutical requirements.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Formulation and optimization of multi-component adducts of selected APIs with various Generally Regard As Safe (GRAS) category coformers using various techniques including solution-based and solid based techniques by applying solvents of suitable polarity

2. Characterization using various analytical techniques such as Differential Scanning Calorimetry (DSC), Thermogravimetric analysis (TGA), Hot Stage Microscopy (HSM), single X-ray diffraction (SXRD) and powder X-ray diffraction (PXRD), Solid state Nuclear Magnetic Resonance (ss NMR), Fourier Transform Infrared Spectroscopy (FT-IR) and Raman Spectroscopy techniques, and Scanning Electron Microscopy (SEM), and Density Function Theory (DFT).

3. Understanding phase behavior by constructing temperature-composition phase diagrams from DSC data of corresponding binary mixtures prepared at various compositions.

4. Evaluation of various pharmaceutical relevant properties such as solubility, dissolution rate, thermodynamic stability, tabletability, compactability, chemical and thermal stability, flowability and manufacturability of the resulting materials and compared with pure forms.

5. To elaborate and access the practical guide to formulate directly compressible tablets or other suitable formulation from the optimized crystalline adducts-based dosage forms development.

6. Significance of the proposed study: (300 words)

The proposed study on "Crystal Engineering: A Cutting-Edge Approach for Ameliorating Biopharmaceutical Performance of Selected Antibiotics" aims to explore the potential of crystal engineering to enhance the therapeutic efficacy and bioavailability of antibiotics. Crystal engineering, the science of designing and optimizing the crystalline forms of pharmaceutical compounds, has emerged as a promising strategy to improve the physical, chemical, and biopharmaceutical properties of drug substances.

Antibiotics are crucial in combating bacterial infections; however, their clinical performance can be hindered by issues such as poor solubility, limited bioavailability, and inconsistent pharmacokinetics. By applying crystal engineering techniques, such as polymorph selection, co-crystallization, and salt formation, the study aims to develop novel crystalline forms of selected antibiotics that exhibit superior solubility, stability, and bioavailability. These improvements can significantly enhance the therapeutic outcomes of antibiotics, ensuring that they reach the target site of action more effectively and at the required concentration.

Additionally, the study will address the challenge of overcoming drug resistance, a growing global concern. By optimizing the formulation of antibiotics at the molecular level, it is possible to increase their efficacy against resistant strains, offering an innovative solution to a persistent public health issue.

The research findings could have wide-reaching implications in the pharmaceutical industry, especially in the development of next-generation antibiotic therapies. The ability to manipulate the crystallization process could open new avenues for drug delivery systems, providing a tailored approach to meet the specific needs of patients. Ultimately, this study aims to contribute to the improvement of patient outcomes through more effective and reliable antibiotic treatments, addressing the urgent need for enhanced biopharmaceutical performance in the fight against bacterial infections.

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7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study holds significant relevance to Gujarat, a state known for its robust pharmaceutical and healthcare industries. Gujarat is home to numerous pharmaceutical manufacturing facilities, including global leaders in drug production and biotechnology, making it a key player in India's pharmaceutical sector. By exploring crystal engineering to enhance the biopharmaceutical performance of antibiotics, this study aligns with the state's focus on advancing pharmaceutical innovation and improving healthcare outcomes.

Antibiotic resistance is a growing concern worldwide, and Gujarat, being a major hub for pharmaceutical research and manufacturing, is well-positioned to lead efforts in addressing this issue. The findings from this study could help local pharmaceutical companies develop more effective antibiotic formulations, improving both the quality and efficacy of antibiotics produced in the region. This would not only benefit public health in Gujarat but also have a broader impact on the national and international markets.

Furthermore, Gujarat has a strong presence of research institutions and universities, making it an ideal setting for collaborative efforts in pharmaceutical research. By conducting this study, the state can contribute to cutting-edge research in the field of crystal engineering, encouraging further innovation and attracting investment in pharmaceutical R&D. Additionally, the successful implementation of the study's outcomes could support the state's vision of becoming a global leader in advanced drug delivery technologies and biopharmaceuticals.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research project is expected to bring significant societal benefits, particularly for the state of Gujarat. By improving the biopharmaceutical performance of antibiotics through crystal engineering, the study could lead to the development of more effective antibiotics with enhanced bioavailability, solubility, and stability. This would directly improve the treatment of bacterial infections, ultimately enhancing patient outcomes, particularly in Gujarat where infectious diseases are prevalent, and access to healthcare may be limited in rural areas. Moreover, the issue of antibiotic resistance, a major global health concern, could be mitigated by optimizing antibiotic formulations to be more effective against resistant strains. This would help reduce the spread of antibiotic resistance and strengthen the state's healthcare infrastructure by reducing treatment failures and the need for expensive, prolonged therapies.

Additionally, the research outcomes could stimulate growth in Gujarat's pharmaceutical industry, which is one of the largest in India. By enabling local companies to produce high-quality, novel antibiotics, the study could attract investment, foster innovation, and create new job opportunities in pharmaceutical research and manufacturing. The development of advanced drug delivery systems could also open new avenues for exports, further contributing to Gujarat's economy. The increased availability of more effective and affordable antibiotics would improve healthcare accessibility, especially for economically disadvantaged communities across the state, thereby reducing the healthcare burden. In summary, the expected findings of this research hold the potential to improve public health, support economic growth, and make quality healthcare more accessible, benefiting both the state of Gujarat and its citizens.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)

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1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	√☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Discover these solid forms of the drug molecules with optimal properties required comprehensive knowledge about intermolecular interactions mainly non-covalent derivatives and the packing modes of the structures Crystal engineering approaches, which can potentially be applied to a wide range of crystalline materials, offer an alternative and fruitful method for improving the solubility, dissolution rate, and subsequent bioavailability of poorly soluble drugs. Here we propose to investigate new crystal forms of selected API with its utility limited to poor aqueous solubility and flow property. The following figure explains the brief outline methodology of the proposed research work.

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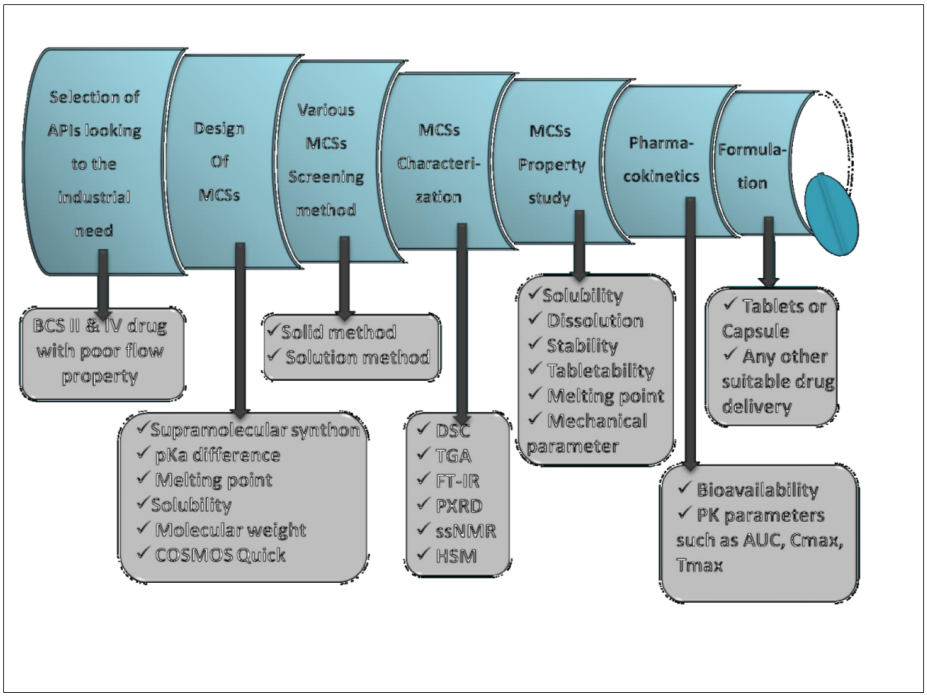

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The findings of the proposed project will be utilized to develop novel multi-component systems (MCSs) of active pharmaceutical ingredients (APIs) that enhance biopharmaceutical performance. These advanced materials will undergo various stages, including preformulation studies, prototype formulation, process development, scale-up, and ultimately the manufacturing of commercial batches. The rapid emergence of new forms of patent applications in recent decades has raised significant concerns within both the industry and academic communities. Notably, approximately 80% of patents granted for co-crystals have been filed by industries or contract research organizations, while only 20% have been submitted by academic institutions and universities. From a regulatory standpoint, the proposed formulations are slated for patent filing, with plans to collaborate with pharmaceutical companies for marketing, supported by industrial R&D units in India. The successful commercial launch of drugs like Steglstro™, Entresto™, Lexapro™, and Suglat™, as well as those in clinical trials by the FDA and EMA, further strengthens the significance of this area of research. Our study is expected to provide substantial benefits to both industry and academia, facilitating the development of the targeted API into a final drug product. Ultimately, the research methodology and infrastructure established through this project will serve as a foundation for a comprehensive, full-scale research initiative in the field of crystal engineering, contributing to the advancement of pharmaceutical sciences.

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Ordering of instrument, installation procedures, research lab arrangement, procuring of chemicals, literature survey followed by establishment of lab and preliminary research experiments set up	June	2022	December	2022
2.	Formulation and optimization of multi-component adducts of selected APIs with various GRAS category coformers using various techniques including solution-based and solid-based techniques by applying solvents of suitable polarity.	January	2023	December	2023
3.	Characterization using various analytical techniques mainly preliminary trails using DSC instrument followed by other techniques	January	2024	June	2024
4.	Formulation development and evaluation of newly design solid forms	July	2024	December	2025
5.	Compilation of data, consolidation report preparation and patent/publication/communication of research paper in international peer-reviewed journals.	January	2026	May	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals	-	-	2,75,000

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2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			90,000
3.	Contingency			60,000
4.	Equipment			26,75,000
5.	Any other special requirement			4,50,000
6.	Overhead			2,00,000
	TOTAL			**37,50,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a) API, polymers, excipients, chemicals, surgical, Kits, b) organic/inorganic solvents, glassware, plastic wares, and c) other materials used for this study to formulate new solid d) forms, and that will be ordered from this budget.	2,75,000	6 months	For experimental work
2.	**Contingency**	60,000		For the performance of experiments, a budget for contingency is required for buying books (if necessary), small laboratory items, electric components, furniture, stationery items, postage, allied items, etc.
3.	**Equipment**			
	a) Differential Scanning Calorimetry	26,75,000		The proposed equipment is highly essential for the solid-state characterization

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				study of newly developed multi-component solids and will be utilized as the preliminary tool for the speedy interpretation of the various solid forms such as eutectics, co-crystals, or co-amorphous.
4.	**Travel**			
	a) A few trips are envisaged to discuss the problem with the people/Lab working in this area, visit places having similar set-ups, finalize the purchases with the suppliers, and attend conferences/symposiums for the dissemination of the result.	90,000		to discuss the problem with the people/Lab working in this area
5.	**Any other special requirement**	4,50,000		Computers, printers, rotary evaporators, scanners, and some other miscellaneous instruments/ types of equipment are required for the preparation of multi-component solids.
6.	**Overhead Budget Detail**	2,00,000		This budget is necessary for the installation of equipment especially DSC. For this, we will required nitrogen purging in the instrument and this will not be covered in the equipment cost. Ntrogen gas cylinder and pipeline of the cylinder, wiring, and other necessary installation things

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				should be covered in this budget.
	Grand Total			**37,50,000**

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Research Project Proposal

June 2022

Part -A

1.	Title of the proposal	Consumer Awareness and Adoption of ESG Investment: A study in Urban Gujarat	
2.	Broad area of proposal	Ethics, accountability and values in society	
3.	Sub Area of proposal	Environment awareness and Corporate Social Responsibility	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Dr. Amisha Ghelani	Assistant Professor Department of Commerce	Email-amisha.ghelani@atmiyauni.ac.in Contact: 9924343521
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	--	--	--
6.	Whether the proposal is transdisciplinary?	Yes / No	
7.	Date of Birth of PI (DD/MM/YYYY)	10/07/1981	
8.	Date of joining the Department of PI (DD/MM/YYYY)	28/01/2021	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Commerce	Saurashtra University	2017	-
ii.	Post Graduation	Commerce	Saurashtra University	2005	63.4
iii.	Under Graduation	Management	Saurashtra University	2001	62.5
iv.	UGG-NET	Mangement	UGC NET	2013	-

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☐ NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐ short-term fellowship (viz Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	Sr. No.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (15 Years + 1 Month) Research Experience: (4 Years)
7.	No. of Publication (Research articles - UGC Approved only)	National:- International: 3
8.	No. of Publication (Book Chapters)	2
	Books Published	-
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Consumer Awareness and Adoption of ESG Investment: A study in Urban Gujarat

2. Abstract (Provide a summary of your research proposal in 300 words)

The concept of corporate social responsibility (CSR) emphasizes that businesses should align their operations and strategies with ethical practices, aiming to support their overarching strategic goals while positively impacting society. This project focuses specifically on the role of CSR in minimizing negative environmental effects and contributing economically to those in need. Often, the general public is not fully aware of the initiatives and programs companies undertake as part of their CSR efforts.

Through this study, the objective is to shed light on the various CSR activities carried out by organizations in Gujarat. Additionally, it aims to assess the level of awareness among the beneficiaries regarding these CSR initiatives. By exploring these aspects, the research seeks to bridge the gap between the efforts made by companies and the understanding or acknowledgment of these efforts by the intended recipients, ultimately fostering a more informed and impactful implementation of CSR programs in the region.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The rising global focus on sustainability has elevated the significance of Environmental, Social, and Governance (ESG) principles in shaping investment decisions. ESG investment, characterized by aligning financial goals with sustainable and ethical practices, has gained prominence as individuals and organizations alike increasingly recognize the interdependence of economic growth, environmental protection, and social well-being. In India, this trend has been underscored by initiatives such as the Sustainable Development Goals (SDGs) and policies promoting green finance. However, the adoption of ESG investments is not uniform across demographics and regions, necessitating localized studies to understand consumer behavior. Urban Gujarat, a region known for its entrepreneurial spirit and financial dynamism, presents a unique opportunity to explore how awareness and adoption of ESG investment are evolving in an urban Indian context.

This study aims to bridge critical gaps in understanding consumer awareness and decision-making regarding ESG investments in Gujarat's urban centers. The research is particularly timely as India's financial markets witness a surge in ESG-focused financial products, including mutual funds, bonds, and indices. Despite these developments, awareness levels among investors and their motivations or hesitations to adopt ESG investing remain underexplored. By examining factors such as demographic characteristics, information access, perceived benefits, and barriers, the study aspires to provide insights into the drivers of ESG adoption and the role of urban

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consumers in advancing sustainable finance.

The importance of this study extends beyond academia to practical implications for policymakers, financial institutions, and ESG product developers. In a world increasingly threatened by climate change, resource depletion, and social inequalities, encouraging sustainable financial practices is imperative. Urban consumers, who are often early adopters of financial innovations, play a critical role in shaping market trends. Understanding their awareness levels, preferences, and barriers can help tailor financial products to better meet their needs while fostering greater adoption of ESG principles.

Furthermore, this study contributes to the discourse on responsible investing by highlighting the intersection of global sustainability goals and local consumer behavior. As Gujarat continues to emerge as an economic powerhouse, aligning its financial systems with ESG principles could serve as a model for other regions. This research will thus provide valuable inputs for designing awareness campaigns, regulatory frameworks, and financial literacy programs aimed at enhancing the adoption of ESG investments.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The field of ESG investment has garnered considerable attention globally, with a surge in studies examining its implications for sustainable finance, corporate responsibility, and investor behavior. Research primarily focuses on the developed markets of Europe and North America, where ESG frameworks are more established, and consumer awareness is relatively higher. Studies have highlighted the growing interest of institutional investors and millennials in ESG-focused products, driven by a combination of ethical considerations and long-term financial returns. However, the integration of ESG criteria into investment strategies in emerging markets like India remains nascent, with limited scholarly exploration of consumer awareness and adoption.

In the Indian context, the majority of research emphasizes corporate ESG disclosures, regulatory developments, and the performance of ESG funds. Few studies have delved into the behavioral aspects of individual investors, especially in urban regions. The awareness, understanding, and acceptance of ESG investment among retail investors in cities like Gujarat remain under-researched. Additionally, gaps exist in exploring the cultural, economic, and informational factors influencing ESG adoption. This study seeks to critically address these gaps, providing localized insights into how urban consumers in Gujarat perceive and adopt ESG investments, and contributing to the broader discourse on sustainable finance in emerging economies.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To assess the level of consumer awareness regarding ESG
2. To identify the factors influencing consumer adoption of ESG investment in urban Gujarat.
3. To analyze the perceived benefits and challenges associated with ESG investments among

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urban consumers.

6. Significance of the proposed study: (300 words)

The proposed study on Consumer Awareness and Adoption of ESG Investment: A Study in Urban Gujarat is significant in addressing the critical gap between the increasing availability of ESG financial products and the understanding and adoption of these products by retail investors in India. As the global focus shifts towards sustainability, ESG investment has emerged as a key driver in aligning financial goals with ethical and responsible practices. However, its adoption in emerging markets like India, especially among urban consumers, remains limited, largely due to insufficient awareness and understanding of its benefits and challenges.

Gujarat, a state renowned for its entrepreneurial spirit and financial acumen, provides an ideal setting for exploring urban consumer behavior in ESG investments. Insights from this study will contribute to understanding how demographic factors, financial literacy, and access to information shape the adoption of ESG principles. By identifying the barriers to adoption and highlighting consumer preferences, the research will offer actionable recommendations to bridge the gap between ESG awareness and practice.

This study is particularly timely in light of India's commitment to sustainable development goals (SDGs) and its growing emphasis on green finance. Policymakers can leverage the findings to design targeted financial literacy programs and regulatory frameworks that promote ESG investments. Additionally, financial institutions and product developers can use the insights to tailor ESG-focused products that align with consumer expectations, ultimately fostering greater acceptance and growth of sustainable investing.

In a broader context, the study contributes to the evolving discourse on sustainable finance in emerging economies, offering a localized perspective that can be extrapolated to similar regions. By fostering consumer engagement with ESG principles, the research has the potential to promote not just financial sustainability but also environmental and social well-being, making it highly relevant and impactful.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, known as India's economic powerhouse, boasts a vibrant urban population with a strong inclination toward entrepreneurship and investment. Its cities, including Ahmedabad, Surat, and Vadodara, are financial hubs with growing investor bases. As India moves toward sustainable development, understanding the consumer behavior of Gujarat's urban investors in the context of ESG (Environmental, Social, and Governance) investment is crucial.

The state's industrial dynamism often intersects with sustainability challenges, making it a

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relevant context for studying ESG principles. Urban investors in Gujarat, with their financial literacy and risk-taking attitude, are well-positioned to lead the adoption of ESG investments. However, the extent of their awareness and readiness to align their portfolios with sustainable practices remains underexplored.

This study will provide localized insights into how Gujarat's urban consumers perceive ESG investments, helping policymakers, financial institutions, and businesses develop targeted strategies to promote sustainable finance in the state.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings of this research are expected to provide substantial benefits to society, particularly within Gujarat, by fostering sustainable financial practices. By assessing the awareness and adoption of ESG (Environmental, Social, and Governance) investments among urban consumers, the study will contribute to promoting responsible investing behaviors that align with environmental and social priorities.

One of the key benefits is the potential to enhance financial literacy and awareness about ESG principles among Gujarat's urban population. As investors become more informed, they are likely to make choices that support sustainable businesses, indirectly driving industries to adopt eco-friendly and socially responsible practices. This, in turn, can help address critical environmental issues such as pollution and resource depletion in the state.

For policymakers and financial institutions, the findings will provide actionable insights into the barriers to ESG adoption and the preferences of urban investors. Tailored initiatives, such as awareness campaigns and ESG-compliant financial products, can emerge as effective tools to promote sustainable investing.

At a broader societal level, increased adoption of ESG investments can strengthen Gujarat's reputation as a forward-thinking state committed to sustainability. By aligning financial growth with environmental and social goals, the research can contribute to long-term economic resilience and improved quality of life for Gujarat's residents.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	✓
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Hypothesis

1. H1: Urban consumers in Gujarat have limited awareness of ESG (Environmental, Social, and Governance) investments.
2. H2: Demographic factors such as age, income, and education significantly influence the adoption of ESG investments in urban Gujarat.
3. H3: Financial literacy and access to reliable information positively impact the willingness to adopt ESG investments.
4. H4: Perceived benefits, such as long-term returns and ethical alignment, outweigh perceived barriers in influencing ESG investment adoption.

Sampling Plan

- Target Population: Retail investors and potential investors residing in urban areas of Gujarat, including cities like Ahmedabad, Surat, Vadodara, and Rajkot.
- Sample Size: Approximately 300–500 respondents, ensuring diversity in age, income, education, and professional background.
- Sampling Technique:
  - A stratified random sampling approach to ensure representation from different

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demographic segments.
- Stratification based on income levels, investment experience, and awareness of ESG principles.

Data Collection

1. Primary Data:
   - Structured questionnaires and online surveys targeting urban investors.
   - Focus group discussions to gather qualitative insights on perceptions and preferences.
2. Secondary Data:
   - Review of existing literature, market reports, and financial data related to ESG investments in India.

Data Analysis

1. Quantitative Analysis:
   - Descriptive statistics (mean, median, mode) to summarize awareness levels and adoption rates.
   - Inferential statistics using regression analysis and ANOVA to test hypotheses about demographic and informational factors influencing adoption.
2. Qualitative Analysis:
   - Thematic analysis of focus group discussions to identify recurring patterns and insights.
3. Software Tools:
   - Use of SPSS or R for statistical analysis.
   - NVivo for qualitative data coding and thematic mapping.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The proposed research will be conducted in a phased manner to ensure a systematic and comprehensive study. The first phase involves an extensive literature review to understand global and local trends in ESG investments. Simultaneously, a structured survey will be designed to capture data on consumer awareness, perceptions, and adoption of ESG investments in urban Gujarat.

The second phase includes primary data collection through online surveys and focus group discussions, targeting a diverse sample of urban investors across major cities like Ahmedabad, Surat, and Vadodara.

In the third phase, data will be analyzed using quantitative and qualitative methods to test hypotheses and derive insights.

The final phase focuses on synthesizing the findings to develop actionable recommendations. The results will be shared with stakeholders such as policymakers, financial institutions, and

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educational bodies to enhance awareness, design targeted ESG products, and promote sustainable investment practices across Gujarat.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Introduction & Data collection	July	2022	November	2022
2.	Data analysis	December	2022	January	2023
3.	Finding, recommendation and future scope of study	February	2023	March	2023
4.					
5.					

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			
2.	Travelling (viz. sample collection, should be Minimum and with justification)			2,50,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3,000
4.	Stationery and Printing (With justification)			50,000
5.	Any other special requirement (Books and Journals)			75,000
6.	Overhead (10% of recurring)			22,000
	TOTAL			400000

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Application form

Part -A

(General Information)

1.	Title of the proposal	AI-Powered Traffic Management System for Smart Cities	
2.	Broad area of proposal	*Engineering*	
3.	Sub Area of proposal		
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Krina masharu	Ass. Prof. & Computer Engineering Dept.	birju.tank@atmiyauni.ac.in, 8320336878, 1230
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
6.	Whether the proposal is transdisciplinary?	Yes / No	
7.	Date of Birth of PI (DD/MM/YYYY)	27/12/1993	
8.	Date of joining the Department of PI (DD/MM/YYYY)	1/1/2022	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	GTU	Pursuing	Pursuing
ii.	Post Graduation	M.Tech (Wireless & Mobile Computing)	GTU	2016	74.1
iii.	Under Graduation	B.E in Computer Engineering	GTU	2014	64%
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐YES	☑NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	-	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (2 Year + 4 Months)
		Research Experience: (- Year + - Months)

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7.	No. of Publication (Research articles - UGC Approved only)	National: - 2
		International: - 4
8.	No. of Publication (Book Chapters)	-
	Books Published	-
(Please enclose the list of papers and books published and/or accepted during last five years)		

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

AI-Powered Traffic Management System for Smart Cities

2. Abstract (Provide a summary of your research proposal in 300 words)

This research aims to develop an AI-powered traffic management system that leverages advanced technologies like machine learning and IoT to optimize traffic flow, reduce congestion, and improve safety in smart cities. By analyzing real-time traffic data, the system can predict congestion hotspots, dynamically adjust traffic signals, and provide intelligent routing suggestions to drivers. This research will contribute to the development of more efficient and sustainable urban transportation systems.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The rapid urbanization and increasing vehicle ownership have led to severe traffic congestion in urban areas worldwide. Traditional traffic management systems often struggle to adapt to dynamic traffic conditions, resulting in significant delays, increased fuel consumption, and heightened air pollution. To address these challenges, the integration of Artificial Intelligence (AI) into traffic management systems emerges as a promising solution.

AI-powered traffic management systems have the potential to revolutionize urban transportation by leveraging advanced algorithms and real-time data to optimize traffic flow, reduce congestion, and enhance overall road safety. By analyzing vast amounts of data from various sources, such as traffic sensors, cameras, and mobile devices, these systems can make intelligent decisions to improve traffic efficiency.

This research paper explores the development and implementation of an AI-powered traffic management system designed for smart cities. The system aims to optimize traffic flow through intelligent signal control, real-time traffic information dissemination, and dynamic route guidance. By employing machine learning techniques, the system can learn from historical and real-time traffic patterns to predict future trends and proactively respond to changing conditions.

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4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)AI-powered traffic management systems hold immense potential to revolutionize urban transportation. By leveraging advanced algorithms and real-time data, these systems can significantly improve traffic efficiency, reduce congestion, and enhance overall urban mobility. However, several critical factors must be considered for their successful implementation and widespread adoption:

Potential Benefits

- **Reduced Congestion:** By optimizing traffic signal timings, identifying congestion hotspots, and providing real-time traffic information, AI-powered systems can help alleviate traffic congestion.
- **Improved Air Quality:** Reduced traffic congestion leads to lower emissions and improved air quality.
- **Enhanced Road Safety:** By detecting and responding to potential hazards, such as accidents or road obstructions, these systems can contribute to increased road safety.
- **Efficient Resource Utilization:** AI-powered systems can help optimize the use of urban infrastructure, such as roads and parking spaces.

Challenges and Considerations

- **Data Privacy and Security:** The collection and analysis of large amounts of personal data raise significant privacy and security concerns. Robust data protection measures must be implemented to safeguard user information.
- **Algorithmic Bias:** AI algorithms can perpetuate biases present in the training data, leading to unfair or discriminatory outcomes. It is crucial to ensure that [1] AI systems are trained on diverse and representative datasets.
- **Infrastructure and Technological Limitations:** The successful implementation of AI-powered traffic management systems requires substantial investments in infrastructure, such as sensors, cameras, and communication networks. Additionally, technological limitations, such as unreliable connectivity or outdated hardware, can hinder their effectiveness.
- **Public Acceptance and Trust:** Public acceptance and trust are essential for the successful deployment of AI-powered systems. Transparent communication and education about the benefits and potential risks of these systems can help build public confidence.
- **Ethical Considerations:** AI-powered systems can have significant societal impacts, and it is important to consider ethical implications, such as job displacement and potential misuse of technology.

Future Directions

- **Advancements in AI and Machine Learning:** Continued research and development in AI and machine learning can lead to more sophisticated and effective traffic management systems.
- **Integration with Other Smart City Technologies:** By integrating with other smart city technologies, such as autonomous vehicles and smart grids, AI-powered traffic management systems can further optimize urban operations.
- **User-Centric Design:** Designing systems that prioritize user needs and preferences can enhance user satisfaction and encourage adoption.

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- **Robust Cybersecurity Measures:** Strong cybersecurity measures are essential to protect against cyberattacks and ensure the reliability of AI-powered traffic management systems.

By addressing these challenges and leveraging the potential benefits, AI-powered traffic management systems can contribute to the creation of more sustainable, efficient, and livable cities.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Data Acquisition and Preprocessing
2. Traffic State Estimation and Prediction
3. Intelligent Traffic Signal Control
4. Incident Detection and Response

6. Significance of the proposed study: (300 words)

The proposed research on an AI-powered traffic management system for smart cities holds significant importance due to the following reasons:

1. **Alleviation of Traffic Congestion:** By employing advanced AI techniques, the system can optimize traffic flow, reduce congestion, and minimize travel time, leading to significant time and fuel savings for commuters.

2. **Enhanced Road Safety:** The system can identify potential accident hotspots and alert authorities, enabling timely intervention and preventing accidents. Real-time traffic information can also help drivers make informed decisions, reducing the risk of collisions.

3. **Reduced Environmental Impact:** Optimized traffic flow and reduced congestion can lead to lower emissions and improved air quality, contributing to a healthier and more sustainable urban environment.

4. **Improved Quality of Life:** Efficient and reliable transportation systems can enhance the quality of life for urban residents by reducing stress, improving productivity, and promoting economic growth.

5. **Advancement of AI Technology:** The development of this system will contribute to the advancement of AI research, particularly in the areas of machine learning, computer vision, and data analytics.

By addressing these critical issues, the proposed research has the potential to make a substantial positive impact on urban transportation and contribute to the development of smarter, more sustainable cities.

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7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, a rapidly developing state in India, faces significant traffic challenges, particularly in its major cities like Ahmedabad and Surat. The increasing number of vehicles, coupled with inadequate infrastructure, often leads to traffic congestion, accidents, and environmental pollution.

An AI-powered traffic management system is highly relevant to Gujarat for the following reasons:

1. **Congestion Mitigation:**
    - **Real-time Traffic Monitoring:** The system can monitor traffic conditions in real-time, identifying congestion hotspots and bottlenecks.
    - **Intelligent Signal Control:** By optimizing signal timings based on real-time traffic data, the system can improve traffic flow and reduce wait times.
    - **Dynamic Route Guidance:** AI can provide drivers with real-time route suggestions to avoid congested areas and minimize travel time.
2. **Accident Reduction:**
    - **Predictive Analytics:** By analyzing historical data and real-time information, the system can identify potential accident-prone areas and alert authorities.
    - **Early Warning Systems:** The system can detect anomalies in traffic patterns, such as sudden braking or lane changes, and trigger early warnings to prevent accidents.
3. **Environmental Impact:**
    - **Reduced Emissions:** By optimizing traffic flow and minimizing idling time, the system can help reduce vehicular emissions and improve air quality.
    - **Sustainable Urban Development:** The system can support the development of sustainable transportation systems by promoting public transportation and encouraging the use of non-polluting vehicles.
4. **Economic Benefits:**
    - **Increased Productivity:** Reduced traffic congestion can lead to increased productivity and economic growth.
    - **Improved Quality of Life:** A more efficient transportation system can enhance the quality of life for residents and visitors.

By implementing an AI-powered traffic management system, Gujarat can significantly improve its urban transportation infrastructure, reduce traffic congestion, and enhance the overall quality of life for its citizens.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

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The successful development and implementation of an AI-powered traffic management system can yield significant benefits for smart cities:

Improved Traffic Efficiency

- **Reduced Congestion:** By optimizing traffic signal timings and suggesting alternative routes, the system can alleviate traffic congestion, reducing travel time for commuters.
- **Enhanced Traffic Flow:** Real-time analysis of traffic data allows for timely adjustments to traffic patterns, preventing bottlenecks and ensuring smooth traffic flow.

Enhanced Road Safety

- **Accident Reduction:** By identifying potential hazards and alerting drivers, the system can contribute to a reduction in accidents and fatalities.
- **Improved Emergency Response:** Real-time traffic data can help emergency services navigate traffic efficiently and reach incident sites promptly.

Environmental Benefits

- **Reduced Emissions:** Optimized traffic flow and reduced idling time can lead to lower emissions of greenhouse gases and air pollutants.
- **Lower Fuel Consumption:** Efficient traffic management can decrease fuel consumption, saving drivers money and reducing environmental impact.

Economic Benefits

- **Increased Productivity:** Reduced travel time and improved traffic flow can enhance productivity and economic growth.
- **Reduced Infrastructure Costs:** By optimizing existing infrastructure, the need for costly expansions can be minimized.

Improved Quality of Life

- **Reduced Stress:** Less traffic congestion and smoother traffic flow can contribute to a lower stress level for drivers.
- **Enhanced Urban Livability:** A well-managed traffic system can make cities more pleasant and livable.

By leveraging the power of AI, cities can create more efficient, sustainable, and safer transportation systems, ultimately improving the quality of life for their residents.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☑

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2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☑
7.	High Impact Teaching	☑
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☑
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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Data Sources:

- **Real-time Traffic Data:**
  - Traffic sensor data from various locations, including road intersections, highways, and arterial roads.
  -
  - Vehicle trajectory data from GPS-enabled devices.
  - Real-time traffic camera feeds.
  -
- **Historical Traffic Data:**
  - Archived traffic data from previous years.
  - Weather data.
  - Public holiday and event calendars.

Data Preprocessing:

- **Cleaning and Imputation:**
  - Handling missing values and outliers.
  -
  - Data normalization and standardization.
- **Feature Engineering:**
  - Creating relevant features, such as traffic density, speed, and flow.
  - Extracting features from image data, such as vehicle count and traffic patterns.
  -

Model Development and Training

Machine Learning Models:

- **Traffic Prediction Models:**
  - Time series forecasting models (e.g., ARIMA, LSTM, Prophet) to predict future traffic conditions.
  - Spatiotemporal models (e.g., ST-LSTM) to capture both spatial and temporal dependencies in traffic data.
  -
- **Traffic Signal Control Models:**
  - Reinforcement learning algorithms (e.g., Q-learning, Deep Q-Network) to optimize signal timings based on real-time traffic conditions.
  - Optimization algorithms (e.g., genetic algorithms, simulated annealing) to find optimal signal timings.
  -
- **Route Guidance Models:**
  - Graph-based algorithms (e.g., Dijkstra's algorithm, A*) to calculate optimal routes.
  -
  - Machine learning models to predict travel times and identify congestion hotspots.
  -

Model Training and Evaluation:

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- **Training Data:**
  - Splitting the preprocessed data into training and testing sets.
  -
- **Model Training:**
  - Training the models using appropriate loss functions and optimization algorithms.
- **Model Evaluation:**
  - Evaluating the models using metrics such as Mean Squared Error (MSE), Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE).

System Implementation and Testing

System Architecture:

- **Data Ingestion Layer:**
  - Collecting and storing real-time and historical traffic data from various sources.
- **Data Processing Layer:**
  - Preprocessing and cleaning the data.
  - Feature engineering to extract relevant information.
- **Model Inference Layer:**
  - Deploying trained models to make predictions and decisions.
- **Control and Decision-Making Layer:**
  - Implementing control strategies for traffic signals and providing route guidance.
  -
- **User Interface Layer:**
  - Developing a user-friendly interface for monitoring traffic conditions and receiving real-time updates.

System Testing:

- **Simulation-Based Testing:**
  - Testing the system in a simulated environment to evaluate its performance under different traffic scenarios.
- **Field Testing:**
  - Deploying the system in a real-world setting to assess its effectiveness in improving traffic flow and reducing congestion.

By following this methodology, we can develop an AI-powered traffic management system that can significantly improve urban mobility and reduce traffic-related problems.

11. **Suggested plan of action:** Define the suggested plan of action in 200 words)

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1. Literature Review

- **State-of-the-art:** Analyze existing traffic management systems and AI applications in transportation.
- **Identify gaps:** Pinpoint areas where AI can significantly improve traffic management.
- **Theoretical foundation:** Explore relevant AI techniques like machine learning, deep learning, and reinforcement learning.

2. Data Collection and Preprocessing

- **Data sources:** Identify and collect data from various sources, including:
  - Traffic sensors (loop detectors, cameras)
  - GPS data from vehicles
  - Social media data (real-time traffic updates)
  - Weather data
- **Data cleaning:** Handle missing values, outliers, and inconsistencies.
- **Feature engineering:** Extract relevant features from raw data (e.g., traffic density, speed, flow).

3. Model Development and Training

- **Model selection:** Choose appropriate AI models (e.g., time series forecasting, reinforcement learning) based on the specific problem.
- **Model training:** Train models on historical and real-time data to predict traffic patterns, optimize signal timing, and generate route recommendations.
- **Model evaluation:** Assess model performance using relevant metrics (e.g., Mean Squared Error, Mean Absolute Error).

4. System Design and Implementation

- **System architecture:** Design the overall system architecture, including data ingestion, processing, modeling, and visualization components.
- **Real-time processing:** Develop algorithms for real-time processing of traffic data and decision-making.
- **User interface:** Create a user-friendly interface for monitoring traffic conditions and controlling the system.
- **Integration with existing infrastructure:** Integrate the system with existing traffic control systems and ITS infrastructure.

5. Field Testing and Validation

- **Pilot deployment:** Deploy the system in a controlled environment to test its performance.
- **Data collection and analysis:** Monitor system performance and collect feedback from users.
- **Model refinement:** Refine the models based on field testing results.

6. Scalability and Sustainability

- **Scalability:** Design the system to handle increasing data volumes and expanding urban

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areas.

- **Sustainability:** Ensure the long-term sustainability of the system through regular maintenance, updates, and adaptation to changing traffic patterns.

7. Ethical Considerations

- **Privacy:** Address privacy concerns related to data collection and usage.
- **Bias:** Mitigate bias in AI models to ensure fair and equitable treatment of all road users.
- **Security:** Implement robust security measures to protect the system from cyberattacks.

By following this plan of action, researchers can develop an effective AI-powered traffic management system that can significantly improve urban mobility and quality of life.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Conduct needs assessment and feasibility study	January	2024	February	2024
2.	Develop system architecture and design the user interface	February	2024	March	2024
3.	Build and test core modules (cataloguing, borrowing system)	March	2024	May	2024
4.	Launch the system in a small library branch	June	2024	July	2024
5.	Roll out system to all branches; train staff	July	2024	September	2024
6.	Monitor performance; implement updates	October	2024	November	2024

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Sensors, b. Actuators, c. Electric items d. Other items (specify)	a. 5000 b. 3000 c. 12000 d. 10000	a. 5 b. 4 c. 10 d. 2	25000 12000 70000 20000

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2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	2500	4	10000
3.	Contingency (Upto maximum for Rs. 3000/-)	3000	1	3000
4.	Stationery and Printing (With justification)	10000	5	50000
5.	Any other special requirement	50000	5	150000
6.	Overhead (10% of recurring) Administrative overhead	-	-	10000
	TOTAL			**350000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

Expense Category	Particular Items	Amount (₹)	Timeline	Justification
1. Consumables	a. Chemicals	25000	Month 1–2	Required for cleaning and maintenance of hardware and storage spaces.
	b. Glassware	12000	Month 1–2	Essential for safe handling of hardware components and equipment testing.
	c. Electric items	70000	Month 1–3	Necessary for wiring, power backups, and small electronic components.
	d. Other items	20000	Month 2–3	Includes adapters, cables, and other auxiliary items for system integration.
2. Travelling	Sample collection (minimum)	10000	Month 3	Travel costs for surveys or sample collection required for system implementation.
3. Contingency	Unforeseen expenses (capped)	3000	Month 1–4	Reserved for minor unexpected expenses during the project.
4. Stationery and Printing	Printing and documentation	50000	Month 2–4	Covers printing of reports, manuals, and communication materials.
5. Special Requirements	Server/cloud setup	150000	Month 2–5	For hosting and managing the library management system efficiently.
6. Development and Licensing	Software development tools	5000	Month 1–6	Major cost for developing and acquiring necessary software tools and licenses.
7. Overhead	Administrative expenses (10%)	5000	Month 1–6	Covers recurring costs like power, internet, and administrative support.
Total		350000		

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Application form

Part -A

(General Information)

1.	Title of the proposal	Urban Traffic Safety Improvement through Black Spot Identification	
2.	Broad area of proposal	Engineering	
3.	Sub Area of proposal	Sustainable Infrastructure	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Mr. Darshan Joshi	Assistant Professor- Civil Engineering	darshan.joshi@atmiyauni.ac.in, 9426418236, 1107
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Miss Freny Maru	Assistant Professor- Civil Engineering	freny.marui@atmiyauni.ac.in, 7984273976, 1107
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	31/12/1992	
8.	Date of joining the Department of PI (DD/MM/YYYY)	02/04/2016	
9.	Whether the PI is registered for Ph.D. on the same topic	N.A.	
10.	If yes then name of university	-	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	-	-	-
ii.	Post Graduation	Transportation Engineering	Gujarat Technological University	2019	78.40
iii.	Under Graduation	Civil Engineering	Gujarat Technological University	2015	77.60
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	YES	☐ NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐short-term fellowship (viz Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	-	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (8 Year + 8 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National:0
		International:3
8.	No. of Publication (Book Chapters)	0

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	Books Published	0
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Urban Traffic Safety Improvement through Black Spot Identification

2. Abstract (Provide a summary of your research proposal in 300 words)

Urban traffic safety remains a critical challenge, with a significant number of accidents occurring at specific locations known as "black spots." These are areas where the frequency and severity of traffic incidents are notably higher than in surrounding areas. The goal of this research is to explore and develop methods for identifying and addressing these black spots to improve overall urban traffic safety.

This study will employ a data-driven approach, analyzing traffic accident records, road conditions, and traffic volume data to identify locations with the highest risk of accidents. By using Geographic Information Systems (GIS) and statistical analysis techniques, the study will pinpoint black spots based on accident frequency, severity, and contributing factors such as road design, lighting, signage, and traffic flow.

The research will assess the effectiveness of various traffic safety measures, such as signal improvements, road redesigns, increased law enforcement, and public awareness campaigns. A comparative analysis will be conducted to evaluate the success of interventions in reducing accidents and improving road safety at these identified black spots.

The study will focus on urban areas, which often face unique challenges like high vehicle density, pedestrian and cyclist interactions, and varying road infrastructure. By identifying black spots and implementing targeted interventions, this research aims to contribute to the development of safer urban transportation networks. The findings are expected to provide valuable insights for urban planners, traffic authorities, and policymakers to implement evidence-based solutions that reduce traffic accidents and enhance public safety.

In conclusion, the research will offer practical solutions for urban traffic safety, demonstrating how data-driven black spot identification and targeted interventions can help reduce accidents and improve the overall safety of urban transportation systems.

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

This study will be structured in several key research activities over a period of time, systematically gathering data, performing analysis, and proposing solutions to mitigate urban traffic accidents.

1. Data Collection and Identification of Black Spots: The first step of the research will be to gather relevant data on urban traffic accidents. This will include traffic accident records (such as crash reports, locations, dates, and severity), traffic volume data, road condition assessments (including factors like road geometry, intersections, and lighting), and environmental conditions (weather, time of day, etc.). In addition to this, data related to traffic management, such as signage, signal systems, and law enforcement presence, will be collected to understand how these factors may influence accident frequency at particular spots.

2. Statistical Analysis of Accident Data: Once black spots are identified, statistical methods such as regression analysis, accident frequency analysis, and accident severity analysis will be used to evaluate and understand the contributing factors behind the high accident rates at these locations. Factors such as road design (e.g., sharp turns, intersections, pedestrian crossings), traffic flow (e.g., high vehicle density, congestion), weather conditions, time of day, and socio-economic factors will be studied to identify underlying causes of traffic incidents.

3. Identification of Safety Measures and Interventions: Based on the analysis, the research will propose specific safety measures to address the identified black spots. Potential interventions could include redesigning intersections, adding pedestrian crossings, improving lighting, changing traffic signal patterns, implementing speed reduction measures, or increasing law enforcement presence.

4. Evaluation of Intervention Effectiveness: After proposing and implementing interventions, the effectiveness of these measures will be evaluated through post-intervention data analysis. Traffic accident data from the period following the interventions will be compared with pre-intervention data to assess changes in accident frequency, severity, and types of incidents.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research in urban traffic safety, particularly focusing on black spot identification, has been steadily advancing in recent years, with many studies leveraging data-driven approaches to pinpoint accident-prone areas. A significant body of work utilizes Geographic Information Systems (GIS) and spatial analysis techniques to map accident locations and identify black spots based on factors such as accident frequency, severity, and contributing road conditions. Statistical methods, including regression analysis, are commonly employed to analyze the causes behind these accidents and to determine which variables, such as road design, traffic flow, or weather conditions, contribute to higher accident rates.

Despite these advancements, several gaps remain in the current research. Many studies focus primarily on accident data without fully incorporating broader factors like socio-economic conditions, driver behavior, and enforcement practices, which may also influence accident occurrence. Additionally, there is limited research on the long-term effectiveness of black spot mitigation strategies. While some studies evaluate interventions, few comprehensively assess how different measures interact over time, especially in rapidly growing urban environments.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To systematically identify and map black spots in urban traffic systems where accidents and traffic violations occur most frequently.

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2. To conduct a detailed analysis of the causes, patterns, and types of accidents occurring at identified black spots.
3. To assess the existing traffic infrastructure, road design, and safety features at black spots.
4. To evaluate the potential effectiveness of proposed safety improvements in reducing accidents, fatalities, and injuries.

6. Significance of the proposed study: (300 words)

Urban traffic accidents are a growing concern worldwide, leading to significant loss of life, injury, and economic costs. The identification and improvement of traffic safety at high-risk locations, commonly referred to as "black spots," is crucial in reducing the frequency and severity of accidents. This study focuses on the significance of identifying and addressing these black spots as a means to improve overall urban traffic safety.

Black spots are intersections or road segments with a disproportionately high number of accidents. They are often the result of factors such as poor road design, inadequate signage, traffic congestion, or environmental conditions. By systematically identifying these locations through data collection and analysis, authorities can prioritize safety interventions, ensuring resources are allocated effectively to mitigate risks where they are most needed.

The proposed study aims to provide a comprehensive framework for identifying urban black spots through traffic data, accident reports, and other relevant factors. By understanding the underlying causes of accidents at these locations, the study will contribute to the development of targeted, evidence-based safety measures, such as improved signage, road redesign, better traffic control, and enhanced public awareness programs.

Addressing urban traffic black spots not only reduces the occurrence of traffic-related accidents and fatalities but also enhances the quality of life for urban residents by making transportation systems safer and more efficient. In the long term, this can lead to reduced healthcare costs, increased economic productivity, and improved public confidence in urban infrastructure. Ultimately, this study will contribute to the advancement of sustainable, safe urban transportation systems that can accommodate growing populations while minimizing the risks associated with traffic accidents.

7. Relevance of the proposed study to Gujarat: (200 words)

The state of Gujarat is continuously working on infrastructure development to support its rapidly expanding urban areas. Identifying black spots will inform better planning and design of roads, intersections, and pedestrian facilities. It will provide data-driven insights into areas that need immediate redesigns or improvements, ensuring that traffic safety aligns with the state's infrastructure development goals.

Gujarat's urban areas have recorded a substantial number of road accidents, some of which occur in specific high-risk zones or black spots. This study will help pinpoint these accident-prone areas, enabling authorities to target interventions that can significantly reduce fatalities and injuries

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

Gujarat's cities are striving to improve mobility, not only for vehicles but also for pedestrians and cyclists. Addressing black spots through improved safety measures will ensure safer and more inclusive urban transportation, encouraging sustainable travel modes like walking and cycling, which aligns with global trends for safer and greener cities.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

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Sr. No.	Area	(✓tick appropriate)
1.	Environment	✓
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

1. Identification of Black Spots: The first step in the research involves identifying traffic black spots in selected urban areas of Gujarat. This will be done by gathering accident data from sources like local traffic police, transportation departments, and insurance companies. The focus will be on areas with a high frequency of road accidents, fatalities, or serious injuries. Mapping tools, such as GIS (Geographic Information System), will be employed to visually identify patterns and cluster high-risk locations.
2. Data Collection:
   Accident Data: Collect historical accident data (at least 3-5 years) from police records, local transportation authorities, and other public safety organizations.
   Traffic Flow Data: Gather traffic volume, speed, and congestion data from urban traffic management systems and surveys.
   Road Condition and Design Data: Review road infrastructure and design aspects (e.g., road width, signage, lighting, pedestrian facilities) that may contribute to accidents.
   Environmental Factors: Document factors such as weather, time of day, and road surface conditions, which could influence accident rates at identified black spots.
3. Surveying Local Stakeholders: Surveys and interviews will be conducted with local authorities, residents, and commuters to understand their perceptions of road safety and the causes of accidents in black spots.
4. Site Visits and Observations: In-depth site visits to the identified black spots will be conducted to directly observe road conditions, traffic behavior, pedestrian movement, and potential risk factors.

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5. Safety Assessment: Based on collected data, safety audits will be carried out for each black spot, focusing on road design flaws, traffic control mechanisms, and other infrastructure-related issues.
6. Monitoring and Evaluation
   Post-Improvement Evaluation: After implementing improvements, continuously monitor traffic accident data to assess the effectiveness of the measures taken.
   Accident Rate Analysis: Evaluate the change in accident rates, frequency, and severity in the identified black spots.
   Feedback Loop: Use the data collected from post-implementation analysis to refine and further improve safety measures.
7. Reporting and Recommendations
   Reporting: Document the findings, analysis, implemented solutions, and their effectiveness in a comprehensive report.
   Recommendations for Future: Provide long-term recommendations for maintaining or further improving traffic safety, and for tackling other potential black spots identified through ongoing data collection.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

As per above description

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Project Planning and Initial Assessment	July	2022	October	2022
2.	Data Collection and Analysis	October	2022	March	2023
3.	Black Spot Identification	March	2023	December	2023
4.	Traffic Survey and Condition Assessment	December	2023	June	2024
5.	Safety Measure Analysis	June	2024	November	2024
6.	Monitoring and Evaluation	November	2024	April	2025
7.	Cost Analysis	April	2025	September	2025
8.	Long-term Monitoring	September	2025	June	2026
9.	Final Evaluation and Report	June	2026	December	2026
10.	Publication	December	2026	March	2027

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13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Project Planning and Initial Assessment	-	-	Rs. 18,500/-
2.	Data Collection and Analysis	-	-	Rs. 37,500/-
3.	Black Spot Identification	-	-	Rs. 55,000/-
4.	Traffic Survey and Condition Assessment	-	-	Rs. 35,000/-
5.	Safety Measure Analysis	-	-	Rs. 25,500/-
6.	Monitoring and Evaluation			Rs. 40,000/-
7.	Cost Analysis			Rs. 25,000/-
8.	Long-term Monitoring			Rs. 50,000/-
9.	Final Evaluation and Report	-	-	Rs. 26,700/-
10.	Publication			Rs. 26,800/-
	TOTAL	-	-	Rs. 3,40,000/-

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	Project Planning and Initial Assessment	18,500	July - October 2022	This covers initial planning activities
2.	Data Collection and Analysis			
	Paper forms for manual surveys	Rs.15/form (2500 form)	October 2022 to March -	2500*15 = 37,500/-

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			2023	
3.	Black Spot Identification			
	Fuel for vehicles used for site visits, and consultancy	Rs.100/liter (550 liters)	March to December-2023	550*100 =55,000/-
4.	Traffic Survey and Condition Assessment	Rs. 35,000/-	Up to June 2024	Allocated for traffic volume counts, speed assessments
5.	Safety Measure Analysis	Rs. 25,000/-	June - November 2024	Budget for analyzing safety measures for identified black spots
6.	Monitoring and Evaluation	Rs. 40,000/-	November 2024 to April -2025	Funds will be used for monitoring the effectiveness of safety measures, including field visits, data collection, and impact evaluation
7.	Cost Analysis	Rs. 25,000/-	April - to September -2025	Budget to evaluate the cost-effectiveness of the safety improvements.
8.	Long-term Monitoring	Rs. 50,000/-	September -2025 to June-2026	This amount is allocated for long-term monitoring of traffic safety improvements, including data collection, surveys, and continued analysis.
9.	Final Evaluation and Report	Rs. 26,700/-	June - December 2026	Budget for the final evaluation of the project's outcomes and for preparing the final report and presentation. Covers analysis, report writing, and presentation costs.
10.	Publication	Rs. 26,800/-	December -2026 to March - 2027	Funds will cover the costs of publishing the final project results, including printing and distributing project reports, and organizing dissemination workshops.
	Grand Total	Rs. 3,40,000/-		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Varicose vein disease prediction using Machine Learning Techniques	
2.	**Broad area of proposal**	Engineering	
3.	**Sub Area of proposal**	Machine Learning	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Divya R. Solanki	Lecturer & Computer Engineering	divya.solanki@atmiyauni.ac.in, 8264805959, 1436
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Mansi H. Chauhan	Lecturer & Computer Engineering	mansi.chauhan@atmiyauni.ac.in, 8140424809, 1436
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	15/08/1998	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	27/12/2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	--	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	-	-	-
ii.	Post Graduation	Computer Engineering	Atmiya University	2021	80.39
iii.	Under Graduation	Computer Engineering	Atmiya Institute of Technology & Science	2019	85.60
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐YES	√ NO
3.	If yes, please indicate whether it was a (√ tick appropriate)	☐short-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	--	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	--	--	--	--	--
	--	--	--	--	--

6.	Total Experience	Teaching Experience: (5 Months)
		Research Experience: --
7.	No. of Publication (Research articles - UGC Approved only)	National: --
		International: 1
8.	No. of Publication (Book Chapters)	--

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	Books Published	--
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Varicose vein disease prediction using Machine Learning Techniques

2. Abstract (Provide a summary of your research proposal in 300 words)

Varicose vein disease is a prevalent vascular condition characterized by the enlargement, twisting, and dysfunction of veins, often leading to pain, swelling, and reduced quality of life. Early detection and intervention are crucial to prevent progression and associated complications such as chronic venous insufficiency. This study explores the application of machine learning (ML) techniques for the prediction and classification of varicose vein disease, leveraging clinical and diagnostic data. Various ML algorithms, including Decision Trees, Support Vector Machines (SVM), Random Forest, K-Nearest Neighbors (KNN), and Artificial Neural Networks (ANN), are implemented and compared to identify the most effective model for prediction. The dataset consists of patient demographics, clinical symptoms, venous flow parameters, and other related features that contribute to the onset of varicose veins. Data preprocessing techniques such as normalization, feature selection, and handling missing values are applied to improve the quality of input data. The models are evaluated based on performance metrics, including accuracy, sensitivity, specificity, precision, and F1-score, to ensure a comprehensive assessment of their predictive capabilities.Initial results indicate that ensemble-based methods such as Random Forest and gradient boosting outperform other classifiers, achieving high accuracy and robustness in prediction. Furthermore, the study demonstrates the potential of integrating machine learning frameworks into clinical decision-making systems to aid healthcare professionals in identifying high-risk individuals and recommending timely interventions.The findings suggest that ML-based prediction models can significantly enhance the early diagnosis and management of varicose vein disease. Future work will focus on integrating real-time imaging data and deep learning techniques to further improve prediction accuracy. This research contributes to the development of intelligent healthcare tools, providing a pathway for personalized treatment and improved patient outcomes.

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Varicose vein disease (VVD) is a chronic and widespread vascular condition characterized by dilated, tortuous, and non-functional veins, most commonly affecting the lower limbs. It occurs due to the malfunction of venous valves, leading to blood pooling, increased venous pressure, and subsequent vein deformities. Symptoms of varicose veins range from mild discomfort and cosmetic concerns to more severe manifestations, including pain, edema, skin changes, and venous ulcers. The prevalence of this disease is increasing globally, affecting approximately 20-30% of adults, with a higher incidence among women and individuals with prolonged standing occupations, obesity, sedentary lifestyles, and genetic predisposition. Despite its high prevalence and burden on healthcare systems, early detection and intervention remain challenging due to limitations in traditional diagnostic approaches and the lack of predictive tools for identifying high-risk individuals.

The proposed study aims to address this gap by leveraging machine learning (ML) techniques to predict the onset and progression of varicose vein disease using clinical, demographic, and venous flow data. Machine learning, a branch of artificial intelligence, has demonstrated significant potential in healthcare for disease prediction, diagnosis, and prognosis by uncovering complex patterns in data that are often overlooked in traditional statistical methods. The objective of this study is to develop and evaluate machine learning models to accurately predict the occurrence of varicose veins, identify key risk factors, and assist clinicians in decision-making for early interventions.

To achieve the stated objective, the project will pursue the following research activities over the study period:

1. **Data Collection and Preprocessing**:

A comprehensive dataset will be created by collecting anonymized patient records from hospitals and clinics, including demographic details (age, gender, BMI, genetic history), occupational factors (prolonged standing or sedentary behavior), clinical symptoms (pain, swelling, fatigue), and venous flow data obtained through Doppler ultrasound or other diagnostic tools. The raw data will undergo preprocessing, including cleaning, normalization, feature extraction, and handling missing values, to ensure it is suitable for machine learning model training.

2. **Feature Selection and Analysis**:

A systematic approach will be undertaken to identify the most significant features contributing to varicose vein disease prediction. Feature selection techniques such as Recursive Feature Elimination (RFE), correlation analysis, and feature importance ranking from ensemble methods like Random Forest will be applied. This step will help prioritize key predictors, such as age, BMI, and venous flow abnormalities, for model optimization.

3. **Development of Machine Learning Models**:

Several machine learning algorithms will be implemented, including:

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- **Decision Trees and Random Forest** for interpretable and ensemble-based predictions.
- **Support Vector Machines (SVM)** for robust classification using hyperplane separation.
- **K-Nearest Neighbors (KNN)** for identifying patterns in smaller datasets.
- **Artificial Neural Networks (ANN)** for capturing non-linear relationships in complex datasets.

Each model will be fine-tuned using hyperparameter optimization techniques such as grid search and cross-validation to ensure optimal performance.

4. Model Evaluation and Comparison:

The performance of the developed models will be evaluated using metrics such as accuracy, sensitivity, specificity, precision, and F1-score. A comparative analysis will be conducted to determine the most effective machine learning model for varicose vein prediction. The robustness and generalizability of the models will be validated using unseen test data.

5. Risk Factor Analysis and Interpretation:

The study will analyze the contribution of specific features to disease prediction by performing feature importance ranking and visualization. This will help identify high-risk factors and provide insights into the primary contributors to varicose vein disease. Understanding these relationships will support clinicians in developing preventive strategies.

6. Development of a Clinical Decision Support System (CDSS):

Based on the best-performing model, a prototype of a Clinical Decision Support System will be designed. The system will integrate machine learning predictions with clinical workflows to assist healthcare providers in identifying individuals at high risk, enabling early diagnosis, preventive measures, and timely intervention.

Importance of the Proposed Study

The significance of the proposed research lies in its potential to transform the current approach to diagnosing and managing varicose vein disease. At present, the identification of varicose veins often occurs during the symptomatic stages, when intervention options are limited, and the disease has already progressed. Predictive machine learning models provide an opportunity to shift this paradigm toward early detection and preventive care. By utilizing clinical and demographic data, ML algorithms can accurately predict individuals at risk, enabling timely interventions and improving patient outcomes.

Furthermore, varicose vein disease imposes a substantial economic burden on healthcare systems, given the rising demand for surgical procedures like sclerotherapy and vein stripping, as well as the costs associated with managing chronic complications. Early prediction through ML-driven tools can reduce healthcare expenditures by minimizing disease progression and avoiding invasive treatments.Another critical contribution of this study is its focus on feature analysis, which will identify key risk factors influencing varicose vein development. Insights gained from this analysis can guide public health initiatives, including targeted lifestyle modifications, awareness campaigns, and preventive measures for at-risk populations, such as individuals with sedentary jobs or hereditary predispositions.

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The integration of machine learning into clinical workflows has the potential to empower healthcare providers with data-driven decision-making tools. The proposed Clinical Decision Support System (CDSS) can serve as a real-time diagnostic aid, ensuring that healthcare professionals have access to predictive insights during patient consultations. This innovation is particularly important in resource-limited settings, where access to specialized diagnostic tools may be constrained.Moreover, the study aligns with the growing emphasis on personalized medicine, where treatment plans and preventive strategies are tailored to individual patient profiles. By leveraging predictive analytics, the proposed system can contribute to personalized care, improving both patient satisfaction and clinical efficiency.

In conclusion, this study will pioneer the application of machine learning techniques to predict varicose vein disease, filling a significant gap in early detection and risk assessment. The research outcomes will have wide-ranging implications for clinical practice, public health strategies, and healthcare systems, ultimately contributing to improved quality of life for individuals affected by varicose veins. Future directions of this work will involve integrating real-time imaging data and deep learning methods to further enhance prediction accuracy and expand the system's capabilities. Through this study, we aim to establish a robust foundation for ML-based healthcare innovations in vascular disease management.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The prediction and diagnosis of varicose vein disease (VVD) have traditionally relied on clinical examinations, patient history, and imaging techniques such as Doppler ultrasound. While these methods are effective for confirming the disease at later stages, they are limited in their ability to predict early onset and identify high-risk individuals. Existing research has largely focused on understanding the epidemiology, pathophysiology, and genetic predisposition of varicose veins, but predictive analytics remains underexplored.

Recent advancements in machine learning (ML) and artificial intelligence (AI) have shown immense potential in healthcare for disease prediction and risk assessment. Studies have successfully implemented ML techniques for cardiovascular diseases, diabetes, and venous thromboembolism prediction. However, limited research has applied ML models to predict VVD. Some preliminary studies have explored using clinical data and basic algorithms such as logistic regression, but these approaches often lack accuracy, scalability, and robustness.

Moreover, research focusing on identifying key risk factors, such as genetic predisposition, BMI, occupational stress, and venous flow patterns, is fragmented. The integration of multiple ML algorithms for comparative analysis and developing comprehensive predictive frameworks remains absent. A critical need exists for advanced, data-driven models that can predict varicose vein disease early, improve clinical decision-making, and guide preventive interventions, which this study aims to address.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. **To develop a comprehensive dataset for varicose vein disease prediction**

- Collect and pre-process clinical, demographic, and diagnostic data, including patient age,

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BMI, genetic predisposition, occupational factors, and venous flow parameters, ensuring data quality and completeness for machine learning analysis.

2. **To identify significant risk factors contributing to varicose vein disease**

- Utilize feature selection techniques to determine the most influential predictors, such as lifestyle factors, genetic history, and venous abnormalities, that contribute to the onset and progression of varicose veins.

3. **To implement and evaluate machine learning models for varicose vein prediction**

- Apply various machine learning algorithms, including Decision Trees, Random Forest, Support Vector Machines (SVM), K-Nearest Neighbors (KNN), and Artificial Neural Networks (ANN), for disease prediction and compare their performance based on accuracy, sensitivity, specificity, and F1-score.

4. **To analyze and interpret the importance of predictive features**

- Perform feature importance ranking and visualization to understand the role of key factors in varicose vein disease, providing clinical insights for risk assessment and prevention.

5. **To develop a Clinical Decision Support System (CDSS) for early diagnosis**

- Design and prototype a user-friendly system integrating the best-performing machine learning model to assist clinicians in identifying high-risk individuals and recommending early interventions.

6. **To validate the robustness and generalizability of the proposed models**

- Evaluate the developed models using real-world data and ensure their reliability and scalability across different patient populations and clinical settings.

6. Significance of the proposed study: (300 words)

The proposed study holds significant importance in addressing the growing burden of varicose vein disease (VVD), a prevalent vascular condition affecting millions worldwide. Varicose veins, if left undiagnosed and untreated, can lead to chronic venous insufficiency, pain, ulcers, and other complications that impair the quality of life. Traditional diagnostic methods, such as physical examinations and imaging tools, are reactive, identifying the disease only after symptoms appear. The lack of predictive tools for early detection hampers timely intervention and preventive care.

This study aims to bridge this gap by leveraging machine learning (ML) techniques to predict the risk of varicose vein disease using clinical, demographic, and diagnostic data. By identifying high-risk individuals early, the study has the potential to transform the current reactive approach into a proactive one, enabling timely lifestyle modifications and medical

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interventions. Furthermore, the use of ML algorithms will enhance the accuracy, efficiency, and objectivity of disease prediction compared to conventional methods.

The research also provides valuable insights into the key risk factors contributing to VVD, such as BMI, genetic predisposition, and occupational habits, which can guide public health strategies and targeted prevention campaigns. The development of a Clinical Decision Support System (CDSS) will offer healthcare professionals an effective tool to improve diagnostic accuracy and clinical decision-making, especially in resource-limited settings.

By integrating machine learning into clinical practice, this study aligns with the broader goals of personalized and data-driven healthcare. It will help reduce healthcare costs associated with advanced-stage treatments and improve patient outcomes through early diagnosis. The findings of this study are expected to contribute significantly to the field of vascular medicine, enhancing the understanding, prediction, and management of varicose vein disease while paving the way for future research involving deep learning and real-time imaging data.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on varicose vein disease (VVD) prediction holds particular relevance to Gujarat, where lifestyle, occupational patterns, and demographic factors contribute significantly to the prevalence of this condition. Gujarat is home to a large workforce engaged in occupations that require prolonged standing, such as textile industries, diamond cutting, manufacturing units, and agricultural activities. Prolonged standing is a well-documented risk factor for VVD, making the population in Gujarat especially vulnerable to this condition.Additionally, the rising prevalence of obesity, sedentary lifestyles, and genetic predisposition in urban and rural areas of Gujarat exacerbates the risk of varicose veins. Women, who form a significant part of the workforce and homemakers, are particularly at risk due to hormonal changes, pregnancy-related factors, and cultural habits that encourage prolonged standing.

The study's outcomes, such as identifying high-risk individuals through machine learning models, will directly benefit the healthcare sector in Gujarat by enabling early diagnosis and prevention. Furthermore, the development of a Clinical Decision Support System (CDSS) will assist healthcare providers, especially in semi-urban and rural areas, where access to specialized vascular care is limited. By addressing a critical healthcare issue, this study aligns with Gujarat's public health goals and promotes improved quality of life, reduced disease burden, and healthcare cost savings.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

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The proposed research project on varicose vein disease (VVD) prediction using machine learning will have substantial societal benefits, especially for the state of Gujarat, where a significant proportion of the population is at risk due to lifestyle, occupational, and demographic factors.

1. **Early Detection and Prevention**: By leveraging machine learning models, the study will enable early identification of high-risk individuals, particularly those engaged in occupations requiring prolonged standing, such as workers in the textile, diamond cutting, and manufacturing industries. Early detection will empower healthcare providers to recommend preventive measures like lifestyle changes, use of compression therapy, and periodic screenings, reducing disease progression.
2. **Improved Healthcare Outcomes**: The development of a Clinical Decision Support System (CDSS) will provide healthcare professionals, especially in rural and semi-urban areas of Gujarat, with a reliable tool for early diagnosis and intervention. This will lead to reduced disease severity, fewer complications like venous ulcers, and improved quality of life for patients.
3. **Economic Benefits**: Early detection and prevention will significantly reduce the financial burden on individuals and the healthcare system. By minimizing the need for advanced treatments such as surgeries, the project will contribute to healthcare cost savings, allowing resources to be allocated more efficiently.
4. **Public Awareness and Education**: The findings will help highlight key risk factors, such as obesity, genetic predisposition, and occupational hazards, fostering awareness campaigns to encourage healthier lifestyles among Gujarat's population.
5. **Support for Vulnerable Groups**: Women, who are at higher risk due to hormonal and pregnancy-related factors, as well as industrial workers, will benefit greatly from targeted interventions based on the study's findings.

Overall, this project will improve the health status of Gujarat's population, reduce the disease burden, and support the state's long-term healthcare goals, promoting societal well-being and economic productivity.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	√
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐

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6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	√
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The methodology of the proposed study involves a structured approach to achieve the research objectives, including specific research activities, hypothesis formulation, sampling, data collection, and data analysis.

Hypothesis

The study is based on the following hypothesis: "Machine learning techniques can effectively predict the risk of varicose vein disease (VVD) by analyzing clinical, demographic, and diagnostic data, and key risk factors can be identified for early diagnosis and prevention."

Specific Research Activities

1. **Data Collection**:
   - Clinical and demographic data will be collected from hospitals, diagnostic centers, and healthcare clinics across urban and rural areas of Gujarat.
   - The data will include patient demographics (age, gender, BMI, lifestyle habits), occupational information (hours of standing/sedentary behavior), clinical symptoms (pain, swelling, fatigue), and diagnostic parameters (venous flow patterns through Doppler ultrasound).
   - Data anonymization and ethical approvals will be ensured before collection to comply with privacy standards.
2. **Sampling Plan**:
   - A stratified random sampling approach will be adopted to ensure diversity and representativeness of the population.
   - The target sample size will include approximately 800-1000 patients, comprising individuals with diagnosed VVD, at-risk individuals, and healthy controls. The inclusion criteria will focus on adults aged 20–70, both genders, and individuals exposed to occupational risk factors.
3. **Data Preprocessing**:
   - The collected raw data will undergo preprocessing steps to ensure its quality and reliability:
     - **Data Cleaning**: Handling missing values and outliers.

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- **Normalization**: Scaling numerical variables for consistency.
- **Feature Engineering**: Extracting and transforming relevant features.

4. **Model Development**:
   - Machine learning models, including Decision Trees, Random Forest, Support Vector Machines (SVM), K-Nearest Neighbors (KNN), and Artificial Neural Networks (ANN), will be developed.
   - Hyperparameter tuning and cross-validation techniques will be employed to optimize model performance.
5. **Data Analysis**:
   - The performance of ML models will be evaluated using accuracy, precision, sensitivity, specificity, and F1-score metrics.
   - Feature importance analysis will be conducted to identify key predictors such as BMI, occupational standing hours, and venous flow abnormalities.
   - Comparative analysis will determine the most effective model for VVD prediction.
6. **Development of Clinical Decision Support System (CDSS)**:
   - A prototype CDSS will be designed based on the best-performing model to assist healthcare professionals in predicting VVD risk and recommending early interventions.

This systematic approach will validate the hypothesis, providing a reliable, data-driven solution for early prediction and risk assessment of varicose vein disease while identifying actionable risk factors to guide clinical and public health strategies.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The proposed study will follow a structured and phased plan of action to ensure the systematic execution of research activities and achieve the defined objectives efficiently:

Phase 1: Data Collection and Preprocessing

- Collaborate with hospitals, clinics, and diagnostic centers in Gujarat to collect patient data, including demographics, clinical symptoms, and diagnostic reports (e.g., Doppler ultrasound results).
- Ensure ethical approval and data anonymization.
- Perform data cleaning, normalization, and feature engineering to prepare high-quality datasets for analysis.

Phase 2: Model Development

- Develop machine learning models, including Decision Trees, Random Forest, SVM, KNN, and ANN, to predict varicose vein disease.
- Use hyperparameter tuning and cross-validation to optimize model performance.

Phase 3: Data Analysis and Risk Factor Identification

- Evaluate model performance using metrics like accuracy, precision, sensitivity, and F1-score.
- Analyze feature importance to identify key predictors such as BMI, age, occupational habits, and venous flow patterns.

Phase 4: Development of Clinical Decision Support System (CDSS)

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- Design a user-friendly prototype CDSS integrating the best-performing model to assist clinicians in predicting VVD risk.

Phase 5: Validation and Dissemination

- Validate the models using test data and real-world scenarios.
- Share findings through research publications, healthcare workshops, and awareness campaigns to promote early diagnosis and prevention strategies in Gujarat.

This actionable plan ensures timely execution, practical outcomes, and direct societal benefits.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Data Collection and Preparation	May	2022	July	2022
2.	Feature Selection and Model Design	August	2022	September	2022
3.	Model Training and Testing	October	2022	December	2022
4.	Model Evaluation and Interpretation	January	2023	February	2023
5.	Development of Clinical Decision Support System (CDSS)	March	2023	March	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	-	-	150000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	-	-	10000
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	3000

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4.	Stationery and Printing (With justification)	-	-	10000
5.	Any other special requirement	-	-	47000
6.	Overhead (10% of recurring)	-	-	-
	TOTAL	-	-	**2,20,000/-**

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Subscription**	-	-	150000
4.	**Travel**	No. of Times in a month	-	-
	a) Conference	-	3 days	50000
	b) Paper Publication	1	-	10000
6.	**Stationery and printing**	-	-	-
	a) Thesis	-	-	6000
	b) Stationary	-	-	4000
	Grand Total	-	-	220000

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Application form

Part -A

(General Information)

1.	Title of the proposal	Portrayal of Women in the novels of Simone de Beauvoir and Kundanika Kapadia	
2.	Broad area of proposal	Humanities	
3.	Sub Area of proposal		
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Drashti Purohit	Assistant Professor Humanities	Mobile No. – 7487082464 Email id – drashti.purohit@atmiyauni.ac.in Extension No. - 1425
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	25/09/1991	
8.	Date of joining the Department of PI (DD/MM/YYYY)	02/08/2021	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university		

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Feminist Concerns in the novels of Simone de Beauvoir and Kundanika Kapadia – A comparative Study	GLS UNIVERSITY	2021	
ii.	Post Graduation	English	Gujarat University	2015	67
iii.	Under Graduation	English	Gujarat University	2012	52
iv.	CSIR/UGG-NET/ SLET/GATE				
2.	Have you previously received any Fellowship from any funding agency?		NO		
3.	If yes, please indicate whether it was a (✓tick appropriate)	short-term fellowship (viz Project fellow, Project assistant, etc.) NA			
		Pre-doctoral fellowship (viz CSIR/UGC JRF or any other) NA			
		Post-doctoral fellowship (viz D S Kothari PDF, or any other) NA			
4.	If yes, mention the details of fellowship and tenure				
5.	Details of ongoing and completed research-funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start-End – MM/YYYY)
6.	Total Experience		Teaching Experience: (07 Year + 10 Months)		

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		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National:
		International: 06
8.	No. of Publication (Book Chapters)	02
	Books Published	02
(Please enclose the list of papers and books published and/or accepted during last five years)		

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Portrayal of Women in the novels of Simone de Beauvoir and Kundanika Kapadia

2. Abstract (Provide a summary of your research proposal in 300 words)

The portrayal of women in literature offers critical insights into societal norms, gender roles, and cultural ideologies. This paper explores the representation of women in the novels of two distinct authors—Simone de Beauvoir, a prominent existentialist feminist, and Kundanika Kapadia, a celebrated Gujarati writer. Simone de Beauvoir's works, especially The Second Sex, delve into the complex intersection of biology, history, and social constructs in shaping women's experiences of oppression and liberation. Her portrayal of women is often grounded in existential philosophy, questioning the concept of woman as "the Other" and advocating for women's autonomy and subjectivity. In contrast, Kundanika Kapadia's novels reflect the socio-cultural fabric of post-independence India, focusing on the struggles of women caught between tradition and modernity. Kapadia's women are often depicted as resilient individuals navigating their roles within family and society, yet they too face the societal pressures of patriarchy, though in ways shaped by Indian culture. By examining the themes of agency, identity, and self-discovery in their works, this paper analyzes how both authors use their narratives to challenge the prevailing gender norms of their respective contexts. While de Beauvoir's approach is rooted in Western feminist philosophy, Kapadia presents a unique perspective through the lens of Indian traditions, making a comparative study of their portrayals of women a rich exploration of universal themes of gender and freedom.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The portrayal of women in literature has always been a critical area of study, offering insight into cultural norms, social dynamics, and gender roles. Literature, as a reflection of society, both mirrors and influences the experiences, struggles, and aspirations of women. Examining the representation of women in the novels of Simone de Beauvoir and Kundanika Kapadia provides an opportunity to explore how two distinct cultural and philosophical contexts engage with similar themes of gender, identity, and autonomy. This research aims to conduct a comparative analysis of the portrayal of women in the works of these two influential writers: Simone de Beauvoir, a foundational figure in existentialist feminism, and Kundanika Kapadia, a prominent Gujarati writer whose works address the nuances of Indian society and its evolving perceptions of women.

The research will explore several core themes, including gender roles, agency, and the intersection of societal expectations and personal identity, within the novels of both authors. Simone de Beauvoir's seminal work The Second Sex has had a profound impact on feminist theory and offers a deep exploration of women's status as "the Other" in patriarchal societies. Her existentialist perspective challenges the reduction of women to passive objects, instead advocating for their active participation in shaping their own destinies. On the other hand, Kundanika Kapadia's novels, which reflect the cultural and social tensions of post-independence India, offer a nuanced portrayal of women caught between traditional expectations and modern influences. In a society still grappling with patriarchy,

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Kapadia's characters navigate complex familial and societal relationships, often questioning their roles within these structures.

This study is vital as it offers a comparative framework for understanding the universal and culturally specific experiences of women across time and space. By examining the works of two authors whose contexts—Western existentialism and Indian post-colonialism—are quite distinct, the research will uncover both the shared struggles of women and the unique ways in which their identities are formed in response to their societies. The study will not only contribute to feminist literary criticism but also offer insights into the intersectionality of gender, class, and culture as represented in literature.

Specific Research Activities

1. Literature Review: The first step in this project will involve a thorough literature review of existing scholarship on both Simone de Beauvoir and Kundanika Kapadia. This will include an exploration of feminist literary theory, particularly existentialist feminism, as well as the cultural contexts of post-colonial Indian literature. Key texts for this part of the research will include The Second Sex by Beauvoir and selected novels by Kapadia such as Pathe Chalu Che and Aparajita. In addition, secondary sources such as journal articles, books, and critical essays on both authors will be reviewed to understand existing interpretations of their works, particularly regarding the portrayal of women.
2. Thematic Analysis: The core of the research will be an in-depth thematic analysis of selected works by both authors. In Beauvoir's work, the focus will be on how she conceptualizes women's liberation and autonomy, examining her famous argument that "one is not born, but rather becomes a woman." Her portrayal of women as existential agents, capable of shaping their own identities, will be explored in relation to the socio-cultural constraints of her time. For Kapadia, the analysis will look at how her characters negotiate the tension between tradition and modernity, as well as their attempts to assert their independence within the confines of familial and societal expectations. Themes such as self-discovery, rebellion, and the critique of patriarchy will be explored in both bodies of work.
3. Comparative Analysis: A key research activity will be the comparative analysis of the portrayals of women in Beauvoir and Kapadia's works. While de Beauvoir's works address Western existentialist thought and the feminist movement in the early-to-mid 20th century, Kapadia's novels engage with the realities of post-independence Indian society and the gender norms that shape the lives of women in that context. This comparative approach will highlight both the universal struggles of women across different cultures and the specific ways in which cultural, social, and political factors shape their experiences. Particular attention will be paid to the representation of women's sexuality, motherhood, agency, and resistance to patriarchy in the novels of both authors.
4. Contextual Framework: The study will also provide a contextual framework for understanding the authors' respective time periods and cultural environments. Beauvoir's philosophical and social commentary is rooted in the historical backdrop of 20th-century France, marked by existentialist thought, the feminist movement, and the quest for sexual liberation. Kapadia, writing in the post-independence Indian context, responds to a nation navigating the tension between tradition and modernity, where women's roles have been historically confined by patriarchy but are evolving with changing social norms. Understanding the historical and social contexts of these two literary traditions is crucial for a deeper comprehension of their portrayal of women.
5. Conclusion and Implications: The final phase of the research will synthesize the findings from the thematic and comparative analysis. The study will discuss how both Beauvoir and Kapadia's portrayals of women reflect their respective social and philosophical milieus and contribute to feminist discourse. It will also explore the implications of their works for contemporary debates about gender, identity, and freedom, highlighting how the themes they address continue to

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resonate in today's world. This research will also provide recommendations for further studies in feminist literary criticism and cross-cultural comparative studies.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The field of gender studies, particularly the portrayal of women in literature, has seen substantial growth in recent decades, with significant research on both Simone de Beauvoir and Kundanika Kapadia. Beauvoir's influence on feminist philosophy, especially her foundational work The Second Sex, has led to extensive scholarly discussions about the existentialist conceptualization of women as "the Other" and their quest for autonomy and self-definition. A substantial body of research exists on Beauvoir's impact on feminist theory, focusing on themes such as oppression, freedom, and the construction of gender. Critical analysis often intersects with existentialism, post-structuralism, and psychoanalysis, offering diverse interpretations of her portrayal of women across different contexts.

However, while Beauvoir's works are well-documented in feminist literature, Kundanika Kapadia's contribution to the portrayal of women in post-colonial Indian literature has not been equally explored in a global feminist context. Kapadia's focus on Indian women navigating the tension between tradition and modernity, especially in the context of family dynamics and societal expectations, has sparked some scholarly attention but remains underrepresented in comparison to Western counterparts. Comparative studies of Beauvoir and Kapadia are relatively rare, and there is a need for more interdisciplinary research that bridges the gap between Western feminist thought and Indian cultural narratives.

Thus, the current research landscape reveals a need for more cross-cultural and comparative studies that examine the portrayal of women across diverse literary traditions.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To Analyze the Portrayal of Women in Simone de Beauvoir's Novels
2. To Explore the Representation of Women in Kundanika Kapadia's Novels
3. To Conduct a Comparative Analysis of Beauvoir and Kapadia's Literary Depictions of Women
4. To Examine the Influence of Socio-Cultural Context on the Portrayal of Women
5. To Investigate the Themes of Liberation and Agency in Both Authors' Works
6. To Contribute to the Field of Feminist Literary Criticism

6. Significance of the proposed study: (300 words)

The significance of the proposed study lies in its potential to offer a nuanced and cross-cultural understanding of the portrayal of women in literature, particularly through the works of Simone de Beauvoir and Kundanika Kapadia. By examining the representation of women in both Western and Indian literary traditions, the study will contribute to bridging the gap between feminist discourses that often emerge in separate cultural contexts. Simone de Beauvoir's existentialist approach to gender, autonomy, and liberation in her works, such as The Second Sex, has had a profound influence on feminist theory. Kundanika Kapadia, on the other hand, presents a unique portrayal of women's roles

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and challenges in post-independence Indian society, where traditional expectations intersect with modernity.

The comparative analysis of these authors is significant as it will shed light on the universal and culturally specific aspects of women's experiences, highlighting how literature can be a powerful tool in reflecting and shaping societal attitudes toward gender roles and identity. This study will also enhance understanding of how women's agency, self-determination, and resistance to patriarchal structures are articulated in different cultural contexts.

Moreover, by examining the impact of socio-cultural and historical factors on the representation of women, the study will offer valuable insights into how literature engages with the ongoing global conversations about gender equality, women's rights, and empowerment. Ultimately, this research will deepen the interdisciplinary connections between feminist theory, literature, and cultural studies, contributing to the broader academic discourse on gender and society.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on the portrayal of women in the novels of Simone de Beauvoir and Kundanika Kapadia holds significant relevance to Gujarat, given the region's unique socio-cultural fabric and its evolving views on gender, tradition, and modernity. Gujarat, with its rich literary heritage, has been home to many renowned authors who have explored the roles of women in society, and Kundanika Kapadia is one of the foremost figures in this regard. Kapadia's works, such as Pathe Chalu Che and Aparajita, deeply engage with the lives of women in Gujarat, reflecting the societal changes post-independence, the tension between traditional values, and the growing push for women's empowerment. By examining her portrayal of women, the study will provide a deeper understanding of the struggles and aspirations of women in Gujarat, a state where both tradition and modernity play crucial roles in shaping gender roles.

Simone de Beauvoir's influence on global feminist thought, especially her existentialist approach to gender, offers a broader philosophical framework for understanding women's identity, autonomy, and liberation. Her works, though not directly related to Gujarat, resonate with the global feminist movement, which has had a significant impact on Indian society, including Gujarat. This comparative study will help contextualize the struggles of women in Gujarat within the global feminist discourse, enriching local conversations about gender justice and equality.

Furthermore, this study will contribute to the understanding of how women in Gujarat, particularly those portrayed by Kapadia, navigate the complexities of family, society, and culture, while also questioning the patriarchal structures that shape their lives. By exploring the intersection of gender and culture in both Western and Indian contexts, the research will offer valuable insights into the relevance of global feminist movements to regional struggles for women's rights in Gujarat. This makes the proposed study not only important from a literary and academic perspective but also highly relevant to contemporary gender debates in Gujarat.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

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The proposed research on the portrayal of women in the novels of Simone de Beauvoir and Kundanika Kapadia carries significant societal benefits, particularly for the state of Gujarat, which is currently navigating complex dynamics between tradition, modernity, and gender equality. Through a comparative analysis of these two authors, the research aims to generate insights that are directly applicable to contemporary debates on gender, identity, and women's empowerment in Gujarat.

The primary benefit of this research lies in its potential to illuminate the evolving roles of women in Gujarat by exploring the nuanced representations found in Kapadia's works. Kapadia's novels depict women's experiences in Gujarat's socio-cultural context, where they grapple with the pressures of maintaining traditional values while seeking independence and self-expression. By analyzing how Kapadia's characters navigate these tensions, the research will help deepen the understanding of local gender dynamics and contribute to ongoing conversations about women's rights and social progress in Gujarat.

Simultaneously, by integrating Simone de Beauvoir's feminist existentialist philosophy, the study will offer a broader, global perspective on women's liberation, autonomy, and resistance to patriarchal structures. Beauvoir's work provides a foundational framework for understanding women as active agents in shaping their own lives, which can inspire and inform the feminist movements in Gujarat. This comparative analysis will highlight both the universal struggles of women and the specific cultural challenges faced by women in Gujarat.

At a societal level, the expected findings can serve to encourage critical reflection on gender roles within Gujarat, particularly in rural and conservative areas, promoting awareness of the importance of gender equality. Additionally, the study can inform educators, policymakers, and social activists, fostering initiatives that challenge patriarchal norms and empower women across the state. Ultimately, the research will contribute to creating a more equitable and inclusive society in Gujarat by addressing the intersection of local traditions and global feminist discourses.

9. The proposal can be broadly classified into any of the below-mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	
2.	Agriculture	
3.	Health and wellness	
4.	Nutrition	
5.	Development of Industrial Problem Solutions	
6.	Resources management and sustainable development	
7.	High Impact Teaching	
8.	Imparting corporate responsibility, ethics, accountability, and values in society	
9.	Social entrepreneurship	
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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Methodology

The proposed study on the portrayal of women in the novels of Simone de Beauvoir and Kundanika Kapadia will employ a qualitative research methodology, focusing on thematic and comparative analysis of the selected works. The research will follow a structured approach, integrating critical literary analysis with feminist theory to explore how both authors depict women's roles, identities, and struggles within their respective socio-cultural contexts.

Hypothesis

The hypothesis guiding this study is that while both Simone de Beauvoir and Kundanika Kapadia portray women as individuals navigating oppressive societal structures, their representation reflects distinct cultural and philosophical frameworks. De Beauvoir's existentialist feminism emphasizes women's autonomy and liberation from patriarchal constructs, while Kapadia's portrayal focuses on the negotiation between tradition and modernity in post-colonial Indian society, particularly in Gujarat.

Sampling Plan

The study will focus on a selection of novels by both authors. For Simone de Beauvoir, key works such as The Second Sex (for theoretical insights) and The Mandarins (a novel) will be analyzed for their depiction of women. For Kundanika Kapadia, novels such as Pathe Chalu Che, Aparajita, and Vishweshwar will be studied, which offer a rich portrayal of women in Gujarat's post-independence socio-cultural context. These texts were chosen because they represent significant contributions to the discourse on women's experiences and empowerment in both Western and Indian settings.

Data Collection

Data will be collected through primary sources, i.e., the novels themselves, and secondary sources such as feminist literary criticism, academic articles, books, and interviews where available. The primary data will involve close readings of the texts to identify themes, character development, narrative techniques, and the portrayal of women. Secondary data will be used to contextualize the findings within broader feminist and literary discourses.

Data Analysis

Data will be analyzed using thematic analysis. The first step will involve identifying recurring themes such as gender roles, autonomy, resistance to patriarchy, and the tension between tradition and modernity. A comparative framework will be used to assess how each author addresses these themes, with particular attention to the cultural and philosophical contexts shaping the portrayals. The analysis will also explore how women's identities are constructed through their relationships with family, society, and sexuality. The study will apply feminist literary theory, particularly existentialist feminism, to interpret the characters' journeys toward self-awareness and empowerment.

Through this methodology, the study will contribute to a deeper understanding of the portrayal of women in literature, offering insights that are both culturally specific and globally relevant.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.					
2.					
3.					
4.					
5.					

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			
2.	Travelling (viz. sample collection, should be Minimum and with justification)	80000		80000
3.	Contingency (Upto maximum for Rs. 3000/-)	3000		3000
4.	Stationery and Printing (With justification)	50000		50000
5.	Any other special requirement	137000		137000
6.	Overhead (10% of recurring)	30000		30000
	TOTAL	300000		300000

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Application form

Part -A

(General Information)

1.	Title of the proposal	DDoS Mitigation in IoT Using Machine Learning and Block chain Integration	
2.	Broad area of proposal	Engineering	
3.	Sub Area of proposal	Machine Learning	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Ms. Gemini Ashokkumar Parmar	Lecturer	9898771786 gemini.parmar@atmiyauni.ac.in 1436
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Ms. Gunjanee J. Vaghela	-	-
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	20/04/1998	
8.	Date of joining the Department of PI (DD/MM/YYYY)	17/01/2022	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	-	

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	-	-	-
ii.	Post-Graduation	-	-	-	-
iii.	Under Graduation	B.E	GTU	2019	76.47%
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐YES	√ NO
3.	If yes, please indicate whether it was a (√ tick appropriate)	☐Short-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	-	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
		-	-	-	-
		-	-	-	-

6.	Total Experience	Teaching Experience: (5 Year + 4 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National:
		International:
8.	No. of Publication (Book Chapters)	-

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	Books Published	-
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

DDoS Mitigation in IoT Using Machine Learning and Block chain Integration.

2. Abstract (Provide a summary of your research proposal in 300 words)

The Internet of Things (IoT) has revolutionized numerous industries, enabling seamless connectivity and automation. However, it's distributed and resource-constrained nature makes it highly susceptible to Distributed Denial of Service (DDoS) attacks, which disrupt network functionality and compromise security. Traditional DDoS mitigation strategies often struggle to adapt to the unique requirements of IoT networks, such as low computational power and high scalability demands. This research proposes an innovative framework that integrates Machine Learning (ML) and Block chain technology to mitigate DDoS attacks in IoT environments.

The proposed approach leverages ML algorithms to analyse IoT traffic in real-time and identify anomalies indicative of DDoS attacks. By extracting features such as packet size, flow dynamics, and traffic frequency, the system achieves accurate detection while minimizing false positives. Simultaneously, a lightweight block chain architecture is employed to create a decentralized and immutable ledger for logging network activities and executing smart contracts. This ensures secure communication, enhances trust, and enables automated threat responses without relying on centralized control.

To validate the framework, experiments were conducted using publicly available IoT traffic datasets in simulated environments. Performance metrics, including detection accuracy, false positive rates, and mitigation latency, demonstrated significant improvements compared to traditional methods. The results also highlight the system's resource efficiency, making it suitable for resource-constrained IoT devices.

This study underscores the potential of integrating ML and Block chain to create a robust and scalable defense mechanism against evolving DDoS threats in IoT ecosystems.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The Internet of Things (IoT) is transforming the way we interact with technology, connecting

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billions of devices across various domains such as healthcare, smart cities, agriculture, and industrial automation. While IoT has introduced unprecedented convenience and efficiency, it has also exposed critical vulnerabilities. One of the most significant threats to IoT networks is Distributed Denial of Service (DDoS) attacks, which overwhelm devices and networks by flooding them with excessive traffic, causing disruptions, financial losses, and potential safety risks.

The unique characteristics of IoT networks, including constrained computational resources, limited storage, and their distributed nature, make them particularly vulnerable to DDoS attacks. Existing mitigation techniques, primarily designed for traditional IT systems, often fail to address these unique challenges effectively. Centralized security solutions are prone to single points of failure and cannot scale adequately to accommodate the exponential growth of IoT devices.

To address these limitations, this study proposes a novel DDoS mitigation framework that integrates Machine Learning (ML) and Block chain technology. ML offers the ability to analyze network traffic and detect anomalous patterns indicative of potential DDoS attacks with high accuracy. By leveraging algorithms such as supervised learning, unsupervised clustering, and deep learning, IoT networks can identify and respond to threats in real-time.

Block chain, with its decentralized, secure, and immutable ledger, complements ML by providing a tamper-proof mechanism for logging network activities and enabling automated responses through smart contracts. Its decentralized architecture ensures resilience, while lightweight Block chain protocols make it feasible for resource-constrained IoT devices.

Combining these technologies creates a synergistic approach to DDoS mitigation in IoT. Machine learning can analyze Block chain-secured data for anomaly detection, enabling real-time monitoring and rapid response to threats. Block chain ensures data integrity for training ML models and supports decentralized, scalable IoT networks that are resilient to attacks. This research aims to develop a robust framework that leverages the strengths of both machine learning and Block chain technology to mitigate DDoS attacks, enhancing the security, reliability, and efficiency of IoT ecosystems while ensuring uninterrupted operations in the face of evolving cyber threats.

Internet of Things (IoT) has transformed industries by enabling seamless connectivity and data exchange between devices, fostering innovations in healthcare, smart cities, transportation, and industrial automation. However, the rapid growth of IoT networks has also introduced significant security challenges, with Distributed Denial of Service (DDoS) attacks emerging as one of the most critical threats. DDoS attacks aim to overwhelm IoT networks by flooding them with malicious traffic, disrupting operations, and causing substantial financial and reputational damage. IoT devices, often resource-constrained and lacking robust security mechanisms, are particularly vulnerable to such attacks, necessitating advanced and efficient mitigation strategies.

The integration of machine learning (ML) and Block chain technology offers a promising solution to address these challenges. Machine learning enables the analysis of network traffic patterns to detect anomalies and identify potential DDoS attacks in real-time, utilizing techniques such as supervised, unsupervised, and reinforcement learning for predictive and

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adaptive defense mechanisms. On the other hand, Block chain technology provides a decentralized, secure, and immutable framework for IoT networks, ensuring tamper-proof data integrity and trust management while eliminating single points of failure that attackers could exploit.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

1. Machine Learning in DDoS Mitigation

- **Anomaly Detection Models**: ML techniques such as supervised learning (e.g., Random Forest, Support Vector Machines) and unsupervised learning (e.g., clustering, auto encoders) are widely used to detect traffic anomalies indicative of DDoS attacks. Deep learning models, like recurrent neural networks (RNNs) and convolutional neural networks (CNNs), have also shown promise in analyzing time-series data and identifying complex attack patterns.
- **Dataset Availability**: Public datasets, such as CICIDS and Bot-IoT, provide benchmarks for training and evaluating ML models, but their applicability to real-world scenarios is sometimes limited due to differences in IoT network structures.
- **Challenges**: Resource constraints of IoT devices and the risk of high false positives or false negatives remain significant barriers to adopting ML in IoT-based DDoS mitigation.

2. Block chain in IoT Security

- **Decentralized Defense**: Block chain is being explored as a decentralized solution for maintaining secure, immutable logs of network activities, making it difficult for attackers to erase traces of their activities.
- **Smart Contracts**: Automated threat responses using smart contracts have demonstrated the ability to trigger actions, such as blocking malicious IPs or isolating compromised devices.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Enhanced Detection of DDoS Attacks
2. Secure Logging and Accountability
3. Automated and Decentralized Mitigation
4. Scalability and Resource Efficiency
5. Collaboration and Trust in Distributed Environments

6. Significance of the proposed study: (300 words)

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1. Addressing IoT Security Vulnerabilities

- **Rising Threat Landscape**: The growing number of IoT devices has made them prime targets for DDoS attacks, with attackers exploiting their resource constraints and vulnerabilities.
- **Comprehensive Defense**: Combining ML and Block chain offers a robust defense mechanism capable of detecting and mitigating attacks efficiently, thus safeguarding IoT networks

2. Real-Time Threat Detection and Response

- ML algorithms can process large volumes of IoT traffic data in real time to identify malicious patterns, enabling immediate responses to DDoS threats.
- Automated responses through Block chain smart contracts ensure rapid mitigation without manual intervention, reducing downtime and damage.

3. Scalability for Expanding IoT Networks

- As IoT networks grow in scale, traditional centralized security solutions struggle to keep up.
- Block chain's decentralized architecture and ML's adaptability make this integrated approach highly scalable, meeting the demands of large and dynamic IoT environments.

4. Enhanced Transparency and Trust

- Block chain ensures the integrity and transparency of security logs, enabling reliable forensic analysis and fostering trust among IoT stakeholders.
- The decentralized nature of Block chain eliminates single points of failure, increasing overall system resilience.

7. Relevance of the proposed study to Gujarat: (200 words)

1. Growing Adoption of IoT Devices

- **Proliferation of IoT**: With billions of IoT devices deployed in domains like healthcare, smart cities, industrial automation, and agriculture, securing these networks has become essential.
- **Vulnerability**: IoT devices often have limited computational and security capabilities, making them highly susceptible to DDoS attacks.

2. Escalating DDoS Threats

- **Frequency and Severity**: DDoS attacks targeting IoT networks have grown significantly, with attackers leveraging botnets composed of compromised IoT devices.
- **Impact**: These attacks can disrupt critical services, compromise safety, and result in

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financial losses and reputational damage.

3. Limitations of Traditional Solutions

- **Centralized Defenses**: Traditional DDoS mitigation approaches rely on centralized servers, which are themselves vulnerable to attacks and lack scalability for IoT environments.
- **Ineffectiveness in IoT Context**: Conventional methods often fail to address the unique requirements of IoT, such as resource constraints and heterogeneity.

4. Advantages of ML and Block chain Integration

- **Real-Time Anomaly Detection**: ML offers powerful tools for detecting and responding to DDoS attacks by analyzing traffic patterns in real time.
- **Decentralized Security**: Block chain ensures a tamper-proof, decentralized system for secure logging and coordination among devices, reducing reliance on single points of failure.
- **Scalability and Adaptability**: This integration is scalable and can adapt to the dynamic and evolving nature of IoT networks and threats.

5. Alignment with Emerging Trends

- **Industry 4.0 and Smart Cities**: Securing IoT infrastructure is critical for the success of smart factories, autonomous transportation, and other smart city initiatives.
- **Data-Driven Security**: The integration aligns with the trend of leveraging big data and ML for predictive and proactive security measures.
- **Block chain Adoption**: Growing acceptance of Block chain technology across industries makes it a viable and forward-looking choice for IoT security.

6. Societal and Economic Importance

- **Critical Infrastructure Protection**: Securing IoT systems in healthcare, energy, and transportation ensures public safety and service continuity.
- **Economic Stability**: Mitigating DDoS attacks reduces the financial losses associated with downtime, data breaches, and recovery efforts.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

1. Enhanced Security for IoT Networks

- **Proactive Threat Detection**: ML models can analyze traffic patterns and detect DDoS attacks in real time, enabling quicker responses and reducing downtime.

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- **Immutable Logs**: Block chain ensures that security events and network activities are logged transparently and cannot be altered, aiding in forensic investigations.

2. Improved Network Resilience

- **Decentralized Architecture**: Block chain reduces the risks associated with centralized points of failure, making IoT networks more robust against large-scale DDoS attacks.
- **Automated Mitigation**: Smart contracts facilitate automated responses, such as isolating compromised devices or rerouting traffic, ensuring uninterrupted service.

3. Scalability and Efficiency

- **Adaptable Framework**: The integration of lightweight ML models and optimized Block chain protocols ensures scalability to support the exponential growth of IoT devices.
- **Resource Efficiency**: Tailored solutions ensure that even resource-constrained IoT devices can participate in the security framework without performance degradation.

4. Improved System Reliability

- **Resilient Infrastructure:** A Block chain-based decentralized framework prevents single points of failure, ensuring network continuity even during attack scenarios.
- **Real-Time Decision Making:** Machine learning models trained on IoT-specific attack patterns enhance the speed and accuracy of DDoS mitigation responses, improving overall system reliability.

5. Advancement in Machine Learning and Block chain Integration

- **Novel Algorithms and Models:** The research may contribute new machine learning models tailored for anomaly detection in IoT environments.
- **Innovative Block chain Frameworks:** Findings could inspire Block chain implementations optimized for resource-constrained IoT devices, balancing security and efficiency.
- **Interdisciplinary Innovation:** By combining machine learning and Block chain, the research may open new avenues for integrating these technologies in other applications.

6. Advancement in Machine Learning and Block chain Integration

- **Novel Algorithms and Models:** The research may contribute new machine learning models tailored for anomaly detection in IoT environments.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)

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1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	√

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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1. Problem Analysis and Requirement Specification

- **Understand IoT Network Characteristics**:
  - Identify IoT devices, protocols, and network topology.
  - Analyze the limitations of existing security mechanisms in IoT environments.
- **Define DDoS Attack Scenarios**:
  - Simulate or study real-world attack patterns, including volumetric and resource-exhaustion DDoS attacks.
- **Set Performance Metrics**:
  - Define metrics such as detection accuracy, false positive rate, response time, and resource consumption for evaluation.

2. Data Collection and Preprocessing

- **IoT Traffic Data**:
  - Use publicly available datasets (e.g., Bot-IoT, CICIDS) or generate synthetic IoT traffic for training ML models.
- **Labeling**:
  - Label traffic as normal or malicious for supervised learning.
- **Feature Extraction**:
  - Extract relevant features such as packet size, traffic flow, frequency, and source/destination patterns.
- **Data Normalization**:
  - Preprocess data to ensure consistency and compatibility with ML models.

3. Machine Learning-Based DDoS Detection

- **Model Selection**:
  - Experiment with algorithms such as Random Forest, Support Vector Machines (SVM), or Neural Networks for supervised detection.
  - Use clustering techniques (e.g., k-means) or auto encoders for unsupervised anomaly detection.
- **Training and Testing**:
  - Split data into training and testing sets.
  - Optimize hyper parameters for better performance.
- **Evaluation**:
  - Evaluate models based on accuracy, precision, recall, and F1-score.

11. Suggested plan of action: Define the suggested plan of action in (200 words)

Phase 1: Project Planning and Requirement Analysis

Duration: 2-3Weeks
Objective: Establish a clear understanding of the project scope, objectives, and requirements.

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Action Items:

1. **Define Project Scope**:
   - Clarify the specific types of DDoS attacks to address (e.g., volumetric, protocol-based, or application layer attacks).
2. **Gather Requirements**:
   - Gather technical, operational, and security requirements for both ML and Block chain components.
3. **Team Formation and Task Allocation**:
   - Assemble a multidisciplinary team consisting of IoT specialists, data scientists (for ML), and Block chain developers.
   - Assign roles and responsibilities.
4. **Literature Review**:
   - Review current research on DDoS mitigation in IoT, focusing on ML and Block chain integration.

Phase 2: Data Collection and Preprocessing

Duration: 4-5 Weeks
Objective: Collect IoT traffic data, prepare it for ML model training, and perform necessary preprocessing.

Action Items:

1. **Dataset Selection**:
   - Select suitable public datasets such as CICIDS, Bot-IoT, or generate synthetic IoT traffic data.
   - Define the scope and characteristics of attack traffic to be modeled.
2. **Data Preprocessing**:
   - Cleanse and preprocess data (e.g., remove noise, normalize values).
   - Perform feature extraction (e.g., packet size, flow duration, IP address behavior) to create meaningful input for ML models.
3. **Labeling**:
   - Label traffic data as normal or malicious for supervised learning.
4. **Split Data**:
   - Split data into training, validation, and test sets.

Phase 3: Machine Learning Model Development

Duration: 6-8 Weeks
Objective: Build, train, and evaluate machine learning models for DDoS detection.

Action Items:

1. **Model Selection**:
   - Select appropriate ML algorithms (e.g., Random Forest, SVM, Deep Learning models) based on data characteristics and attack patterns.

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- Explore anomaly detection techniques using clustering or unsupervised learning.

2. **Model Training**:
   - Train models using the labeled IoT traffic data.
   - Tune model parameters and optimize for detection accuracy and low false positive rates.
3. **Model Evaluation**:
   - Evaluate models using performance metrics (accuracy, precision, recall, F1-score, false positives).
   - Test models on unseen attack data to assess robustness and generalization.
4. **Model Refinement**:
   - Iterate on model design based on evaluation results, adjusting features, algorithms, or training parameters.

Phase 4: Block chain Design and Integration

Duration: 4-6 Weeks
Objective: Develop and integrate Block chain technology to ensure secure and decentralized mitigation actions.

Action Items:

1. **Block chain Selection**:
   - Choose a suitable Block chain framework, such as Hyperledger or Ethereum (lightweight version) for IoT applications.
   - Decide on consensus mechanisms (e.g., Proof of Authority, Proof of Stake) to suit the resource constraints of IoT devices.
2. **Smart Contract Development**:
   - Develop smart contracts to automate response actions (e.g., blocking malicious IPs, isolating devices) once an attack is detected by the ML model.
   - Ensure the contract logic is transparent and verifiable.
3. **Decentralized Logging and Data Integrity**:
   - Implement a tamper-proof Block chain ledger to store detected anomalies and mitigation actions.
   - Ensure that logs are securely and efficiently stored for audit and forensic purposes.
4. **System Integration**:
   - Integrate the ML-based DDoS detection system with the Block chain network for seamless real-time responses.

Phase 5: System Testing and Optimization

Duration: 6-8 Weeks
Objective: Test the integrated system for performance, security, and scalability.

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Action Items:

1. **Simulated Attack Testing**:
   - Test the integrated system in a simulated IoT environment under controlled DDoS attack conditions (e.g., flooding, amplification).
   - Measure system performance in terms of detection time, response time, and accuracy.
2. **Scalability Testing**:
   - Assess system scalability by increasing the number of IoT devices and attack traffic.
   - Identify potential bottlenecks or limitations in the Block chain network or ML model performance.
3. **Stress Testing**:
   - Test the system under extreme attack conditions to ensure that it remains resilient and continues to function optimally.
4. **Optimize Efficiency**:
   - Tune the system for resource efficiency, particularly in IoT devices with limited computational power and energy.

Phase 6: Real-World Deployment and Validation

Duration: 6-8 Weeks
Objective: Deploy the system in a real-world IoT network to validate its effectiveness and operational feasibility.

Action Items:

1. **Pilot Deployment**:
   - Deploy the system in a small-scale real-world IoT network, such as a smart home or a small industrial setup.
   - Ensure devices are compatible with the Block chain and ML-based detection system.
2. **Monitor System Performance**:
   - Continuously monitor the system for real-time attack detection and mitigation.
   - Gather data on performance metrics in a live environment, including detection time, false positives, and operational efficiency.
3. **Feedback Collection**:
   - Gather feedback from stakeholders (e.g., network operators, device manufacturers) on system usability and performance.

Phase 7: Final Reporting and Future Recommendations

Duration: 2-3 Weeks
Objective: Document the findings, improvements, and suggestions for future work.

Action Items:

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1. **Analysis and Reporting**:
   - Compile results from testing and real-world deployment.
   - Analyze the effectiveness of the ML and Block chain integration, highlighting strengths and weaknesses.
2. **Recommendations for Improvement**:
   - Suggest improvements in system design, optimization, or expansion to larger networks.
   - Provide future research directions based on the findings.
3. **Publication and Dissemination**:
   - Publish research findings and share insights with the broader academic and industry communities.
   - Present the developed solution at conferences or in journals focusing on IoT security and Block chain.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Analyze the impact of DDoS attacks on IoT systems	Month 1	2022	Month 2	2022
2.	Collect data for detecting DDoS attacks	Month 2	2022	Month 3	2022
3.	Design and train ML models to detect DDoS attacks	Month 3	2022	Month 5	2022
4.	Develop a system for real-time DDoS detection and mitigation	Month 9	2022	Month 10	2022
5.	Test the system in simulated IoT environments	Month 10	2022	Month 12	2022
6.	Prepare detailed documentation and project report.	Month 1	2023	Month 4	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware,			175000

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	c. Electric items d. Other items (specify)			
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			10000
3.	Contingency (Upto maximum for Rs. 3000/-)			3000
4.	Stationery and Printing (With justification)			12000
5.	Any other special requirement			25000
6.	Overhead (10% of recurring)			-
	TOTAL			2,25,000

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Formulation and Evaluation of Withaferin A Phytosome: A Novel approach to Enhance Bioavailability and Therapeutic Potential	
2.	**Broad area of proposal**	Pharmacy	
3.	**Sub Area of proposal**	Pharmaceutics	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Hani Mukeshbhal Jani	Assistant Professor (Pharmaceutics)	hani.jani@atmiyauni.ac.in 9724513038 1713
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	-	-	-
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	06/02/1993	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	07-01-2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	NA	
10.	**If yes then name of university**	NA	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	-	-	-
ii.	Post Graduation	M Pharm (Pharmaceutics)	Saurashtra University	2016	81
iii.	Under Graduation	B Pharm	Gujarat Technological University	2014	62
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	✓☐ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	NA	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (3 Year + 6 Months)
		Research Experience: (0 Year + 6 Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: NA
		International: NA

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8.	No. of Publication (Book Chapters)	1
	Books Published	NA
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Formulation and Evaluation of Withaferin A Phytosome: A Novel approach to Enhance Bioavailability and Therapeutic Potential

2. Abstract (Provide a summary of your research proposal in 300 words)

Withaferin A, a bioactive compound derived from *Withania somnifera* (Ashwagandha), demonstrates significant therapeutic properties, including anti-inflammatory, anticancer, and neuroprotective effects. Despite its potential, the clinical application of Withaferin A is limited due to poor bioavailability, arising from low aqueous solubility and rapid metabolism. Phytosome technology, which complexes active phytochemicals with phospholipids, offers a promising strategy to enhance solubility, stability, and absorption, thereby improving therapeutic efficacy. This study aims to develop a Withaferin A phytosome and evaluate its physicochemical properties, bioavailability, and biological activities. The phytosome will be formulated by complexing Withaferin A with phosphatidylcholine using a solvent evaporation method. Physicochemical characterization included particle size and zeta potential analysis (via dynamic light scattering), encapsulation efficiency (quantified using HPLC), solubility studies, and stability assessments under various conditions. In vivo studies will be conducted using Wistar rats. The phytosome formulation is expected to significantly enhance the solubility, stability, and bioavailability of Withaferin A. Additionally, it exhibit superior anti-inflammatory and antioxidant effects compared to the free compound. This study provides a novel approach to overcoming the bioavailability challenges of Withaferin A, paving the way for its effective application in the treatment of inflammatory and oxidative stress-related diseases.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Specific Research Activities

The proposed study aims to address the bioavailability challenges of Withaferin A, a promising bioactive compound derived from Withania somnifera, by developing a phytosome formulation. The specific research activities planned during the project period are outlined below:

1. Formulation and Optimization of the Withaferin A Phytosome.

- Procure or extract Withaferin A with a high degree of purity.
- Procure phosphatidylcholine and other necessary excipients to ensure compatibility and

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stability.
- Utilize organic solvents such as ethanol and chloroform for complexation.
- Development of the Phytosome Complex:
- Dissolve Withaferin A and phosphatidylcholine in a suitable organic solvent.
- Use a rotary evaporator to remove the solvent under reduced pressure, forming a thin film.
- Hydrate the thin film with distilled water to form the phytosome complex.
- Employ homogenization techniques to achieve uniform particle size and dispersion.
- Lyophilize the phytosome complex to enhance stability and ease of storage for further testing.

2.Optimization:

Conduct preliminary testing to optimize the ratio of Withaferin A to phosphatidylcholine, hydration conditions, and homogenization parameters to achieve maximum encapsulation efficiency and stability.

3. Physicochemical Characterization

- Particle Size and Zeta Potential:
- Encapsulation Efficiency:
- Quantify the encapsulation efficiency of Withaferin.
- Solubility Studies:
- Stability Analysis:
- Pharmacokinetics and Biological Activity Studies
- Pharmacokinetic Studies:
- Anti-inflammatory Activity:
- Antioxidant Activity:

4. Data Analysis and Reporting

Importance of the Proposed Study

The proposed study holds significant importance in advancing the therapeutic potential of Withaferin A. Despite its extensive pharmacological benefits, the clinical application of Withaferin A has been constrained by poor bioavailability due to its low solubility and rapid metabolic clearance. Addressing these challenges is essential for unlocking its full therapeutic potential, particularly in treating inflammation, oxidative stress, and cancer.

1. Overcoming Bioavailability Challenges: Improve Solubility, Enhance Stability, Prolong Circulation Time
2. Advancing Therapeutic Efficacy: Boost Anti-inflammatory Effects, Strengthen Antioxidant Activity
3. Bridging the Gap Between Preclinical and Clinical Research
4. Improve Patient Compliance:

This study bridges the gap between preclinical research and clinical application by addressing formulation challenges. The outcomes will provide valuable insights into the pharmacokinetics and pharmacodynamics of Withaferin A in its phytosome form, setting the stage for future clinical trials.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The therapeutic potential of Withaferin A, derived from *Withania somnifera*, has been widely studied, with strong evidence supporting its anti-inflammatory, anticancer, and neuroprotective properties. Despite these promising attributes, its clinical application remains limited due to poor aqueous solubility, rapid metabolism, and low bioavailability. Numerous studies have explored strategies to overcome these challenges, including nanoformulations, liposomes, and polymeric

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nanoparticles. However, these approaches often face issues such as complex manufacturing processes, scalability, and potential biocompatibility concerns. Phytosome technology has emerged as a promising solution for enhancing the bioavailability of poorly soluble phytochemicals. By forming lipid-compatible molecular complexes, phytosomes improve the solubility, absorption, and stability of bioactive compounds, addressing the limitations of conventional formulations. Research on phytosomes has shown significant improvements in the pharmacokinetic and therapeutic profiles of various phytochemicals, such as curcumin and quercetin. However, studies specifically focusing on Withaferin A phytosomes remain sparse.
Existing research highlights the need for further exploration of Withaferin A phytosome formulations, particularly in terms of physicochemical characterization, pharmacokinetics, and biological activities. Advancements in this field could pave the way for more effective therapeutic applications of Withaferin A, addressing its current bioavailability challenges and unlocking its full clinical potential.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To formulate a Withaferin A phytosome
2. To characterize the physicochemical properties of the Withaferin A phytosome
3. To compare the solubility and stability of the Withaferin A phytosome
4. To evaluate the pharmacokinetic parameters of the Withaferin A phytosome
5. To assess the anti-inflammatory and antioxidant activity of the phytosome

6. Significance of the proposed study: (300 words)

The proposed study leverages phytosome technology, an innovative drug delivery system, to enhance the pharmacological potential of Withaferin A. Phytosomes, formed by complexing active phytochemicals with phospholipids, improve solubility, stability, and absorption of poorly bioavailable compounds. This approach not only addresses the pharmacokinetic challenges associated with Withaferin A but also ensures a more targeted and sustained therapeutic effect. By formulating and characterizing the Withaferin A phytosome, this study aims to optimize its physicochemical properties, such as particle size, encapsulation efficiency, and stability under various conditions. The investigation of bioavailability in a preclinical rat model will provide critical insights into the improved pharmacokinetic parameters of the phytosome. Furthermore, evaluating its anti-inflammatory and antioxidant activities will help establish its potential for treating inflammation- and oxidative stress-related disorders, such as arthritis, neurodegenerative diseases, and cancer. This research holds significant implications for advancing Withaferin A into clinical applications. The findings could pave the way for developing a novel, efficacious drug delivery platform, enhancing therapeutic outcomes and patient compliance. Furthermore, the study contributes to the growing field of phytopharmaceuticals, emphasizing the integration of traditional medicinal compounds with modern nanotechnology. Ultimately, it aligns with the broader objective of harnessing natural compounds to develop sustainable and effective therapies for global health challenges.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, known for its rich biodiversity and thriving pharmaceutical industry, has a strong tradition of utilizing medicinal plants in healthcare. *Withania somnifera* (Ashwagandha), a key ingredient in traditional Ayurvedic medicine, is widely cultivated in Gujarat due to its adaptability to the region's climatic conditions. Leveraging such locally available resources for advanced pharmaceutical applications aligns with the state's focus on integrating traditional knowledge with modern science. Additionally, the study aligns with Gujarat's emphasis on sustainability by utilizing natural compounds and modern technologies. It supports the local

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economy by promoting value addition to indigenous plants and encourages collaborations between academic institutions and pharmaceutical companies in the state. Thus, this research is well-positioned to contribute to Gujarat's socio-economic development and global competitiveness in the phytopharmaceutical industry

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The development of a Withaferin A phytosome has the potential to generate multiple societal benefits, particularly for the state of Gujarat, which is known for its strong pharmaceutical industry, agricultural diversity, and traditional use of medicinal plants.

1. Enhanced Healthcare Outcomes:
The proposed research aims to overcome the bioavailability challenges of Withaferin A, making it a more effective therapeutic option for addressing chronic conditions like inflammation, cancer, and neurodegenerative diseases.

2. Economic Development:
Withaferin A is derived from *Withania somnifera*, which is cultivated in Gujarat. Enhancing the value of this locally available resource through innovative formulations can boost income for farmers and encourage the sustainable cultivation of medicinal plants.

3. Traditional Knowledge and Modern Science Integration:
The project reinforces Gujarat's heritage of utilizing Ayurvedic principles by combining traditional herbal remedies with cutting-edge nanotechnology.

4. Environmental Sustainability:
By utilizing plant-based compounds and sustainable production methods, this research promotes environmentally friendly practices.

5. Knowledge Dissemination and Collaboration:
The research can strengthen collaborations between academic institutions, industries, and government bodies in Gujarat.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	✓☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐

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6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The formulation of Withaferin A into a phytosome complex using phosphatidylcholine will enhance its solubility, stability, and bioavailability, thereby improving its therapeutic efficacy in terms of anti-inflammatory and antioxidant activities compared to free Withaferin A.

1. Formulation of Withaferin A Phytosome

The first step of the methodology involves the preparation of the Withaferin A phytosome by dissolving Withaferin A and phosphatidylcholine in an appropriate organic solvent (ethanol and chloroform). The solvent will be evaporated using a rotary evaporator to form a thin lipid film. The film will be hydrated with distilled water and homogenized to form the phytosome complex, which will be lyophilized for further characterization.

2. Physicochemical Characterization

The physicochemical properties of the Withaferin A phytosome will be extensively evaluated. Particle size, zeta potential, Encapsulation efficiency, Solubility studies will be performed by of Withaferin A.

3. In Vivo Evaluation

In vivo pharmacokinetics, anti-inflammatory, and antioxidant activity studies will be conducted in healthy adult Wistar rats. The rats will be divided into three groups:

- **Group 1:** Control (vehicle).
- **Group 2:** Free Withaferin A.
- **Group 3:** Withaferin A Phytosome.

Pharmacokinetics:

Oral doses of free Withaferin A and the phytosome formulation will be administered to the rats. Blood samples will be collected at various intervals (0, 1, 2, 4, 8, 12, and 24 hours) post-administration, and plasma concentrations of Withaferin A will be measured using LC-MS/MS. Pharmacokinetic parameters, such as Cmax, Tmax, and AUC (area under the curve), will be calculated to determine the bioavailability of the phytosome formulation.

Anti-inflammatory Activity:

The anti-inflammatory effect will be assessed by inducing paw edema in rats using carrageenan injection. The reduction in paw volume post-treatment with the phytosome and free Withaferin A

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will be measured to evaluate the anti-inflammatory potential.
Antioxidant Activity:
The serum levels of antioxidant markers (superoxide dismutase, catalase, glutathione peroxidase) will be measured to evaluate the antioxidant effects of the phytosome formulation compared to the free compound.
4. Sampling Plan and Data Collection
A total of 36 rats will be used in the study, divided into three experimental groups. Data collection will involve regular monitoring of animal health, recording of pharmacokinetic profiles, and biochemical analysis of the serum for antioxidant markers. Data points will be collected at specified intervals post-treatment for all biological assays.
5. Data Analysis
The collected data will be analyzed using one-way ANOVA followed by Tukey's post-hoc test to compare the effects of different treatments. A p-value of less than 0.05 will be considered statistically significant. The data will be presented as mean ± standard deviation for each group, and the outcomes will be interpreted in terms of the therapeutic potential of the phytosome formulation.
This comprehensive methodology aims to validate the hypothesis that the Withaferin A phytosome will enhance the compound's therapeutic properties compared to its free form, thereby supporting its potential clinical application.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Literature Review and Ingredient Selection (Weeks 1-2): Conduct a comprehensive review of existing research. Identify key compounds and active ingredients.

Weeks 1-4 will focus on the formulation and optimization of the Withaferin A phytosome. This involves preparing the phospholipid complex by dissolving Withaferin A and phosphatidylcholine in suitable solvents, followed by solvent evaporation, hydration, and homogenization. The complex will be lyophilized for further analysis.

Weeks 5-8 will be dedicated to the physicochemical characterization of the phytosome. During this period, key parameters such as particle size, zeta potential, encapsulation efficiency, and solubility will be assessed. These properties will provide insights into the stability, dispersion, and drug release potential of the phytosome formulation. Stability studies will also be performed to evaluate the formulation's robustness under varying environmental conditions.

Weeks 9-12 will involve in vivo studies. Rats will be divided into three groups, and oral doses of free Withaferin A and the phytosome formulation will be administered. Blood samples will be collected at different time points to assess pharmacokinetics and bioavailability. Additionally, anti-inflammatory and antioxidant activity will be evaluated using carrageenan-induced paw edema and serum antioxidant marker measurements, respectively.

Finally, **Weeks 13-14** will be dedicated to data analysis, interpretation, and report preparation. Statistical analyses will be performed to determine the significance of the results, and the findings will be compiled for publication or further research dissemination.

12. Schedule of the Project Task

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Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review, Ingredient Selection, Procurement	June	2022	September	2022
2.	Formulation Development	October	2022	January	2023
3.	Evaluations of Phytosomes	February	2023	May	2023
4.	Ethical Approval and Performance of trial	June	2023	August	2023
5.	Data Analysis and Interpretation, Final Report	September	2023	October	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables			
	a. Chemicals	20,000	13	2,60,000
	b. Glassware,	5,000	5	25,000
	c. Electric items	1000	1	1000
	d. Other items (Evaluation from sophisticated instruments)	20,000	6	1,20,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	5,000	3	15,000
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	2,000
4.	Stationery and Printing-documentation, publication etc.. (With justification)	-	-	7,000
5.	Any other special requirement	-	-	10,000
6.	Overhead (10% of recurring)	-	-	10,000
	TOTAL			**4,50,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

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S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a) Isolated Phytocompound	2,00,000	June – July	Components for formulating immunity-boosting gummies.
	b) Phosphatidylcholine	60,000	June – July	Required for the complexation process for phytosome.
2.	**B. Glassware**			
	a) Beakers, measuring cylinders,RBF	10,000	June – July	Essential for mixing and measuring ingredients during formulation.
	b) Eppendorf tube, spatula, shaker etc..	14,000	June – July	Conducting tests and sample preparations during the analysis phase.
	c) Stirring rods, funnels, etc.	1000	Throughout the Project	Necessary for preparing phytosome for each trial and error batches
3.	**C. Any other consumable items (like wires/ electric items etc)**			
	a) Electricity for phytosome preparation	1000	Throughout the Project	Machine works by electricity for project
4.	**Travel**	No. of Times in a month		
	a) Purpose 1- sample analysis at other institute	15,000	3-4	High sophisticated instruments required for product analysis
5.	**Contingency**			
	Ingredient shortages	2,000	Throughout the Project	Unforeseen expenses related to ingredient shortages or unexpected costs.
6.	**Stationery and printing**			
	a) Purpose 1	7000	September -October	Printing research findings, reports, and promotional materials.

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	AI-Driven Portfolio Optimization	
2.	**Broad area of proposal**	Artificial Intelligence	
3.	**Sub Area of proposal**	Management	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Kairvi Rathod	Assistant Professor, Department of Management, FoBC	kairvi.rathod@atmiyauni.ac.in 8866743771
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**	25/05/1993	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	25/01/2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	NA	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Management	Saurashtra University	2020	-
ii.	Post Graduation	MBA	GTU	2015	80%
iii.	Under Graduation	BBA	Saurashtra University	2013	76%
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	√ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (6 Years + 6 Months)
		Research Experience: (2 Years + 6 Months)
7.	No. of Publication (Research articles -	National: 3

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	UGC Approved only)	International:6
8.	No. of Publication (Book Chapters)	
	Books Published	
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

AI-Driven Portfolio Optimization

2. Abstract (Provide a summary of your research proposal in 300 words)

The advent of Artificial Intelligence (AI) has revolutionized the financial sector, particularly in portfolio management. AI-driven portfolio optimization leverages advanced algorithms to analyze vast amounts of financial data, assess risk, and enhance decision-making processes. This research proposal aims to explore the application of AI in optimizing investment portfolios, with a focus on improving risk-adjusted returns, adaptability to market changes, and long-term performance.

The study will investigate various AI techniques, including machine learning (ML), deep learning (DL), and reinforcement learning (RL), to optimize asset allocation and manage investment risks more effectively than traditional methods. The research will evaluate the effectiveness of AI-driven models in adapting to dynamic market conditions, forecasting asset returns, and minimizing exposure to volatility. Additionally, the study will compare AI-based optimization methods with conventional portfolio optimization techniques, such as the Markowitz model, to identify their advantages and limitations.

By integrating AI with financial theory, the research will provide insights into how AI can enhance portfolio performance while addressing key challenges such as risk diversification, overfitting, and data limitations. The study will also explore the role of AI in enhancing decision-making processes for investors, from individual to institutional levels.

The findings will contribute to the growing body of literature on AI in finance and offer practical recommendations for financial professionals looking to implement AI-based portfolio optimization strategies. By advancing the understanding of AI's potential in finance, the research aims to promote more efficient, robust, and profitable investment strategies in the evolving financial landscape.

Key words: AI Systems, Finance, Decision Making, Professionals, Profit making

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Artificial Intelligence (AI) has rapidly transformed the financial industry, providing advanced tools for portfolio management that enable more efficient and data-driven investment strategies. Traditional portfolio optimization techniques, such as the Markowitz Mean-Variance Optimization (MVO), have proven effective but are limited by assumptions of constant returns, normal distributions of asset returns, and static risk preferences. In contrast, AI-driven portfolio optimization leverages machine learning (ML), deep learning (DL), and reinforcement learning (RL) to overcome these limitations, offering more dynamic, flexible, and adaptive approaches to portfolio management. This research aims to explore the potential of AI to optimize investment portfolios, improve risk-adjusted returns, and enable more precise forecasting and decision-making.

Research Activities

The proposed study will focus on the following key research activities:

1. **Literature Review and Theoretical Framework Development:**
   - **Activities:** The first phase of the research will involve a comprehensive review of existing literature on portfolio optimization, both traditional and AI-driven. This will include examining the limitations of classic approaches (e.g., Markowitz MVO) and identifying the strengths of AI techniques, particularly machine learning and reinforcement learning, in portfolio management.
   - **Outcome:** A theoretical framework will be developed to guide the comparison of AI-driven portfolio optimization methods with traditional techniques, considering factors such as risk, return, transaction costs, and adaptability to market dynamics.
2. **Data Collection and Preprocessing:**
   - **Activities:** Data from historical financial markets, including stock prices, bond yields, forex rates, and macroeconomic indicators, will be collected from reliable financial databases. This data will be preprocessed to handle missing values, normalize different variables, and reduce noise to ensure high-quality input for AI models.
   - **Outcome:** A clean, processed dataset will be prepared for training and validating various AI models, ensuring that the models can learn from high-quality data and produce reliable predictions.
3. **Model Development and Testing:**
   - **Activities:** Various AI techniques will be employed to build and optimize portfolio models. This will include:
     - **Machine Learning (ML) Models:** Supervised learning algorithms like Support Vector Machines (SVM), Random Forests, and Gradient Boosting Machines (GBM) will be used to predict asset returns based on historical data.
     - **Deep Learning (DL) Models:** Neural networks, including Long Short-Term Memory (LSTM) networks, will be applied to analyze time-series data and forecast future asset prices and portfolio performance.
     - **Reinforcement Learning (RL) Models:** RL, particularly techniques like Q-learning and Proximal Policy Optimization (PPO), will be used to develop models that can learn optimal portfolio allocation strategies through trial and error, adapting to changing market conditions.
   - **Outcome:** These AI models will be trained to maximize portfolio returns while minimizing risk, and their performance will be compared against traditional portfolio optimization models.

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4. **Risk and Return Analysis:**
   - **Activities:** Analyzing the risk-adjusted returns of AI-driven portfolios will be central to the study. Metrics such as the Sharpe ratio, Sortino ratio, and drawdown will be used to evaluate the performance of AI models in comparison to traditional portfolio optimization strategies. Sensitivity analysis will also be conducted to determine how different factors (e.g., market volatility, transaction costs, and liquidity) affect the performance of AI-driven portfolios.
   - **Outcome:** A clear understanding of the risk-return trade-offs associated with AI-driven portfolio optimization will be developed, providing evidence of their effectiveness compared to classical models.
5. **Model Comparison and Evaluation:**
   - **Activities:** The performance of AI-driven portfolio optimization methods will be compared with traditional techniques (such as the Markowitz model) based on criteria including risk-adjusted returns, adaptability to market conditions, and overfitting. The research will also examine the ability of AI models to dynamically adjust to changing market conditions and their robustness to unforeseen economic events.
   - **Outcome:** The evaluation will provide insights into the strengths and weaknesses of AI-driven portfolio optimization in real-world financial settings, highlighting the conditions under which AI models outperform traditional methods.
6. **Practical Implementation and Recommendations:**
   - **Activities:** Based on the findings from the model development and evaluation phases, practical implementation guidelines will be proposed for investors and portfolio managers. These recommendations will include best practices for adopting AI-driven portfolio optimization, potential challenges to be aware of (e.g., data quality, model overfitting), and strategies for incorporating AI into existing investment strategies.
   - **Outcome:** Practical recommendations will be provided to financial institutions and individual investors on how to leverage AI for more effective portfolio management.

Importance of the Proposed Study

The proposed study is highly significant for several reasons, primarily due to the transformative potential of AI in the realm of finance. The importance of this research can be summarized in the following key areas:

1. **Enhancing Portfolio Management Efficiency:** Traditional portfolio optimization methods rely on historical data and static risk preferences, often failing to capture the complexities of real-time market dynamics. AI-driven optimization offers a more robust alternative by leveraging advanced algorithms that can process vast amounts of data, adapt to changing market conditions, and offer more personalized investment strategies. This research will provide valuable insights into how AI can improve portfolio management by increasing efficiency and precision in asset allocation.
2. **Improving Risk-Adjusted Returns:** A major goal of portfolio management is to balance risk and return. AI techniques, particularly reinforcement learning, can dynamically adjust portfolios to minimize risks while maximizing returns, even in volatile market conditions. By comparing AI methods with traditional approaches, this study will provide evidence of how AI can potentially enhance risk-adjusted returns, offering more profitable investment strategies.
3. **Adapting to Market Changes:** Financial markets are increasingly volatile and unpredictable. AI-driven models, particularly deep learning and reinforcement learning, are capable of learning from data patterns and adjusting portfolio strategies in real-time, thereby improving adaptability to changing market conditions. This research will

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evaluate the effectiveness of AI models in adapting to these fluctuations, which is critical for long-term investment success.

4. **Bridging the Gap Between AI and Traditional Finance:** While AI has been widely adopted in various sectors, its integration into traditional finance, particularly portfolio optimization, is still in its nascent stages. This research will bridge the gap between AI and traditional financial theories, providing a comprehensive comparison of classical and AI-driven optimization techniques. It will help financial professionals better understand the strengths and limitations of both approaches.
5. **Practical Applications for Investors and Financial Institutions:** The findings of this research will have direct implications for both institutional investors and individual investors. By demonstrating the potential of AI to optimize investment portfolios, the study will provide actionable insights into how financial institutions can integrate AI into their portfolio management strategies, creating more efficient and profitable investment solutions.

In summary, the proposed research aims to push the boundaries of traditional portfolio management by integrating AI technologies. The findings will provide a deeper understanding of AI's potential in finance, contributing to the development of advanced, data-driven investment strategies that can outperform traditional methods while managing risk more effectively.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Current research in AI-driven portfolio optimization is rapidly evolving, yet it remains in an exploratory phase. Traditional portfolio optimization models, such as the Markowitz mean-variance optimization, have dominated the field for decades, but they are limited by assumptions of normality in returns and constant risk preferences. AI techniques, including machine learning (ML), deep learning (DL), and reinforcement learning (RL), are emerging as powerful alternatives to address these limitations, offering more dynamic, adaptive, and data-driven approaches.

In the past few years, studies have demonstrated the ability of machine learning models, like support vector machines and random forests, to predict asset returns and improve portfolio allocation. Deep learning techniques, such as Long Short-Term Memory (LSTM) networks, are being employed for time-series forecasting and volatility modeling. Furthermore, reinforcement learning has shown potential in portfolio optimization by continuously adapting asset allocation strategies based on evolving market conditions.

However, despite the promise, challenges remain. Overfitting, data quality, and the complexity of real-world market dynamics are significant hurdles. Moreover, while AI models excel in adapting to historical data, their ability to generalize to unseen market conditions or economic shocks is still debated. Research also lags in providing robust, practical guidelines for integrating AI models into traditional investment strategies. Therefore, while progress is being made, the field requires more interdisciplinary studies, validation, and real-world application to achieve consistent, reliable results in portfolio optimization.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

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- **Develop AI-Driven Portfolio Optimization Models:**
To design and implement AI models, including machine learning (ML), deep learning (DL), and reinforcement learning (RL), for optimizing investment portfolios. These models will aim to enhance asset allocation decisions by predicting returns, managing risk, and adapting to dynamic market conditions.

- **Compare AI-Based Optimization with Traditional Methods:**
To critically compare the performance of AI-driven portfolio optimization techniques with traditional methods, such as the Markowitz Mean-Variance Optimization (MVO) model. The comparison will focus on risk-adjusted returns, adaptability to market fluctuations, and the ability to handle large datasets.

- **Evaluate the Impact of AI on Risk-Return Trade-offs:**
To assess how AI models balance risk and return in portfolio management, aiming to improve risk-adjusted returns. This objective will involve analyzing key performance metrics, such as the Sharpe ratio, Sortino ratio, and drawdowns, to measure the effectiveness of AI-driven portfolios.

- **Investigate the Adaptability of AI Models to Market Dynamics:**
To examine how AI models, particularly reinforcement learning, can adapt to changing market conditions, economic events, and unforeseen shocks. The study will explore whether AI-driven portfolios can dynamically adjust allocations to optimize long-term performance.

- **Analyze Model Robustness and Overfitting Issues:**
To evaluate the robustness of AI models against overfitting and their generalization ability to new, unseen market conditions. The study will test different regularization techniques and validation methods to minimize model risk and ensure reliable performance.

- **Provide Practical Guidelines for AI Integration in Portfolio Management:**
To develop actionable insights and best practices for financial institutions and individual investors seeking to implement AI-driven portfolio optimization. This will include recommendations on model selection, data requirements, and integration with existing investment strategies.

6. Significance of the proposed study: (300 words)

The proposed study on AI-driven portfolio optimization is significant due to its potential to revolutionize investment strategies and enhance portfolio performance. Traditional portfolio optimization methods, such as Markowitz's mean-variance approach, are constrained by assumptions of static risk preferences, normality of returns, and limited adaptability to changing market conditions. As financial markets become more complex and volatile, AI-driven techniques offer a much-needed solution to improve decision-making and optimize asset allocation in real-time.

One of the key contributions of this research is the application of advanced AI techniques—machine learning (ML), deep learning (DL), and reinforcement learning (RL)—to optimize portfolios based on data-driven insights rather than predefined assumptions. These methods can process vast amounts of historical and real-time data, uncover complex patterns, and adapt to evolving market dynamics, leading to more accurate predictions of asset returns and better risk management. By leveraging these technologies, AI-driven models have the potential to deliver

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superior risk-adjusted returns and reduce portfolio volatility.

Furthermore, this study will bridge the gap between traditional finance and modern AI technologies by comparing AI-based optimization techniques with classic models. The research will provide a thorough understanding of the strengths and limitations of both approaches, highlighting how AI can overcome the shortcomings of conventional models in addressing market uncertainty and complexity.

The practical implications of this study are also significant for investors and financial institutions. By developing actionable guidelines for incorporating AI into portfolio management, this research will help them make more informed, data-driven decisions, ultimately enhancing the efficiency and profitability of investment strategies. In a rapidly evolving financial landscape, this study has the potential to drive innovation and promote a more adaptive, resilient, and profitable investment ecosystem.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, one of India's most economically dynamic states, has a rapidly growing financial sector, driven by its vibrant business environment, entrepreneurial spirit, and increasing adoption of technology in finance. The proposed research on AI-driven portfolio optimization is highly relevant to Gujarat, as it can significantly enhance the state's investment strategies and financial innovation.

Gujarat hosts a variety of financial institutions, from traditional banks to emerging fintech startups, which can greatly benefit from AI's ability to optimize portfolios in a rapidly changing market. As the state continues to embrace digital transformation, AI-powered portfolio management systems can help financial institutions and investors make data-driven decisions that improve risk-adjusted returns, ensure better diversification, and address volatility in both domestic and global markets.

Additionally, Gujarat is home to a growing number of retail investors and small businesses that can leverage AI-driven portfolio optimization for more informed investment decisions. The adoption of these advanced techniques will contribute to the state's financial inclusion efforts by enabling more individuals and institutions to access sophisticated investment tools.

By integrating AI into Gujarat's financial ecosystem, this study will foster innovation in portfolio management, help adapt to market fluctuations, and align with global trends in finance. The results could enhance both individual and institutional investments, boosting the state's overall economic growth and stability.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings of this research on AI-driven portfolio optimization are expected to bring significant benefits to the societal and economic landscape of Gujarat. The integration of AI into portfolio management can lead to a more efficient and inclusive financial environment, offering advantages to individuals, businesses, and financial institutions within the state.

1. **Improved Financial Inclusion and Accessibility:**
   By demonstrating how AI can optimize portfolio management, the research will make sophisticated investment strategies more accessible to retail investors and small

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businesses across Gujarat. AI-driven models can empower individuals, particularly from underserved or rural areas, to make data-informed investment decisions, thereby promoting financial inclusion. This can result in better wealth creation opportunities and a more diversified investment portfolio for these individuals, contributing to reducing financial inequalities in the state.

2. **Enhanced Risk Management:**
   AI-driven portfolio optimization models will enable financial institutions and investors in Gujarat to better manage risks, especially in volatile market conditions. By adapting to changing market dynamics, AI can minimize potential losses and enhance portfolio resilience. This will be particularly valuable in times of economic uncertainty or market fluctuations, providing a more stable financial ecosystem for both institutional and individual investors.
3. **Boosting Local Financial Innovation:**
   The research will contribute to the ongoing digital transformation of Gujarat's financial sector, helping local financial institutions adopt cutting-edge AI technologies. This can position Gujarat as a leader in financial innovation, attracting more investments and talent to the region. Fintech startups in the state can implement AI-driven portfolio optimization models to improve their offerings, benefitting from advanced, data-driven decision-making tools.
4. **Economic Growth and Stability:**
   By improving portfolio performance and optimizing asset allocation, the research will ultimately contribute to higher returns on investments. This can stimulate economic growth, as more efficient investment strategies could lead to increased capital flow into Gujarat's economy, benefiting local businesses, infrastructure projects, and overall economic stability. The adoption of AI in finance aligns with global trends, ensuring that Gujarat remains competitive in a rapidly evolving financial landscape.

In sum, the proposed research will enhance the financial decision-making capabilities of investors and institutions in Gujarat, promote financial inclusion, and foster economic stability, growth, and innovation within the state.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐

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6.	Resources management and sustainable development	√
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	√
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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Methodology

The proposed research on AI-driven portfolio optimization will follow a systematic approach that encompasses various stages, from data collection to model evaluation. The methodology will focus on developing, testing, and evaluating AI models for portfolio optimization, comparing these with traditional methods, and analyzing their effectiveness in managing risk-adjusted returns.

Research Activities

1. **Literature Review and Framework Development (Months 1-2)**
   The first step will involve reviewing existing literature on portfolio optimization, AI applications in finance, and traditional models like the Markowitz Mean-Variance Optimization. This will help define the research framework, key variables to be considered (risk, return, asset correlation), and the AI methods most suited for portfolio optimization.
2. **Data Collection and Preprocessing (Months 3-4)**
   Historical financial data for asset prices, returns, macroeconomic indicators, and other relevant financial variables will be collected from reliable sources such as financial databases (e.g., Yahoo Finance, Quandl). The data will be cleaned and preprocessed to handle missing values, remove outliers, and normalize the data. The dataset will include various asset classes, such as equities, bonds, and commodities, to ensure diversity in the portfolio models.
3. **Model Development and Training (Months 5-7)**
   AI models including machine learning (e.g., Random Forest, Support Vector Machines), deep learning (e.g., LSTM networks), and reinforcement learning (e.g., Q-learning) will be developed. These models will be trained on historical data to predict asset returns and optimize portfolio allocations. The training process will involve selecting appropriate hyperparameters and using cross-validation to avoid overfitting.
4. **Model Evaluation and Comparison (Months 8-9)**
   AI-driven models will be tested on out-of-sample data to evaluate their performance in real-world conditions. The performance metrics, such as Sharpe ratio, Sortino ratio, drawdowns, and risk-adjusted returns, will be used to compare AI models with traditional portfolio optimization approaches. A sensitivity analysis will be conducted to assess how sensitive the models are to different market conditions.
5. **Results Analysis and Report Generation (Months 10-12)**
   The final phase will involve a comprehensive analysis of the results, focusing on the advantages and limitations of AI-driven portfolio optimization. Insights will be drawn regarding the adaptability, accuracy, and robustness of AI models in portfolio management. The findings will be compiled into a final report, offering recommendations for real-world applications.

Hypothesis

The primary hypothesis is:
AI-driven portfolio optimization models will outperform traditional methods, such as the Markowitz Mean-Variance Optimization, in terms of risk-adjusted returns, adaptability to market conditions, and robustness to market shocks.

Sampling Plan

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The study will utilize historical data from various financial markets, with a focus on assets from major global indices, including equities, bonds, and commodities. The data sample will cover a period of at least 5-10 years, ensuring diverse market conditions (bull and bear markets, economic shocks, etc.). A stratified sampling approach will be used to ensure that the data includes assets with different risk profiles and market behaviors.

Data Collection and Analysis

Data will be collected from publicly available financial sources like Yahoo Finance, Quandl, and Bloomberg, focusing on daily, weekly, and monthly price data for a wide range of asset classes. The data will be preprocessed and split into training and testing sets for model development. The analysis will involve:

- **Descriptive Statistics:** To summarize and understand the distribution of the data.
- **Correlation Analysis:** To assess the relationships between asset returns.
- **Model Evaluation Metrics:** Including Sharpe ratio, Sortino ratio, and maximum drawdown to evaluate risk-adjusted returns and portfolio performance.
- **Statistical Testing:** To test the hypothesis and compare the effectiveness of AI-based models versus traditional methods.

In conclusion, this methodology will enable a comprehensive evaluation of AI-driven portfolio optimization techniques, assessing their potential to outperform traditional approaches in managing risk and maximizing returns.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The research on AI-driven portfolio optimization will follow a structured plan to ensure thorough analysis and effective outcomes. The suggested plan of action is as follows:

1. **Initial Literature Review and Framework Design (Months 1-2):**
   Begin with an in-depth review of existing research on portfolio optimization, both traditional and AI-based methods. Develop a theoretical framework that identifies key variables, methodologies, and performance metrics to guide the study.
2. **Data Collection and Preprocessing (Months 3-4):**
   Collect historical financial data from reputable sources, including stock prices, returns, and macroeconomic indicators. Preprocess the data to handle missing values, normalize variables, and ensure its quality for machine learning applications.
3. **Model Development and Training (Months 5-7):**
   Develop and implement various AI models, such as machine learning algorithms (e.g., Random Forest, SVM), deep learning models (e.g., LSTM), and reinforcement learning techniques (e.g., Q-learning). Train these models on historical data to predict asset returns and optimize portfolio allocation.
4. **Model Evaluation and Comparison (Months 8-9):**
   Evaluate the performance of AI-driven models using out-of-sample testing, comparing their risk-adjusted returns, adaptability, and robustness against traditional portfolio optimization models.
5. **Results Analysis and Reporting (Months 10-12):**
   Analyze the results, draw conclusions on the effectiveness of AI-driven portfolio optimization, and generate actionable insights and recommendations. Compile findings

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into a final research report.

This plan of action ensures a systematic approach to investigating AI's potential in portfolio optimization.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Data Collection and Cleaning	April – May	2021	May	2021
2.	Model Development (Scoring & NLP)	June to August	2021	August	2021
3.	Integration of Alternative Data	September	2021	September	2021
4.	Backtesting and Validation	Oct & Nov	2021	November	2021
5.	Final Toolkit and Report Development	December	2021	December	2021

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			130,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			50,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3000
4.	Stationery and Printing (With justification)			50,000
5.	Any other special requirement			117,000

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6.	Overhead (10% of recurring)			50,000
	TOTAL			**400,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
	b)			
	c)			
2.	**B. Glassware**			
	a)			
	b)			
	c)			
3.	**C. Any other consumable items (like wires/ electric items etc)**	130,000		
	a)			
	b)			
4.	**Travel**	50000		
	a) Purpose 1			
	b) Purpose 2			
5.	**Contingency**	3000		
6.	**Stationery and printing**	50000		
	a) Purpose 1			
	b) Purpose 2			
7.	**Any other special requirement**	117000		
8.	**Overhead**	50000		
	Grand Total	**400,000**		

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Timeline of Usage of Funds (May - March)

1. **May-June**:
   - Initial setup and procurement of chemicals, glassware, and consumables.
   - Begin sample collection and lab work for ESG data analysis.
   - Initiate travel for field visits and data collection in Gujarat.
2. **June-August**:
   - Continued procurement of consumables and supplies for experimental and data analysis stages.
   - Travel for meetings and further data collection from industry stakeholders.
   - Ongoing analysis and testing of ESG-related data with AI models.
3. **September-October**:
   - Further development of AI models and refinement of data collection techniques.
   - Continued procurement of hardware and software for AI analysis.
   - Travel to meet with investors, present findings, and adjust research scope based on feedback.
4. **November-March**:
   - Completion of final research analysis and preparation of reports.
   - Printing and binding of research reports and papers.
   - Final meetings and travel to share findings with stakeholders, partners, and the academic community.

Justification for the Budget:

- **Consumables** (chemicals, glassware, etc.): These are essential for conducting experiments, calibrating systems, and analyzing ESG data, ensuring the integrity and accuracy of the study.
- **Travel**: The research necessitates field visits to collect primary ESG data, engage with local stakeholders, and facilitate collaboration with investors, which directly informs the study's application in Gujarat.
- **Contingency**: A small fund is set aside for any unplanned costs that may arise, ensuring that the research can proceed without financial disruptions.
- **Stationery and Printing**: These costs are crucial for documentation, presenting findings, and disseminating results to stakeholders and the academic community.

This budget ensures the smooth execution of the research project while maintaining transparency and accountability for the allocation of funds.

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	AI Ethics and Fairness in Finance	
2.	**Broad area of proposal**	Artificial Intelligence	
3.	**Sub Area of proposal**	Management	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Kairvi Rathod	Assistant Professor, Department of Management, FoBC	kairvi.rathod@atmiyauni.ac.in 8866743771
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**	25/05/1993	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	25/01/2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	NA	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Management	Saurashtra University	2020	-
ii.	Post Graduation	MBA	GTU	2015	80%
iii.	Under Graduation	BBA	Saurashtra University	2013	76%
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	√ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (6 Years + 6 Months)
		Research Experience: (2 Years + 6 Months)
7.	No. of Publication (Research articles -	National: 3

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	UGC Approved only)	International:6
8.	No. of Publication (Book Chapters)	
	Books Published	
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

AI Ethics and Fairness in Finance

2. Abstract (Provide a summary of your research proposal in 300 words)

The integration of Artificial Intelligence (AI) in finance is transforming decision-making processes, enhancing efficiency, and enabling predictive analytics. However, the rapid adoption of AI systems also raises critical ethical concerns, particularly regarding fairness, bias, and accountability. This research proposal aims to explore the ethical dimensions of AI in finance, with a focus on ensuring fairness in algorithmic decision-making.

Key objectives include identifying potential biases in AI models used for financial applications such as credit scoring, fraud detection, and investment strategies, and examining their impacts on marginalized communities. The research will evaluate existing frameworks for fairness and accountability in AI, analyzing their applicability and effectiveness in financial contexts. Furthermore, it will investigate the trade-offs between algorithmic accuracy, transparency, and fairness, providing recommendations for balancing these factors.

Methodologically, the study will employ a mixed approach, combining quantitative analyses of AI model outputs with qualitative assessments of stakeholder perspectives, including regulators, financial institutions, and affected individuals. Case studies will be used to illustrate real-world implications of biased AI systems, highlighting lessons learned and best practices.

The findings will contribute to the growing discourse on ethical AI by proposing a set of actionable guidelines for designing and implementing fair, transparent, and accountable AI systems in finance. These guidelines aim to support policymakers and financial organizations in minimizing unintended harm while promoting trust and inclusivity. By addressing the ethical challenges of AI in finance, this research seeks to bridge the gap between technological innovation and societal responsibility, ensuring that AI benefits are equitably distributed across diverse populations.

Key words: AI Systems, Ethics, Fairness, Finance, Decision Making.

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3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The growing integration of Artificial Intelligence (AI) in the financial sector is reshaping the way financial services are delivered, decisions are made, and risks are managed. AI-powered applications, including credit scoring, fraud detection, algorithmic trading, and customer personalization, have demonstrated remarkable potential to enhance efficiency, reduce costs, and unlock new opportunities in finance. However, the deployment of AI in finance also raises critical ethical concerns, particularly in relation to fairness, bias, transparency, and accountability.

Financial decisions, when influenced by biased algorithms, can have profound consequences, potentially perpetuating systemic inequalities and disproportionately affecting marginalized communities. Discrimination in credit access, lending rates, or insurance pricing, for example, can undermine trust in financial institutions and exacerbate social disparities. At the heart of these challenges lies the question of how to ensure fairness in AI systems while maintaining their operational efficiency and predictive capabilities.

This study seeks to address these pressing concerns by examining the ethical dimensions of AI in finance. By focusing on fairness in algorithmic decision-making, the research aims to identify biases in existing AI models, evaluate their societal implications, and propose actionable frameworks to mitigate these risks. The ultimate goal is to ensure that AI technologies in finance are designed ` in a way that promotes equity, transparency, and accountability, fostering trust and inclusivity in the financial ecosystem.

To achieve the objectives of the proposed study, the following research activities will be pursued:

1. **Identification and Analysis of Bias in Financial AI Models:**
   - Conduct a comprehensive review of commonly used AI models in finance, such as credit scoring algorithms, fraud detection systems, and investment recommendation engines.
   - Analyze datasets used in these models to identify potential sources of bias, including historical inequalities, data imbalances, and algorithmic design choices.
   - Evaluate the impact of these biases on different demographic groups, with a particular focus on underserved and marginalized populations.
2. **Evaluation of Fairness Metrics and Frameworks:**
   - Investigate existing fairness metrics and frameworks in AI, such as equal opportunity, demographic parity, and individual fairness, to assess their applicability in financial contexts.
   - Develop criteria to measure fairness in financial AI systems and evaluate the trade-offs between fairness, accuracy, and operational efficiency.
3. **Development of Mitigation Strategies:**
   - Explore and test techniques for bias mitigation, including pre-processing, in-processing, and post-processing methods.
   - Propose best practices for designing fair and transparent AI models, including guidelines for data collection, feature selection, and algorithmic auditing.
4. **Stakeholder Engagement and Policy Recommendations:**
   - Conduct interviews and focus groups with key stakeholders, including regulators, financial institutions, and affected individuals, to gather insights on the challenges and expectations related to ethical AI deployment in finance.

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- Develop actionable policy recommendations to guide the ethical use of AI in financial decision-making.

5. **Case Studies and Real-World Applications:**
   - Analyze real-world cases where biased AI systems have led to ethical dilemmas or adverse outcomes in finance.
   - Document lessons learned and highlight successful examples of fair AI implementation.

Importance of the Proposed Study

The proposed study holds significant importance for multiple reasons, spanning both societal and technological dimensions:

1. **Addressing Systemic Inequalities:**
   Financial systems play a pivotal role in economic mobility and social equity. Biased AI systems can inadvertently reinforce existing inequalities, leading to unfair practices such as discriminatory lending or pricing. By identifying and mitigating these biases, the study aims to promote equitable access to financial services for all individuals, regardless of their demographic background.
2. **Enhancing Trust in Financial Institutions:**
   Trust is a cornerstone of the financial industry. Unethical AI practices can erode public confidence, resulting in reputational damage and regulatory backlash for financial institutions. By fostering ethical AI practices, the study seeks to enhance trust between financial institutions and their customers, regulators, and the broader society.
3. **Balancing Innovation and Responsibility:**
   AI-driven innovation in finance has the potential to unlock significant economic value. However, this value must not come at the expense of fairness and accountability. The study's focus on balancing technological innovation with ethical responsibility will help financial institutions leverage AI's benefits while minimizing unintended harm.
4. **Guiding Policy and Regulation:**
   Policymakers and regulators face significant challenges in keeping pace with the rapid evolution of AI technologies. This study will provide evidence-based insights and recommendations to guide the development of ethical standards and regulatory frameworks for AI in finance, ensuring that legal and ethical considerations are adequately addressed.
5. **Advancing the Field of Ethical AI:**
   The findings of this research will contribute to the broader field of ethical AI by extending existing frameworks and proposing novel approaches tailored to the unique challenges of the financial sector. This will enrich the academic discourse and provide valuable insights for practitioners and researchers alike.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The field of AI ethics and fairness in finance is gaining significant attention as the adoption of AI in financial decision-making continues to expand. Current research highlights critical issues such as algorithmic bias, lack of transparency, and the societal implications of automated financial systems. Studies have shown that biases embedded in historical data and model design can lead to discriminatory outcomes in areas like credit scoring, loan approvals, and insurance pricing.

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Research on fairness metrics, such as demographic parity and equal opportunity, has provided useful frameworks for evaluating bias in AI systems. However, these metrics often involve trade-offs with model accuracy and operational efficiency, making their practical application in finance challenging. Efforts to develop bias mitigation techniques, including pre-processing and algorithmic adjustments, are promising but require further refinement and validation in diverse financial contexts.

Despite advancements, gaps remain in the integration of ethical principles into AI lifecycle processes. Current regulatory frameworks are fragmented and struggle to keep pace with technological innovation. Stakeholder engagement, particularly with underrepresented communities, is also limited. Overall, while progress has been made in understanding and addressing bias in financial AI systems, more interdisciplinary and application-specific research is needed to develop robust, actionable solutions that align with ethical and regulatory expectations.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

- **Identify Bias in AI Financial Systems:**
To analyze and detect biases in existing AI algorithms used in financial applications, such as credit scoring, fraud detection, and investment strategies, and to understand their impact on different demographic groups.

- **Evaluate Fairness Metrics and Ethical Frameworks:**
To assess the effectiveness and applicability of existing fairness metrics, such as demographic parity and equal opportunity, in financial contexts and propose criteria tailored for ethical financial AI.

- **Develop Bias Mitigation Strategies:**
To design and test methods for reducing bias in AI financial systems, including pre-processing, in-processing, and post-processing techniques, while maintaining the operational efficiency of the models.

- **Enhance Transparency and Accountability:**
To propose mechanisms for improving the interpretability of AI algorithms in finance, ensuring stakeholders understand decision-making processes, and fostering accountability.

- **Engage Stakeholders for Inclusive Insights:**
To collaborate with regulators, financial institutions, technologists, and impacted communities to gather diverse perspectives and refine ethical guidelines for AI deployment in finance.

- **Propose Policy and Regulatory Recommendations:**
To develop actionable policies and frameworks that guide the ethical use of AI in finance, addressing issues of fairness, transparency, and compliance with societal and legal standards.

6. Significance of the proposed study: (300 words)

The proposed study on AI ethics and fairness in finance is critically significant due to the increasing reliance on AI-driven systems in financial decision-making. Financial institutions are using AI for applications such as credit scoring, fraud detection, risk assessment, and personalized financial services. While these technologies offer efficiency and innovation, they

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also raise ethical concerns, particularly regarding fairness, bias, and accountability.

One of the key contributions of this study is its focus on identifying and addressing biases in financial AI systems. Biased algorithms can perpetuate systemic inequalities by disproportionately disadvantaging certain demographic groups, such as women, minorities, and low-income individuals. By uncovering these biases and developing methods to mitigate them, the study aims to promote equity and inclusivity in financial services.

This research is also significant in enhancing transparency and accountability in AI systems. Lack of interpretability in AI decision-making processes erodes trust between financial institutions and their customers. By proposing mechanisms to improve transparency, the study will help build public confidence in AI-driven financial systems.

Additionally, the study will provide actionable policy and regulatory recommendations to guide ethical AI deployment. Policymakers and regulators currently face challenges in keeping pace with technological advancements in AI. This research will bridge the gap between innovation and societal responsibility by offering evidence-based guidelines.

Finally, the findings of this study will contribute to global financial inclusion by ensuring that AI technologies are designed to benefit all users equitably. By addressing the ethical challenges of AI in finance, this research aligns with broader efforts to create a fairer, more inclusive financial ecosystem while safeguarding the principles of justice and equity.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on AI ethics and fairness in finance is highly relevant to Gujarat, a rapidly growing economic hub in India with a vibrant financial and industrial ecosystem. Gujarat's financial institutions, microfinance organizations, and fintech startups are increasingly adopting AI-driven solutions to enhance decision-making, streamline operations, and improve customer experiences. However, the ethical challenges associated with AI, such as bias and lack of transparency, have the potential to affect diverse communities across the state.

Gujarat's population includes a mix of urban and rural demographics, with significant representation from marginalized and economically weaker sections. Biased AI systems in financial services, such as discriminatory credit scoring or loan approvals, could disproportionately disadvantage these groups, exacerbating existing economic inequalities. Addressing these biases is crucial to ensuring equitable access to financial services in the state.

Moreover, Gujarat's emerging fintech sector can benefit from the proposed study by adopting ethical AI practices that foster trust and inclusivity. The study's findings will also support policymakers and regulators in Gujarat in developing localized guidelines for fair AI deployment.

By promoting ethical AI systems, this research aligns with Gujarat's broader vision of inclusive economic growth, ensuring that technological advancements in finance benefit all sections of society equitably.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings of the proposed research on AI ethics and fairness in finance are expected to

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deliver significant societal benefits, particularly for Gujarat, a state with a diverse population and a growing financial ecosystem.

1. **Promoting Equitable Access to Financial Services:**
   By identifying and addressing biases in AI systems, the research will help financial institutions in Gujarat design fair and inclusive financial services. This is particularly crucial for rural and underprivileged communities, ensuring equitable access to credit, insurance, and investment opportunities without discrimination based on gender, caste, or socio-economic background.
2. **Enhancing Trust in Financial Systems:**
   Transparent and fair AI systems will foster public confidence in financial institutions across Gujarat. Trust is a key driver for the adoption of digital financial services, especially among traditionally underserved populations such as small-scale farmers, artisans, and entrepreneurs.
3. **Empowering Gujarat's Fintech Sector:**
   Gujarat's growing fintech ecosystem will benefit from actionable insights and ethical frameworks proposed by the research. By adopting ethical AI practices, fintech startups and financial institutions in the state can enhance their competitiveness, attract investments, and align with global standards of responsible innovation.
4. **Strengthening Regulatory Frameworks:**
   The study will provide evidence-based recommendations to policymakers and regulators in Gujarat to develop localized guidelines for AI use in finance. This will help create a regulatory environment that balances innovation with ethical responsibility, ensuring that AI technologies serve societal needs.
5. **Advancing Financial Inclusion and Economic Growth:**
   Ethical and fair AI systems will contribute to broader financial inclusion in Gujarat, empowering marginalized groups and fostering economic growth at the grassroots level. This aligns with Gujarat's vision for inclusive development, leveraging technology to create a fair and prosperous financial ecosystem for all.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐

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6.	Resources management and sustainable development	√
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	√
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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Methodology

The methodology for the proposed research on AI ethics and fairness in finance will adopt a mixed-methods approach, combining both quantitative and qualitative research techniques. This approach allows for a comprehensive evaluation of AI systems used in finance, focusing on bias detection, fairness evaluation, and the development of ethical guidelines.

Research Activities

1. **Identification and Analysis of Bias in AI Models:**
   - **Activities:** Conduct an in-depth review of financial AI systems, including credit scoring, lending algorithms, fraud detection models, and investment strategies. Evaluate the underlying data used to train these models for potential biases—whether it's historical data that perpetuates inequalities or features that inadvertently favor certain demographic groups.
   - **Hypothesis:** Financial AI systems are likely to exhibit biases based on race, gender, and socio-economic status, leading to discriminatory outcomes in credit access and loan approval.
2. **Evaluation of Fairness Metrics:**
   - **Activities:** Examine existing fairness metrics (e.g., demographic parity, equal opportunity) and assess their applicability in the financial sector. This will involve a comparative analysis of multiple fairness frameworks to propose the most relevant ones for financial decision-making.
   - **Hypothesis:** Traditional fairness metrics may not fully capture the complexities of financial systems and may need to be adapted to ensure equity in financial outcomes.
3. **Development of Bias Mitigation Strategies:**
   - **Activities:** Test existing bias mitigation techniques (e.g., re-weighting, adversarial debiasing) in financial models and suggest improvements based on findings.
   - **Hypothesis:** Bias mitigation methods that adjust data processing, model training, or post-modeling interventions can significantly reduce discriminatory outcomes without sacrificing predictive accuracy.
4. **Stakeholder Engagement and Policy Recommendations:**
   - **Activities:** Conduct interviews and focus groups with stakeholders, including financial institutions, regulators, AI developers, and marginalized communities, to understand their concerns about AI fairness and gather insights on potential solutions.
   - **Hypothesis:** Stakeholders will emphasize the need for transparent, accountable AI systems to ensure trust and fairness in financial decision-making.

Sampling Plan

- **Target Population:** The study will focus on financial institutions and fintech companies in Gujarat, involving a cross-section of urban and rural regions to assess the diversity of financial AI applications.
- **Sample Selection:** A purposive sampling technique will be used to select financial institutions, fintech startups, and regulatory bodies that are actively using AI in their processes. Additionally, marginalized communities (e.g., rural populations, low-income groups) will be included in the stakeholder interviews.

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Data Collection

- **Quantitative Data:** The primary data will be collected from financial models used in credit scoring, lending, fraud detection, and investment strategies. This will involve obtaining the datasets used to train these models and evaluating the outputs for potential biases.
- **Qualitative Data:** Interviews and focus groups will be conducted with key stakeholders, including financial professionals, AI developers, regulators, and individuals from marginalized groups. These sessions will provide insights into public perceptions and ethical concerns related to AI in finance.

Data Analysis

- **Quantitative Analysis:** Statistical methods such as regression analysis, fairness metrics (e.g., demographic parity, equal opportunity), and bias detection algorithms will be employed to analyze the financial models' outputs and identify biases.
- **Qualitative Analysis:** Thematic analysis will be applied to the interview and focus group transcripts to identify recurring concerns, ethical dilemmas, and suggestions for policy improvements. NVivo or similar software tools will be used for coding and categorizing qualitative data.

Expected Outcomes

The research will produce a comprehensive understanding of the biases inherent in financial AI models, evaluate fairness metrics, and propose actionable strategies for mitigating these biases. The findings will inform the development of ethical AI guidelines, benefiting both financial institutions and regulatory bodies in Gujarat, fostering a more inclusive and transparent financial ecosystem.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The proposed research will follow a structured plan of action to address the ethical challenges and fairness issues in AI applications within finance:

1. **Phase 1: Literature Review and Framework Development (Months 1-2)**
   - Conduct a thorough review of existing literature on AI fairness, bias detection, and ethical frameworks within the financial sector.
   - Develop a conceptual framework for evaluating fairness in financial AI systems, incorporating relevant fairness metrics and ethical principles.
2. **Phase 2: Data Collection and Stakeholder Engagement (Months 3-6)**
   - Collect quantitative data from financial institutions, focusing on AI systems used for credit scoring, lending, fraud detection, and investment.
   - Conduct qualitative interviews and focus groups with stakeholders, including financial professionals, AI developers, regulators, and marginalized communities.
3. **Phase 3: Data Analysis and Bias Detection (Months 7-9)**
   - Perform statistical analysis and fairness assessments on AI models to identify potential biases in decision-making processes.
   - Test existing bias mitigation techniques and propose improvements based on the findings.
4. **Phase 4: Policy and Ethical Guidelines Development (Months 10-12)**

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- Synthesize findings from data analysis and stakeholder engagement to develop actionable policy recommendations and ethical AI guidelines tailored for the financial sector.
- Present the findings in a final report, offering insights into best practices for fair AI deployment in finance.

The plan ensures comprehensive data collection, stakeholder involvement, and practical outcomes to address AI fairness and ethics in finance.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Data Collection and Cleaning	April – May	2021	May	2021
2.	Model Development (Scoring & NLP)	June to August	2021	August	2021
3.	Integration of Alternative Data	September	2021	September	2021
4.	Backtesting and Validation	Oct & Nov	2021	November	2021
5.	Final Toolkit and Report Development	December	2021	December	2021

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			150,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			50,000
3.	Contingency (Upto maximum for Rs. 3000/-)			3000

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4.	Stationery and Printing (With justification)			50,000
5.	Any other special requirement			97,000
6.	Overhead (10% of recurring)			50,000
	TOTAL			**400,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
	b)			
	c)			
2.	**B. Glassware**			
	a)			
	b)			
	c)			
3.	**C. Any other consumable items (like wires/ electric items etc)**	150,000		
	a)			
	b)			
4.	**Travel**	50000		
	a) Purpose 1			
	b) Purpose 2			
5.	**Contingency**	3000		
6.	**Stationery and printing**	50000		
	a) Purpose 1			
	b) Purpose 2			
7.	**Any other special requirement**	97000		

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8.	**Overhead**	50000		
	Grand Total	**400,000**		

Timeline of Usage of Funds (May - March)

1. **May-June**:
   - Initial setup and procurement of chemicals, glassware, and consumables.
   - Begin sample collection and lab work for ESG data analysis.
   - Initiate travel for field visits and data collection in Gujarat.
2. **June-August**:
   - Continued procurement of consumables and supplies for experimental and data analysis stages.
   - Travel for meetings and further data collection from industry stakeholders.
   - Ongoing analysis and testing of ESG-related data with AI models.
3. **September-October**:
   - Further development of AI models and refinement of data collection techniques.
   - Continued procurement of hardware and software for AI analysis.
   - Travel to meet with investors, present findings, and adjust research scope based on feedback.
4. **November-March**:
   - Completion of final research analysis and preparation of reports.
   - Printing and binding of research reports and papers.
   - Final meetings and travel to share findings with stakeholders, partners, and the academic community.

Justification for the Budget:

- **Consumables** (chemicals, glassware, etc.): These are essential for conducting experiments, calibrating systems, and analyzing ESG data, ensuring the integrity and accuracy of the study.
- **Travel**: The research necessitates field visits to collect primary ESG data, engage with local stakeholders, and facilitate collaboration with investors, which directly informs the study's application in Gujarat.
- **Contingency**: A small fund is set aside for any unplanned costs that may arise, ensuring that the research can proceed without financial disruptions.
- **Stationery and Printing**: These costs are crucial for documentation, presenting findings, and disseminating results to stakeholders and the academic community.

This budget ensures the smooth execution of the research project while maintaining transparency and accountability for the allocation of funds.

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Aspect Based Sentiment Analysis of Product Review	
2.	**Broad area of proposal**	Engineering	
3.	**Sub Area of proposal**	Data Mining	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Kajal VishalbhaiParadava	Lecturer(Computer Engineering)	Kajal.paradava@atmiyauni.ac.in 8849983117
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	07/05/1992	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	19/07/2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**		

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.				
ii.	Post Graduation				
iii.	Under Graduation	Computer	GTU	2013	71.80%
iv.	CSIR/UGG-NET/ SLET/GATE				

2.	Have you previously received any Fellowship from any funding agency?	☐YES	✓NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)

6.	Total Experience	Teaching Experience: (Year + Months)
		Research Experience: (10 Months)
7.	No. of Publication (Research articles - UGC Approved only)	National:
		International:
8.	No. of Publication (Book Chapters)	

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	Books Published	
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Aspect Based Sentiment Analysis of Product Review.

2. Abstract (Provide a summary of your research proposal in 300 words)

The increasing reliance on e-commerce has led to an explosion of product reviews, making it crucial to analyze user feedback effectively. Aspect-Based Sentiment Analysis (ABSA) has emerged as a specialized approach to sentiment analysis that identifies and evaluates sentiments tied to specific aspects of products. This study focuses on applying ABSA to beauty product reviews sourced from the Female Daily website. The proposed methodology leverages Word2Vec for word embedding and Support Vector Machine (SVM) for sentiment classification.

Word2Vec, a popular word embedding technique, captures semantic relationships between words, enabling the model to understand context effectively. The Support Vector Machine (SVM), a robust machine learning algorithm, is utilized for its capability to classify sentiments with high accuracy even in limited training data scenarios. The process begins with data preprocessing to remove noise and standardize the text. Aspect term extraction is performed using linguistic patterns and rule-based approaches, followed by sentiment polarity classification for each identified aspect.

Our research highlights the importance of addressing challenges such as handling imbalanced datasets, understanding domain-specific jargon, and dealing with contextual dependencies in reviews. The experimental results demonstrate that the Word2Vec-SVM combination achieves commendable accuracy in detecting sentiment for key product aspects, outperforming several baseline models.

This paper contributes to the growing field of ABSA by presenting an effective framework tailored for beauty product reviews, providing actionable insights for consumers and businesses. Future work aims to integrate advanced deep learning models and address multi-language reviews for broader applicability.

Keywords: Aspect-Based Sentiment Analysis, Word2Vec, Support Vector Machine, Sentiment Polarity, Product Reviews, Beauty Industry.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The rapid growth of e-commerce and digital platforms has transformed consumer behavior, making online reviews an integral part of the decision-making process. In this context, Aspect-Based Sentiment

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Analysis (ABSA) has gained prominence as a fine-grained method of extracting actionable insights from reviews. Unlike traditional sentiment analysis, which provides an overall sentiment polarity for a given text, ABSA identifies sentiments associated with specific attributes or "aspects" of a product or service. This capability is especially critical in industries like beauty and cosmetics, where customer preferences are highly nuanced, and feedback often focuses on distinct product attributes such as packaging, texture, and efficacy.

Specific Research Activities

The proposed study aims to conduct Aspect-Based Sentiment Analysis on beauty product reviews from the Female Daily website. To achieve this, the project will involve the following key research activities:

Data Collection and Preprocessing

Gathering a comprehensive dataset of beauty product reviews from the Female Daily website.

Performing preprocessing tasks, including removing noise (e.g., emojis, special characters), handling misspellings, and standardizing text formats.

Tokenization and stop-word removal to ensure a cleaner and more efficient analysis process.

Aspect Term Extraction

Using linguistic patterns, dependency parsing, and rule-based approaches to identify aspect terms in the reviews.

Comparing various extraction techniques to evaluate their effectiveness in capturing domain-specific aspects.

Sentiment Polarity Detection

Employing Word2Vec embeddings to represent the semantic and contextual relationships between words in the dataset.

Training a Support Vector Machine (SVM) classifier to categorize sentiments (positive, negative, neutral) for each identified aspect.

Model Optimization and Evaluation

Fine-tuning Word2Vec parameters and SVM hyperparameters to achieve optimal performance.

Evaluating the model's performance using metrics such as precision, recall, F1-score, and accuracy.

Analysis and Interpretation

Conducting a detailed analysis of the results to identify patterns in customer preferences.

Generating insights that can guide beauty brands in product improvement and customer engagement strategies.

Importance of the Proposed Study

Advancing Sentiment Analysis Research

The proposed study contributes to the field of Natural Language Processing (NLP) by focusing on aspect-specific sentiment analysis. Existing research often emphasizes overall sentiment classification, which provides limited insights. ABSA, however, bridges this gap by delivering a granular understanding of sentiments tied to specific product attributes. This study applies ABSA in the context of beauty product reviews, a domain that remains underexplored despite its economic and social significance.

Addressing Domain-Specific Challenges

Beauty product reviews often contain unique language characteristics, including jargon, abbreviations, and highly subjective expressions. For example, terms like "hydrating," "matte finish," or "long-lasting" carry domain-specific meanings that require specialized analysis techniques. The proposed study

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addresses these challenges by leveraging Word2Vec embeddings to capture semantic nuances and SVM classifiers to handle imbalanced datasets effectively.

Practical Applications for Businesses

From a business perspective, understanding customer feedback at a granular level is critical for competitive advantage. ABSA allows companies to pinpoint strengths and weaknesses in their products based on consumer sentiment. For example, a brand might discover that customers appreciate the packaging of a product but are dissatisfied with its effectiveness. Such insights enable businesses to make informed decisions about product development, marketing, and customer service.

Improving Consumer Experience

The study also has implications for enhancing consumer experiences. By extracting detailed feedback, platforms like Female Daily can improve their recommendation systems, ensuring that users receive product suggestions aligned with their preferences. Furthermore, ABSA can empower consumers to make more informed choices by highlighting reviews that address specific concerns or aspects.

Technical Contributions

The combination of Word2Vec embeddings and SVM classifiers represents a robust yet computationally efficient approach to ABSA. Word2Vec captures the contextual relationships between words, enabling better understanding of domain-specific language, while SVM provides a strong baseline for sentiment classification. The study's methodology and results can serve as a foundation for future research in applying advanced machine learning techniques to ABSA, such as transformer-based models (e.g., BERT) and unsupervised learning approaches.

Broader Impacts

While the study focuses on beauty product reviews, its findings and methodologies are transferable to other domains such as electronics, fashion, and hospitality. This versatility underscores the broader relevance of ABSA in driving consumer insights and fostering innovation across industries.

Conclusion

The proposed study on Aspect-Based Sentiment Analysis of beauty product reviews aims to address critical gaps in sentiment analysis research and offer practical value to businesses and consumers alike. By employing a systematic approach that combines state-of-the-art techniques in NLP and machine learning, the study seeks to deliver actionable insights into customer sentiments at an unprecedented level of granularity. This research not only enhances our understanding of consumer behavior in the beauty industry but also lays the groundwork for further advancements in ABSA across various fields.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Aspect-Based Sentiment Analysis (ABSA) has garnered significant attention in recent years due to its ability to provide detailed insights into customer opinions. Current research primarily focuses on developing robust methods for aspect extraction and sentiment classification. Traditional approaches rely on rule-based and statistical methods, which, while interpretable, often struggle with domain-specific complexities and scalability. Machine learning models, particularly Support Vector Machines (SVM) and logistic regression, have proven effective in sentiment classification but are limited in capturing the contextual relationships between words.

Recent advancements in Natural Language Processing (NLP) have introduced neural network-based techniques such as Word2Vec, GloVe, and transformer models like BERT, which excel at understanding semantic and syntactic nuances. Despite these advancements, challenges remain in handling imbalanced datasets, ambiguous language, and domain-specific terminologies, especially in sectors like

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beauty and cosmetics.

Few studies have applied ABSA to beauty product reviews, leaving a gap in exploring customer feedback in this domain. Moreover, existing research often overlooks integrating fine-grained sentiment analysis into practical applications for businesses. This highlights the need for a framework that not only addresses technical challenges but also delivers actionable insights. The proposed study aims to fill this gap by leveraging Word2Vec and SVM to analyze beauty product reviews comprehensively.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. Develop a Robust Framework for Aspect-Based Sentiment Analysis (ABSA)

Design and implement a systematic approach to identify and classify sentiments associated with specific product aspects in beauty product reviews.

2. Utilize Advanced Natural Language Processing (NLP) Techniques:

Leverage Word2Vec embeddings to capture semantic relationships and contextual nuances in the text, ensuring accurate interpretation of domain-specific language.

3. Optimize Sentiment Classification Using Machine Learning Models:

Employ Support Vector Machine (SVM) for sentiment polarity detection and fine-tune its hyperparameters to enhance classification accuracy.

4. Address Domain-Specific Challenges in Sentiment Analysis

Tackle issues like imbalanced datasets, domain-specific terminologies, and contextual dependencies prevalent in beauty product reviews.

5. Evaluate the Effectiveness of the Proposed Framework:

Assess the performance of the ABSA model using standard metrics such as precision, recall, F1-score, and accuracy, and compare it against baseline methods.

6. Significance of the proposed study: (300 words)

The proposed study on Aspect-Based Sentiment Analysis (ABSA) of beauty product reviews addresses a critical need in understanding consumer preferences at a granular level. As e-commerce platforms grow, customer reviews have become a vital resource for evaluating products, making it essential to analyze feedback effectively. This research is significant in multiple ways:

Enhancing Consumer Insights:
By identifying and classifying sentiments associated with specific product aspects, this study provides detailed insights into what consumers value. For instance, in the beauty industry, aspects like product texture, packaging, and skin compatibility are crucial. Understanding consumer sentiments toward these aspects enables brands to align their offerings with market demands.

Advancing Natural Language Processing (NLP):
The study contributes to the NLP domain by applying Word2Vec embeddings and Support Vector Machine (SVM) to the less-explored field of beauty product reviews. It addresses domain-specific challenges like handling jargon, ambiguous sentiments, and imbalanced data, paving the way for more specialized applications of ABSA.

Practical Applications for Businesses:
The insights derived from this study can inform product development, marketing strategies, and customer service improvements. For example, brands can identify features that resonate positively with consumers or areas requiring enhancement, thereby gaining a competitive edge.

Empowering Consumers:

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ABSA helps consumers make informed purchasing decisions by highlighting sentiments tied to specific product attributes. This fosters transparency and trust between brands and their customers.

Laying the Foundation for Future Research:
This study serves as a stepping stone for exploring advanced techniques like transformer-based models (e.g., BERT) and expanding ABSA to other industries. Its methodologies and findings are scalable, offering value beyond the beauty sector.

In summary, the proposed study is a valuable contribution to both academia and industry, driving innovation and delivering actionable insights in sentiment analysis.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study on Aspect-Based Sentiment Analysis (ABSA) of beauty product reviews holds significant relevance for Gujarat, a state known for its thriving entrepreneurial ecosystem and growing prominence in the beauty and cosmetics industry. Gujarat is home to a robust manufacturing sector, including pharmaceuticals and personal care products, and has witnessed a surge in small and medium enterprises (SMEs) focusing on beauty and wellness.

With increasing internet penetration and e-commerce adoption in Gujarat, online platforms have become key channels for consumers to share and seek product reviews. By applying ABSA, this study provides an opportunity for local beauty brands to gain valuable insights into customer preferences. Understanding specific sentiments related to product attributes, such as packaging, quality, and skin compatibility, can help Gujarat-based companies refine their offerings and enhance customer satisfaction.

Furthermore, the study aligns with Gujarat's vision of fostering innovation and leveraging technology for business growth. It introduces advanced Natural Language Processing (NLP) techniques that local startups and SMEs can adopt to better analyze customer feedback.

The insights generated from this research can also benefit Gujarat's growing e-commerce platforms and marketplaces, empowering them to improve recommendation systems and create tailored marketing strategies. This relevance underscores the potential of ABSA in driving consumer-centric growth in Gujarat's beauty and cosmetics industry.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

Empowering Local Businesses:
Gujarat is a hub for small and medium enterprises (SMEs) in the beauty and cosmetics sector. The insights derived from this study can help these businesses better understand consumer preferences, enabling them to enhance product quality and align offerings with market demand. By addressing specific consumer concerns, local companies can build stronger brand loyalty and expand their customer base.

Boosting E-commerce Growth:
As online shopping becomes more prevalent in Gujarat, platforms hosting product reviews can utilize the study's findings to refine their recommendation systems and personalize the consumer experience. This, in turn, drives consumer trust and accelerates the growth of e-commerce in the state.

Enhancing Consumer Awareness:
Consumers in Gujarat can benefit from more transparent and accessible information about products. By identifying sentiments tied to specific aspects, the research helps consumers make informed decisions, ultimately leading to greater satisfaction and reduced instances of buyer's remorse.

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Promoting Technological Advancement:
The project encourages the adoption of advanced technologies like Natural Language Processing (NLP) and machine learning among businesses in Gujarat. This aligns with the state's focus on fostering innovation and digital transformation, contributing to economic development.

Driving Employment and Skill Development:
By highlighting the importance of data-driven decision-making, the study can inspire the growth of data science roles in Gujarat. Training professionals in sentiment analysis and NLP can create job opportunities and upskill the workforce, contributing to the state's socio-economic growth.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	✓
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The methodology for the proposed study on Aspect-Based Sentiment Analysis (ABSA) of beauty product reviews is designed to systematically address the research objectives and ensure reliable results. The key activities include hypothesis formulation, sampling, data collection, and data analysis.

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Hypothesis

The study is based on the hypothesis that the integration of Word2Vec embeddings and Support Vector Machine (SVM) can effectively extract and classify sentiments for specific aspects in beauty product reviews, outperforming traditional approaches in accuracy and precision.

Sampling Plan

The research will focus on beauty product reviews collected from the Female Daily website, a popular platform for beauty enthusiasts. A stratified sampling approach will be used to ensure representation across diverse product categories such as skincare, makeup, and haircare. The dataset will include reviews of varying lengths, sentiment polarities, and complexity to capture a wide spectrum of opinions. A sample size of 10,000 reviews is targeted for meaningful analysis.

Data Collection

1. Source Identification:
   Reviews will be sourced using web scraping techniques, ensuring adherence to ethical guidelines and platform permissions.
2. Preprocessing:
   Data will be cleaned to remove noise, including emojis, HTML tags, and special characters. Text will be tokenized, lowercased, and standardized. Stop-word removal and lemmatization will also be applied.

Data Analysis

1. Aspect Term Extraction:
   Linguistic patterns and rule-based methods will be used to identify product aspects mentioned in the reviews, such as “texture,” “packaging,” and “effectiveness.”
2. Word Embedding:
   Word2Vec will generate vector representations of words, capturing semantic relationships and contextual nuances.
3. Sentiment Classification:
   Sentiments associated with each aspect will be classified as positive, negative, or neutral using SVM. Hyperparameter tuning will optimize the classifier's performance.
4. Evaluation:
   The model’s effectiveness will be assessed using precision, recall, F1-score, and accuracy metrics. Comparative analysis with baseline models will validate its performance.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Suggested Plan of Action

The proposed study on Aspect-Based Sentiment Analysis (ABSA) of beauty product reviews will follow a structured timeline to ensure timely completion and achieve research goals efficiently:

1. Initial Setup and Literature Review (Month 1):
   - Finalize research objectives and scope.
   - Conduct a thorough literature review on ABSA, sentiment analysis techniques, and domain-specific challenges in beauty product reviews.
   - Identify tools and technologies required for data collection, processing, and model development.

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2. Data Collection and Preprocessing (Month 2-3):
   - Gather a dataset of beauty product reviews from the Female Daily website using web scraping techniques.
   - Perform data preprocessing, including cleaning, tokenization, stop-word removal, and normalization to ensure quality input for analysis.
3. Model Development and Aspect Extraction (Month 4-5):
   - Develop a method for aspect term extraction using rule-based and pattern recognition techniques.
   - Implement Word2Vec embeddings to capture semantic relationships, followed by training the SVM classifier for sentiment analysis.
4. Model Evaluation and Optimization (Month 6):
   - Evaluate the model's performance using metrics such as accuracy, precision, recall, and F1-score.
   - Fine-tune hyperparameters to optimize the model's effectiveness.
5. Analysis, Reporting, and Conclusion (Month 7-8):
   - Analyze the results to derive actionable insights for businesses and consumers.
   - Compile findings into a comprehensive report and prepare for dissemination through publications and presentations.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Initial Setup and Literature Review	July	2022	July	2022
2.	Data Collection and Preprocessing	August	2022	October	2022
3.	Model Development and Aspect Extraction	November	2022	January	2023
4.	Model Evaluation and Optimization	February	2023	February	2023
5.	Analysis, Reporting, and Conclusion	March	2023	April	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items			180000

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	d. Other items (specify)			
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			10000
3.	Contingency (Upto maximum for Rs. 3000/-)			2000
4.	Stationery and Printing (With justification)			10000
5.	Any other special requirement			10000
6.	Overhead (10% of recurring)			9000
	TOTAL			**2,21000**

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Holistic Health and Wellness Innovations: Developing A2-Milk based Skincare Solutions with Herbal Infusions for Enhanced Skin and Overall Well-being
2.	**Broad area of proposal**	*Pharmacy*
3.	**Sub Area of proposal**	Health and Wellness
4.	**Details of Principal Investigator (PI)**	

	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Ms. Kelsi A. Chhatrala	Assistant Professor (Pharmacology)	kelsi.chhatrala@atmiyauni.ac.in, +91 7874747806, 1713
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Shikha Thakur	Assistant Professor (Pharmacology)	+91 7876089949 shikha.thakur@atmiyauni.ac.in
	Aayushi Agarwal Bansal	Assistant Professor (Pharmaceutical Chemistry)	+91 8909465863 aayushi.bansal@atmiyauni.ac.in
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**	21/10/1997	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	05/02/2022	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	NA	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Pharmacy	Atmiya University	Ongoing	NA
ii.	Post Graduation	Pharmacology	Saurashtra University	2021	8.34
iii.	Under Graduation	B.pharm	Gujarat Technological University	2019	7.14
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	✓ ☐ NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	NA	
5.	Details of on-going and completed research funded projects (if any)		

S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
-	-	-	-	-
-	-	-	-	-

6.	Total Experience	Teaching Experience: (……1… Year + …05…… Months)
		Research Experience: (……..Year + …….. Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: NA
		International: NA
8.	No. of Publication (Book Chapters)	NA
	Books Published	NA
(Please enclose the list of papers and books published and/or accepted during last five years)		

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Holistic Health and Wellness Innovations: Developing A2-Milk based Skincare Solutions with Herbal Infusions for Enhanced Skin and Overall Well-being

2. Abstract (Provide a summary of your research proposal in 300 words)

With an increasing focus on natural, sustainable, and creative ways to improve general well-being, holistic health and wellness have attracted a lot of attention in recent years. By combining the advantages of traditional knowledge with contemporary technology, this study investigates the creation of skincare products based on A2-milk and enhanced with herbal infusions. The A2 beta-casein protein variation found in A2 milk, which comes from native cow breeds, is linked to better digestibility and fewer inflammatory reactions than A1 milk. Because of its distinct makeup, A2 milk is a perfect foundation for skincare products.

The initiative looks into the vitamins, minerals, and amino acids that are bioactive in A2 milk and help hydrate, nourish, and repair skin. Additionally, because of their well-established anti-inflammatory, antibacterial, and antioxidant qualities, herbal infusions made from plants including ashwagandha, aloe vera, turmeric, and neem are included. It is believed that the combination of these herbs with A2 milk will improve barrier function, promote skin health, and alleviate irritation, dryness, and acne.

The study's methodology includes consumer trials, in-vitro testing, and physicochemical analysis to assess the formulations' safety, effectiveness, and sensory appeal. In keeping with the ideas of environmentally friendly innovation, sustainability is also prioritized through the sourcing of organic and ethical ingredients.

The goal of this study is to support the expanding market for multipurpose, clean-label skincare products that appeal to contemporary customers looking for all-encompassing health solutions. Beyond skincare, the combination of herbs and A2 milk represents a more comprehensive strategy for promoting wellbeing through biotechnological innovations inspired by nature. It is anticipated that the results would open up new business prospects in the wellness sector and stimulate more multidisciplinary studies on the relationship between conventional wisdom and modern health sciences.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Introduction

Holistic health and wellness emphasize the interconnectedness of physical, mental, and emotional well-being, promoting a lifestyle that integrates natural, sustainable, and science-backed solutions. With the increasing global demand for clean-label, multifunctional products, the skincare industry are undergoing a paradigm shift toward formulations that prioritize consumer health and environmental sustainability. In this context, A2 milk, derived from indigenous cow breeds, and herbal infusions emerge as potent resources for developing innovative skincare solutions. The proposed research seeks to harness the nutritional richness of A2 milk and the therapeutic potential of herbs to create products that enhance skin health

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while aligning with holistic wellness principles.

Research Objectives and Activities

The primary objective of this project is to develop A2-milk-based skincare solutions infused with herbal extracts, evaluating their efficacy, safety, and consumer acceptability. The following specific research activities will be pursued:

1. **Characterization of A2 Milk:**
   A detailed physicochemical analysis of A2 milk will be conducted to quantify its bioactive components, including beta-casein, vitamins, minerals, and amino acids. This analysis will provide insights into the suitability of A2 milk for skincare applications and its potential benefits for skin nourishment and repair.
2. **Selection and Analysis of Herbal Infusions:**
   Herbal extracts such as aloe vera (for hydration), turmeric (for anti-inflammatory properties), neem (for antimicrobial effects), and ashwagandha (for anti-aging benefits) will be selected. The active compounds in these herbs will be characterized using advanced analytical techniques to ensure their efficacy and stability in formulations.
3. **Formulation Development:**
   Skincare formulations, including creams, lotions, and serums, will be developed by combining A2 milk with the selected herbal infusions. The formulation process will involve optimizing the ratios, stabilizers, and delivery systems to enhance the efficacy and sensory appeal of the products.
4. **In-Vitro and In-Vivo Testing:**
   Safety and efficacy tests will be conducted on the developed formulations. In-vitro studies will assess antioxidant activity, antimicrobial properties, and skin compatibility, while in-vivo trials will involve dermatological evaluations to test for irritation, hydration, and overall consumer acceptability.
5. **Sustainability Assessment:**
   The project will explore the ethical sourcing of A2 milk and herbs, minimizing waste during production and using biodegradable packaging. Life-cycle analyses will assess the environmental impact of the formulations.
6. **Consumer Studies:**
   Surveys and focus groups will evaluate consumer preferences, perceptions, and willingness to adopt A2-milk-based skincare products. Feedback will be incorporated into refining the formulations.

Importance of the Proposed Study

Addressing the Demand for Natural and Functional Skincare

Modern consumers are increasingly seeking skincare products that are free from harsh chemicals and synthetic additives. A2 milk provides an excellent natural base enriched with essential nutrients that are beneficial for the skin. When combined with herbal extracts, it offers a powerful synergy that addresses common skin concerns such as dryness, inflammation, and acne. This project aims to meet this demand by delivering scientifically validated, functional skincare products.

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Leveraging the Nutritional Potential of A2 Milk

A2 milk contains bioactive compounds that support skin hydration, elasticity, and repair. Its unique protein structure, devoid of A1 beta-casein, makes it less likely to trigger inflammatory responses. By incorporating A2 milk into skincare formulations, the study harnesses these benefits for topical applications, expanding its utility beyond dietary consumption.

Harnessing the Power of Herbal Medicine

Herbs like turmeric, neem, and aloe vera have been used in traditional medicine for centuries due to their potent therapeutic properties. Combining these herbs with A2 milk creates a formulation rooted in both modern science and ancient wisdom, promoting holistic wellness through an integrative approach.

Promoting Sustainable and Ethical Practices

The project aligns with global sustainability goals by emphasizing the use of natural, renewable, and eco-friendly ingredients. Indigenous cow breeds, the primary source of A2 milk, are often linked to sustainable agricultural practices. Promoting their use in commercial applications can encourage conservation efforts and support rural livelihoods.

Bridging Traditional Knowledge and Modern Biotechnology

The fusion of A2 milk and herbal infusions exemplifies the potential of biotechnological innovations inspired by traditional knowledge systems. By systematically investigating the synergistic effects of these natural ingredients, the study bridges the gap between cultural heritage and contemporary health sciences.

Driving Commercial and Societal Benefits

The global skincare market is projected to grow significantly, driven by consumer interest in wellness-oriented products. The successful development of A2-milk-based formulations can open new avenues for commercialization, benefiting the wellness and dairy industries. Additionally, the project advocates for the importance of indigenous cow breeds, contributing to their conservation and cultural significance.

Conclusion

The proposed study aims to pioneer a new class of skincare solutions that merge the nutritional benefits of A2 milk with the therapeutic properties of herbal infusions. By systematically addressing formulation development, efficacy testing, and sustainability considerations, this research contributes to the broader goals of holistic wellness, environmental stewardship, and consumer empowerment. The outcomes are expected to inspire further interdisciplinary research and set a benchmark for innovation in the wellness industry.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

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The intersection of natural ingredients and skincare has garnered substantial attention, driven by growing consumer demand for clean-label and sustainable products. A2 milk, primarily known for its dietary benefits, is emerging as a promising ingredient for skincare due to its unique bioactive components, including A2 beta-casein, vitamins, and amino acids. Current research primarily focuses on the nutritional and digestive advantages of A2 milk, with limited exploration of its topical applications. While studies have highlighted its anti-inflammatory and skin-repairing properties, comprehensive evaluations of its skincare potential remain sparse.

Herbal extracts, on the other hand, have been extensively studied for their therapeutic properties in skincare. Ingredients like turmeric, neem, aloe vera, and ashwagandha are well-documented for their antioxidant, antimicrobial, and anti-inflammatory benefits. However, most existing formulations use these herbs individually or in conventional bases, overlooking the potential synergy with bioactive-rich substances like A2 milk.

Few studies have investigated the combination of A2 milk and herbal infusions in skincare, representing a significant research gap. This underscores the need for interdisciplinary studies integrating the nutritional benefits of A2 milk with the proven efficacy of herbal compounds to develop multifunctional, science-backed skincare solutions. Addressing this gap could redefine natural skincare and inspire future innovations.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. **To evaluate the physicochemical properties of A2 milk**
   Conduct a comprehensive analysis of A2 milk to characterize its bioactive components, including proteins, vitamins, and minerals, and assess their potential for enhancing skin health through topical application.
2. **To identify and optimize herbal infusions for synergistic formulations**
   Select and analyze herbal extracts such as aloe vera, turmeric, neem, and ashwagandha for their antioxidant, antimicrobial, and anti-inflammatory properties, ensuring compatibility and stability when combined with A2 milk in skincare products.
3. **To develop and standardize A2-milk-based skincare formulations**
   Formulate creams, serums, and lotions by integrating A2 milk and herbal infusions, optimizing the formulations for efficacy, stability, and sensory appeal through advanced cosmetic science techniques.
4. **To assess the efficacy and safety of the developed formulations**
   Conduct in-vitro and in-vivo studies to evaluate the antioxidant activity, hydration capacity, skin barrier improvement, and dermatological safety of the formulations, ensuring compliance with industry standards.
5. **To investigate consumer preferences and product acceptability**
   Perform consumer surveys and focus group discussions to gather feedback on the usability, effectiveness, and appeal of the A2-milk-based products, incorporating insights to refine formulations.
6. **To promote sustainability and ethical sourcing in product development**
   Ensure that all ingredients, including A2 milk and herbal extracts, are sourced sustainably and ethically, minimizing environmental impact and supporting local agricultural practices aligned with holistic wellness principles.

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6. Significance of the proposed study: (300 words)

The proposed study holds significant scientific, societal, and commercial relevance, addressing critical needs in the evolving landscape of holistic health, skincare innovation, and sustainability.

First, this research pioneers the utilization of A2 milk in skincare, extending its benefits beyond nutrition to address topical skin health challenges. A2 milk, enriched with bioactive components such as beta-casein, vitamins, and essential amino acids, has shown promise in reducing inflammation and promoting skin repair. By leveraging these properties, the study introduces a novel ingredient to the natural skincare industry, potentially transforming current formulation paradigms.

Second, the integration of herbal infusions such as aloe vera, turmeric, neem, and ashwagandha enhances the therapeutic value of the formulations. These herbs, rooted in traditional medicine, offer a wide range of skin benefits, including antioxidant, antimicrobial, and anti-inflammatory effects. Combining these with A2 milk aligns with consumer demand for multifunctional products that promote holistic wellness through natural and scientifically validated solutions.

From a sustainability perspective, the study underscores the importance of ethical sourcing and eco-friendly practices. Promoting the use of A2 milk from indigenous cows supports biodiversity conservation and rural livelihoods, aligning with global goals for sustainable development.

Commercially, the research addresses the burgeoning demand for clean-label and functional skincare products. The global skincare industry is rapidly expanding, with consumers increasingly prioritizing products that are effective, safe, and environmentally responsible. The success of this project can open new avenues for innovation and market differentiation.

Finally, this study bridges the gap between traditional knowledge and modern biotechnology, demonstrating the value of interdisciplinary approaches. It fosters innovation while honoring cultural heritage, inspiring further research in sustainable and nature-inspired health solutions. This dual focus on science and tradition makes the study a meaningful contribution to the fields of wellness and biocosmetics.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study holds significant relevance to Gujarat, a state renowned for its rich agricultural heritage, dairy farming, and traditional herbal practices. Gujarat is home to several indigenous cow breeds, such as the Gir and Kankrej, that produce A2 milk, known for its health benefits. By focusing on A2 milk-based skincare formulations, this study offers a unique opportunity to create value-added products that not only support the local dairy industry but also promote the preservation of these indigenous breeds.

Furthermore, Gujarat has a long history of herbal medicine and is a major producer of medicinal plants. The integration of locally sourced herbs like turmeric, neem, and aloe vera in the study supports regional agriculture and traditional knowledge, fostering economic opportunities for farmers and rural communities.

This research aligns with the state's goals of promoting sustainable and ethical practices in agriculture and industry. It also contributes to the growing demand for natural, eco-friendly

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skincare solutions, opening avenues for local businesses in the wellness and biocosmetic sectors. By incorporating indigenous resources and modern scientific approaches, the study strengthens Gujarat's position as a leader in sustainable health and wellness innovations, benefiting both the economy and public health.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research holds immense potential for societal and economic impact, particularly in Gujarat, a state known for its rich agricultural heritage and innovative spirit.

1. **Support for Indigenous Cattle Breeds:**
   Gujarat is home to several indigenous cow breeds that produce A2 milk, such as Gir and Kankrej. The project promotes the utilization of A2 milk, creating a sustainable demand for these breeds and encouraging their conservation. This can lead to enhanced livelihoods for local farmers and dairy cooperatives while preserving the state's biodiversity.
2. **Empowerment of Rural Communities:**
   The research emphasizes ethical sourcing of raw materials, including A2 milk and herbal extracts. This approach supports rural communities engaged in dairy farming and herbal cultivation, providing them with sustainable income opportunities and reducing urban migration.
3. **Boost to Local Industries:**
   Gujarat's thriving dairy and agricultural sectors can benefit significantly from the commercialization of A2-milk-based skincare products. Establishing production units and supply chains for such innovative products can stimulate local entrepreneurship, create jobs, and contribute to the state's economy.
4. **Promotion of Holistic Wellness:**
   By introducing clean-label skincare solutions rooted in natural ingredients, the research aligns with the growing consumer demand for holistic wellness. The availability of such products locally will encourage healthier lifestyle choices and reduce dependency on chemical-laden cosmetics.
5. **Positioning Gujarat as a Hub for Green Innovation:**
   The study reinforces Gujarat's reputation as a leader in sustainability and innovation. By promoting eco-friendly practices in product development, the research showcases the state as a pioneer in integrating traditional knowledge with modern science.

The findings of this research will create a ripple effect, benefiting local communities, enhancing environmental stewardship, and fostering Gujarat's leadership in the wellness and biocosmetic industries.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)

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1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	✓ ☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Methodology

The methodology for this research is designed to systematically evaluate the potential of A2 milk-based skincare solutions infused with herbal extracts. It involves a multidisciplinary approach integrating biochemistry, dermatology, and consumer research.

Research Hypothesis

The primary hypothesis is that A2 milk, enriched with bioactive compounds, when combined with therapeutic herbal infusions, creates effective and sustainable skincare formulations that enhance skin health, reduce inflammation, and improve hydration.

Specific Research Activities

1. **Characterization of Raw Materials:**
   - **A2 Milk:** Analyze its physicochemical properties, including protein composition

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(A2 beta-casein), vitamins, and minerals.
   - **Herbal Extracts:** Select herbs such as turmeric, neem, aloe vera, and ashwagandha; perform phytochemical analysis to identify active compounds and assess their stability in formulations.
2. **Formulation Development:**
   Develop creams, serums, and lotions by optimizing ratios of A2 milk and herbal extracts. Use emulsifiers, stabilizers, and delivery systems to ensure product stability and effectiveness.
3. **Sampling Plan:**
   - **Raw Material Sources:** Source A2 milk from indigenous cows (e.g., Gir, Kankrej breeds) in Gujarat and procure organically grown herbs.
   - **Test Subjects:** For in-vivo studies, recruit 50 volunteers representing diverse skin types and conditions.
4. **Data Collection:**
   - **In-Vitro Studies:** Test formulations for antioxidant, antimicrobial, and anti-inflammatory activities.
   - **In-Vivo Studies:** Conduct dermatological assessments to measure hydration levels, irritation potential, and skin barrier improvement.
   - **Consumer Feedback:** Gather data through focus groups and surveys on usability, texture, and overall satisfaction.
5. **Data Analysis:**
   - Use statistical tools to analyze physicochemical properties, biological activity, and consumer feedback.
   - Perform comparative studies to evaluate the efficacy of formulations against existing natural skincare products.
   - Use regression analysis to determine correlations between active components and skin health benefits.

This comprehensive methodology ensures that the research produces scientifically validated, consumer-friendly, and sustainable skincare products, bridging traditional knowledge and modern scientific advancements.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The proposed research project will be executed over a 24-month period, structured into distinct phases to ensure systematic progress and comprehensive outcomes.

Phase 1: Project Initiation and Planning (Months 1-2)

- **Establish Research Team:** Assemble a multidisciplinary team comprising biochemists, dermatologists, formulation scientists, and market analysts.
- **Finalize Research Design:** Refine research objectives, methodologies, and timelines.
- **Secure Resources:** Procure necessary equipment, materials, and secure partnerships with local dairy farms and herbal suppliers in Gujarat.

Phase 2: Raw Material Characterization (Months 3-5)

- **A2 Milk Analysis:** Conduct physicochemical and biochemical analyses of A2 milk to

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identify key bioactive components.

- **Herbal Extract Profiling:** Analyze selected herbs (aloe vera, turmeric, neem, ashwagandha) for their active compounds and assess their compatibility with A2 milk.

Phase 3: Formulation Development (Months 6-9)

- **Prototype Creation:** Develop initial skincare formulations (creams, lotions, serums) by integrating A2 milk with herbal infusions.
- **Optimization:** Adjust ingredient ratios, stabilize formulations, and enhance sensory attributes through iterative testing.

Phase 4: Testing and Evaluation (Months 10-18)

- **In-Vitro Testing:** Assess antioxidant, antimicrobial, and anti-inflammatory properties of formulations.
- **In-Vivo Trials:** Conduct dermatological assessments with 50 volunteers to evaluate safety, efficacy, and skin health improvements.
- **Consumer Studies:** Execute surveys and focus groups to gather feedback on product usability and satisfaction.

Phase 5: Data Analysis and Refinement (Months 19-24)

- **Analyze Results:** Utilize statistical tools to interpret data from in-vitro, in-vivo, and consumer studies.
- **Refine Formulations:** Incorporate feedback and data insights to enhance product formulations for optimal performance and appeal.

Phase 6: Sustainability and Ethical Sourcing Assessment (Months 25-29)

- **Evaluate Supply Chain:** Ensure all ingredients are sourced sustainably and ethically, conducting life-cycle assessments to minimize environmental impact.
- **Implement Best Practices:** Adopt eco-friendly packaging and production methods based on sustainability findings.

Phase 7: Finalization and Reporting (Months 30-36)

- **Finalize Products:** Complete the development of finalized skincare formulations ready for commercialization.
- **Prepare Documentation:** Compile comprehensive research reports, including methodology, findings, and recommendations.
- **Disseminate Findings:** Present results through academic publications, industry conferences, and stakeholder meetings to facilitate knowledge transfer and commercial opportunities.

This structured plan of action ensures a thorough investigation of A2 milk-based skincare solutions, promoting innovation, sustainability, and market readiness by the project's conclusion.

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1	Project Initiation and Planning	June	2023	July	2023
2	Raw Material Characterization (A2 Milk and Herbal Extracts)	August	2023	October	2023
3	Formulation Development	November	2023	February	2024
4	Testing and Evaluation (In-Vitro, In-Vivo, Consumer Studies)	March	2024	November	2024
5	Data Analysis and Refinement of Formulations	December	2024	May	2025
6	Sustainability Assessment and Ethical Sourcing	June	2025	October	2025
7	Finalization of Products and Reporting	November	2025	April	2026

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)			2,66,000
2.	Travelling (viz. sample collection, with justification)			12,000
3.	Contingency (Upto maximum ₹5,000/-)			3000

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4.	Stationery and Printing (with justification)	2000	5	6000
5.	Any other special requirement	7000	5	8000
6.	Overhead (10% of recurring)			25,000
	TOTAL			₹3,20,000

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
(a)	Laboratory-grade chemicals for analysis	25,000	August 2023 - October 2023	Required for characterization of A2 milk and herbal extracts (e.g., assays).
(b)	Chemicals for formulation	35,000	November 2023 - February 2024	For developing stable formulations with emulsifiers, stabilizers, and preservatives.
(c)	Chemicals for testing and evaluation	25,000	March 2024 - November 2024	Needed for dermatological, in-vitro, and in-vivo tests, including stability studies.
2.	**B. Glassware**			
(a)	Beakers, flasks, and test tubes	15,000	August 2023 - October 2023	For preparing and storing formulations during initial research stages.
(b)	Pipettes, burettes, and measuring cylinders	10,000	November 2023 - February 2024	Accurate mixing and measurement during formulation and testing.
(c)	Glass containers for storage and packaging	10,000	March 2024 -	Used for test batches of formulations for stability

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			November 2024	and consumer testing.
3.	**C. Any other consumable items (like wires/ electric items etc)**			
(a)	Wires, electrical items (heating plates, mixers)	10,000	August 2023 - October 2023	Needed for equipment operation during analysis and formulation.
(b)	Packaging materials (jars, tubes, labels)	25,000	March 2024 - November 2024	For packaging products during testing phases.
4.	**Travel**	No. of Times in a month		
(a)	Sample collection (milk, herbs)	20,000	August 2023 - October 2023	Travel to source A2 milk and herbal raw materials from Gujarat suppliers.
(b)	Meetings and data collection	25,000	March 2024 - November 2024	For consumer studies, surveys, and focus groups across Gujarat.
5.	**Contingency**			
		5,000	Throughout the project	To address unforeseen expenses or emergencies.
6.	**Stationery and printing**			
(a)	Reports, surveys, and consent forms	5,000	August 2023 - February 2024	Printing materials for data collection and documentation.
(b)	Office supplies	3,000	Throughout the project	Basic supplies for record-keeping and team coordination.
7.	**Overheads (10% of**	41,000	Throughout	Administrative and

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	Recurring Expenses)		the project	operational expenses.
	Grand Total	₹3,20,000		

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Application form

Part -A

(General Information)

1.	Title of the proposal	Diseases Detection in Plant Using Machine Learning Algorithms	
2.	Broad area of proposal	Engineering	
3.	Sub Area of proposal	Machine Learning	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Kishan T. Karmur	Lecturer	Kishan.karmur@atmiyauni.ac.in 8200414971, 1436
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	-	-	-
6.	Whether the proposal is transdisciplinary?	No	
7.	Date of Birth of PI (DD/MM/YYYY)	18/08/1995	
8.	Date of joining the Department of PI (DD/MM/YYYY)	06/12/2021	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	-	-	-
ii.	Post Graduation	-	-	-	-
iii.	Under Graduation	Computer Engineering	GTU	2016	67.40%
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐YES	☐NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	--	

	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (5 Year + 3 Months)
		Research Experience: (.....Year + ... Months)
7.	No. of Publication (Research articles - UGC Approved only)	National:
		International:

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8.	No. of Publication (Book Chapters)	-
	Books Published	-
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Diseases Detection in Plant Using Machine Learning Algorithms

2. Abstract (Provide a summary of your research proposal in 300 words)

Early detection of plant diseases is vital for crop health and food security. Traditional diagnostic methods are time-consuming, labor-intensive, and prone to errors. Machine learning (ML) algorithms, such as decision trees, support vector machines, k-nearest neighbors, and deep learning, offer a promising solution for automating plant disease identification and classification. This paper examines the use of these techniques, focusing on image-based disease detection and data-driven approaches. It also addresses challenges like data collection, model accuracy, and environmental adaptability. Integrating ML into precision agriculture can improve disease detection, reduce crop losses, and promote sustainable farming practices.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The rapid growth of global populations and the increasing demand for food production make plant disease management a critical aspect of modern agriculture. Plant diseases pose a significant threat to crops, leading to substantial losses in yield and quality. Traditional methods of disease detection, which often rely on manual inspection by agricultural experts, are time-consuming, labour-intensive, and prone to errors. Moreover, the vast variety of plant species and the diversity of diseases they can suffer from makes timely and accurate diagnosis a challenging task.

Recent advancements in machine learning (ML) have opened new avenues for improving plant disease detection. ML algorithms, which allow for the automated analysis of large datasets, have the potential to accurately identify and classify plant diseases with high efficiency. By leveraging techniques such as image recognition, pattern recognition, and data mining, ML models can detect subtle symptoms that may be missed by the human eye, offering a more reliable solution to early disease detection.

This paper proposes to explore the application of various machine learning algorithms—such as

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decision trees, support vector machines, k-nearest neighbors, and deep learning—for detecting plant diseases. The goal is to investigate how these models can be trained on datasets that include plant images, environmental data, and disease symptoms, in order to create robust systems for disease identification in real-time.

Research Activities and Proposal

1. **Dataset Collection and Preprocessing**: One of the first challenges in implementing machine learning for plant disease detection is gathering diverse, high-quality datasets. This paper will propose the creation of a comprehensive dataset consisting of high-resolution images of healthy and diseased plants, along with associated metadata such as environmental factors, plant species, and disease types. Data preprocessing techniques such as image enhancement, normalization, and feature extraction will be applied to prepare the dataset for model training.
2. **Exploring Machine Learning Models**: A range of machine learning algorithms will be explored for disease classification. These include traditional algorithms like decision trees and k-nearest neighbors, as well as more advanced techniques such as deep learning-based convolutional neural networks (CNNs). The study will focus on comparing the performance of these models in terms of accuracy, precision, and recall when applied to plant disease identification.
3. **Model Training and Evaluation**: The proposed research will focus on training the selected ML models using the curated dataset and evaluating their performance through cross-validation. Key evaluation metrics will include accuracy, sensitivity, specificity, and F1-score. Additionally, the study will address challenges related to overfitting, data imbalance, and model generalization to ensure that the models can effectively adapt to different plant species and disease types.
4. **Integration with Agricultural Practices**: Finally, the study will investigate how these ML-based disease detection systems can be integrated into real-world agricultural settings. This includes the development of user-friendly applications for farmers, which can be used on mobile devices or integrated into automated agricultural systems like drones or robots for real-time monitoring.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The application of machine learning (ML) techniques in plant disease detection has gained significant momentum in recent years due to the increasing need for efficient agricultural practices. Current research in this area primarily focuses on developing automated systems to identify plant diseases accurately and rapidly, using a combination of image processing, deep learning, and traditional machine learning models. Convolutional Neural Networks (CNNs), in particular, have shown promising results in identifying disease symptoms from plant images, including leaf spots, wilting, and blights.

Research has advanced in collecting large-scale datasets from various crops, which are critical for training machine learning models. However, challenges remain in the variability of disease manifestations across different plant species, environmental conditions, and stages of infection. This limits the generalization of models, especially in diverse agricultural contexts. Additionally, there is ongoing research into combining multiple sensor data, such as temperature, humidity, and soil conditions, alongside visual data for improved accuracy.

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While some commercial applications of ML-based disease detection systems exist, issues like real-time processing, computational cost, and scalability in field environments remain underexplored. Therefore, current research is shifting towards improving model robustness, increasing the interpretability of machine learning predictions, and integrating these systems into low-cost, portable devices for use by farmers globally.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1.Develop a Comprehensive Dataset:
2. Implement Advanced Machine Learning Models:
3. Enhance Model Generalization:
4. Integrate Multi-Source Data:
5. Optimize for Real-Time, Field-Based Detection

6. Significance of the proposed study: (300 words)

The proposed study on plant disease detection using machine learning techniques holds significant potential to revolutionize agricultural practices by providing an efficient, cost-effective, and scalable solution for early disease detection. One of the primary challenges in modern agriculture is the rapid identification and management of plant diseases, which can severely affect crop yields and quality. Traditionally, disease detection relies on manual inspection, which is time-consuming, labor-intensive, and prone to human error. Machine learning techniques, especially image-based approaches, can automate and enhance this process by quickly identifying disease symptoms, even in the early stages, leading to more timely interventions.

The significance of this study lies in its ability to create an intelligent, real-time disease detection system that can be used by farmers in diverse agricultural settings. By leveraging machine learning models, particularly deep learning and computer vision techniques, the proposed research can contribute to highly accurate disease classification and prediction, minimizing the risk of widespread crop damage. Moreover, the integration of environmental data, such as temperature, humidity, and soil conditions, can further enhance the reliability of the disease detection models, providing a holistic view of plant health.

In addition, the proposed system can enable precision agriculture by supporting targeted treatment strategies, reducing the use of pesticides and fertilizers, and minimizing environmental impact. Farmers can make data-driven decisions, saving time and resources while promoting sustainable agricultural practices. Furthermore, the research can help bridge the technology gap in resource-limited areas by developing affordable, portable disease detection tools that do not require specialized technical expertise. Overall, this study has the potential to increase global food security, improve crop productivity, and contribute to environmentally sustainable farming practices, making it highly significant for both the agricultural community and society at large.

7. Relevance of the proposed study to Gujarat: (200 words)

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The proposed study on plant disease detection using machine learning techniques is highly relevant to Gujarat, a state that plays a significant role in India's agricultural economy. Gujarat is known for its diverse agricultural landscape, with crops such as cotton, groundnut, maize, wheat, and various fruits and vegetables being extensively cultivated. However, plant diseases, including bacterial, fungal, and viral infections, continue to pose significant challenges to crop productivity, leading to substantial economic losses.

By implementing machine learning techniques for disease detection, this research can provide Gujarat's farmers with a powerful tool to identify diseases at an early stage, allowing for timely interventions. The adoption of automated disease detection systems, especially those based on image processing and deep learning, can help address the lack of expert knowledge in rural areas and reduce dependency on manual inspection, which is often inefficient and delayed.

Gujarat's farmers, particularly in regions with high agricultural diversity such as Saurashtra, can benefit from the integration of environmental factors (temperature, humidity, soil conditions) in disease prediction, as these regions experience varied climatic conditions that impact disease spread. Furthermore, the study's focus on developing low-cost, real-time disease detection systems can make technology accessible to small and medium-scale farmers in Gujarat, promoting sustainable farming practices, reducing pesticide usage, and improving crop yield. Thus, the proposed research is directly aligned with Gujarat's agricultural needs, contributing to enhanced productivity, sustainability, and food security.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The expected findings of the proposed research on plant disease detection using machine learning techniques can bring transformative benefits to society, particularly in the state of Gujarat, which is a major agricultural hub. The state is known for its vast and diverse agricultural production, including crops such as cotton, groundnut, mustard, and various fruits and vegetables. However, plant diseases continue to pose significant challenges, often leading to substantial yield losses. By leveraging machine learning for early disease detection, the proposed research could lead to several societal benefits.

Enhanced Crop Productivity and Food Security: Early detection of plant diseases using machine learning can help farmers in Gujarat manage outbreaks before they cause significant damage. By identifying diseases at the initial stages, farmers can take prompt corrective actions, such as targeted pesticide application, reducing crop loss and improving overall yield. This directly contributes to food security in the state by ensuring stable and higher crop production.

Economic Empowerment of Farmers: The development of affordable, real-time disease detection tools will empower farmers, especially smallholders, with the ability to manage crops more effectively. This can lead to increased profitability through reduced losses and more efficient use of resources. Machine learning-based systems can also minimize dependency on expert advice, which is often unavailable in remote areas, enabling farmers to make independent, informed decisions.

Sustainability and Environmental Benefits: By promoting the use of precision agriculture, where pesticides and fertilizers are applied only when necessary, the research can significantly reduce the overuse of chemicals. This will help preserve soil health, reduce water contamination, and minimize harmful environmental impacts, contributing to sustainable farming practices in Gujarat.

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Job Creation and Technological Advancement: The integration of machine learning in agriculture can spur the growth of agri-tech industries in Gujarat, leading to the creation of skilled jobs and fostering innovation in the agricultural sector. This can position the state as a leader in smart agriculture, encouraging further investment in technology-driven solutions.

Overall, the expected benefits of this research can lead to a more resilient, sustainable, and prosperous agricultural sector in Gujarat.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, dataaalysis. (300- 400 words)

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1. **Data Collection and Preprocessing**

- **Data Collection**: Gather a comprehensive dataset that includes images of healthy and diseased plants. This dataset should cover various crops and diseases (bacterial, fungal, viral, etc.) and be sourced from different growth stages and environmental conditions. The dataset may also include additional information such as temperature, humidity, and soil moisture to enhance disease prediction accuracy.
- **Data Augmentation**: To improve model performance and generalization, use data augmentation techniques (such as rotation, flipping, scaling, and color adjustments) to create variations of existing images.
- **Data Labeling**: Properly label the dataset with the disease type, affected plant part (e.g., leaves, stems), and disease severity. This will form the ground truth for model training.
- **Data Preprocessing**: Perform image preprocessing tasks like resizing, normalization, and noise reduction. This helps ensure that the dataset is in a suitable format for training the model.

2. **Feature Extraction**

- **Image-Based Features**: Extract relevant features from images using techniques such as color histograms, texture analysis (e.g., using GLCM), and shape descriptors. These features help in distinguishing between healthy and diseased plants.
- **Advanced Feature Extraction**: Utilize deep learning models like Convolutional Neural Networks (CNNs) for automatic feature extraction from raw images. CNNs can capture complex patterns in the images that may not be easily detectable using traditional methods.

3. **Model Development**

- **Model Selection**: Evaluate different machine learning algorithms for disease classification. The most commonly used techniques for image-based disease detection include:
  - **Convolutional Neural Networks (CNNs)**: These models are highly effective for image classification tasks and can automatically learn features from images, making them ideal for plant disease detection.
  - **Support Vector Machines (SVM)**: SVMs can be used if features are hand-crafted, and they have shown success in binary classification tasks.
  - **Random Forest or Decision Trees**: These can be useful for non-image-based data or when combining environmental parameters with image data.
  - **Transfer Learning**: Leverage pre-trained CNNs (such as VGG16, ResNet, or Inception) and fine-tune them on the plant disease dataset to improve performance with a smaller dataset.

4. **Model Training**

- **Data Splitting**: Split the dataset into training, validation, and testing sets, typically in a 70-15-15 ratio, to avoid overfitting and ensure the model generalizes well to unseen data.
- **Training the Model**: Train the selected machine learning model using the training dataset. This involves adjusting the model's weights (in deep learning) or

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hyperparameters (in traditional machine learning) to minimize prediction errors.

- **Cross-Validation**: Use k-fold cross-validation to evaluate model performance and ensure that it is not overfitting to a particular subset of the data.

5. **Model Evaluation**

- **Performance Metrics**: Evaluate the model using metrics like accuracy, precision, recall, F1-score, and confusion matrices to assess how well the model classifies diseased vs. healthy plants. Additionally, for multi-class problems (i.e., identifying different diseases), metrics like macro/micro-average precision and recall are useful.
- **Error Analysis**: Identify any common types of misclassifications and fine-tune the model accordingly. This could involve adding more diverse images to the dataset or modifying the model architecture.

6. **Integration of Environmental Data**

- **Multi-Source Data Integration**: Combine environmental factors (such as temperature, humidity, and soil moisture) with image data to improve disease prediction. This can be done by concatenating these features with the image features before passing them through the model.
- **Data Fusion**: Use techniques like feature fusion or early fusion to integrate sensor data with image data. This can improve model accuracy, especially in cases where environmental conditions significantly influence disease occurrence.

7. **Model Deployment**

- **Real-Time Detection**: Deploy the trained model on a cloud-based or mobile platform where farmers can upload images or capture images using drones or smartphones. The model will then provide real-time disease diagnosis and recommend treatment options.
- **Edge Computing**: For field-based applications, deploy the model on edge devices (e.g., Raspberry Pi or mobile phones) that allow real-time detection without requiring an internet connection.
- **User Interface**: Develop an easy-to-use interface where farmers can upload plant images and receive disease diagnosis and actionable recommendations.

8. **Post-Processing and Visualization**

- **Visualization Tools**: Use heatmaps, graphical visualizations, or overlays to help users understand the model's predictions (e.g., highlighting diseased regions of the plant).
- **Recommendations**: Based on the disease diagnosis, the system can provide treatment recommendations, including pesticide use, organic methods, or preventive measures.

9. **Model Updates and Maintenance**

- **Continuous Learning**: Continuously update the model with new data to improve its accuracy and adapt to evolving disease patterns. This can involve collecting feedback from farmers and incorporating it into the training process.
- **Model Monitoring**: Regularly evaluate the deployed model to ensure it maintains performance over time, especially when environmental or agricultural conditions change.

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11. Suggested plan of action: Define the suggested plan of action in 200 words)

Phase 1: Data Collection and Preprocessing (1–2 months)

- Collect a comprehensive dataset of images of healthy and diseased plants, covering various crops and disease types.
- Annotate the data with labels for accurate training and validation.
- Preprocess the images by resizing, normalizing, and applying augmentation techniques to create a robust dataset.

Phase 2: Feature Extraction and Model Development (2–3 months)

- Extract relevant features from the plant images using traditional methods and deep learning models.
- Develop and evaluate machine learning models, particularly CNNs and SVMs, for disease classification.
- Incorporate environmental data such as temperature and humidity to enhance model performance.

Phase 3: Model Training and Evaluation (2 months)

- Split the dataset into training, validation, and test sets.
- Train the model and evaluate its performance using key metrics like accuracy, precision, recall, and F1-score.
- Fine-tune the model based on error analysis and cross-validation results.

Phase 4: System Development and Deployment (3 months)

- Integrate the trained model into a user-friendly mobile or cloud-based platform.
- Develop a real-time disease detection system with easy-to-interpret results and treatment recommendations.
- Test the system in the field with real-time data to ensure accuracy and usability.

Phase 5: Feedback, Improvement, and Maintenance (Ongoing)

- Collect user feedback from farmers and improve the model continuously.
- Update the system to include new diseases and crops, ensuring adaptability and long-term efficacy.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1	Data Collection and Preprocessing	Month 1	Year 1	Month 2	Year 1
2	Feature Extraction and Model Development	Month 2	Year 1	Month 4	Year 1
3	Model Training and Evaluation	Month 4	Year 1	Month 5	Year 1

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4	Model Fine-tuning and Optimization	Month 5	Year 1	Month 6	Year 1
5	System Development and Integration	Month 6	Year 1	Month 9	Year 1
6	Testing, Deployment, and Feedback	Month 9	Year 1	Month 12	Year 1

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	-	-	145000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	-	-	6000
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	3000
4.	Stationery and Printing (With justification)	-	-	6000
5.	Any other special requirement	-	-	40000
6.	Overhead (10% of recurring)	-	-	
	TOTAL	-	-	**2,00,000/-**

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Sentiment Analysis of E - Commerce Cloth Review using Machine learning	
2.	**Broad area of proposal**	Engineering	
3.	**Sub Area of proposal**	Machine Learning	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Mansi Harjivan Chauhan	Lecturer & Computer Engineering	mansi.chuahan@atmiyauni.ac.in 8140424809,1436
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	DivyaRameshbhai Solanki	Lecturer & Computer Engineering	divya.solanki@atmiyauni.ac.in 8264805959,1436
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	30/06/1998	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	19/07/2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	-	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	-	-	-	-
ii.	Post Graduation	Computer Engineering	Gujarat Technological University	2021	83.40 %
iii.	Under Graduation	Computer Engineering	Gujarat Technological University	2019	73.90%
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐YES	☐NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐short-term fellowship (*viz*Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz*CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz*D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	--	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	--	--	--	--	--
	--	--	--	--	--

6.	Total Experience	Teaching Experience: (1 Year + 6 Months)
		Research Experience: --
7.	No. of Publication (Research articles - UGC Approved only)	National: --

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		International: 2
8.	No. of Publication (Book Chapters)	--
	Books Published	--
(Please enclose the list of papers and books published and/or acceptedduring last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Sentiment Analysis of E - Commerce Cloth Review using Machine Learning

2. Abstract (Provide a summary of your research proposal in 300 words)

The rise of e-commerce has significantly transformed consumer shopping behaviors, and product reviews play a critical role in shaping purchasing decisions. In this study, we focus on the sentiment analysis of e-commerce clothing reviews using machine learning techniques. The goal is to develop an automated system to classify the sentiments expressed in customer feedback—positive, negative, or neutral—related to apparel products. We utilize various machine learning algorithms, including Naive Bayes, Support Vector Machines (SVM), and deep learning models, to analyze textual data from a large collection of online reviews. The effectiveness of each model is evaluated based on accuracy, precision, recall, and F1-score metrics. Additionally, data preprocessing techniques such as tokenization, stopword removal, and vectorization (TF-IDF) are applied to enhance the quality of the input for the models. The results show that machine learning-based sentiment analysis can effectively determine the emotional tone of clothing reviews, providing valuable insights for e-commerce platforms and consumers. This study highlights the potential of sentiment analysis to improve customer experience, drive business strategies, and assist in product development.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

The e-commerce industry has experienced significant growth over the past decade, largely transforming how consumers shop for products and services. As the digital marketplace continues to expand, so does the volume of consumer-generated content, especially in the form of product reviews. These reviews have become an essential part of the modern shopping experience, offering both positive and negative feedback from customers who have previously purchased products. Consumers rely heavily on reviews when making purchasing decisions, and as a result, they have become one of the most influential aspects of e-commerce platforms. In

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particular, product reviews related to apparel and clothing are an important source of information for potential buyers, as they provide insights into product quality, fit, style, and other key attributes.

While reviews are invaluable to both consumers and sellers, manually analyzing vast amounts of textual data is a labor-intensive and time-consuming process. As the number of reviews grows, it becomes increasingly difficult for e-commerce platforms to process and extract meaningful insights. This challenge has led to the development of automated methods to streamline the analysis of online reviews. Sentiment analysis, also known as opinion mining, is one such method that has gained considerable attention. Sentiment analysis uses natural language processing (NLP) and machine learning techniques to automatically classify and extract subjective information from textual data, identifying whether the sentiment expressed in a piece of text is positive, negative, or neutral.

The primary goal of sentiment analysis in the context of e-commerce clothing reviews is to gauge customer satisfaction and understand consumer preferences. Understanding the sentiment behind a review can help retailers and manufacturers identify key strengths and weaknesses of their products, monitor brand reputation, and tailor marketing efforts to meet customer expectations. Moreover, positive or negative sentiment trends could help businesses identify potential issues related to sizing, material quality, delivery, or other features of the clothing items, which can, in turn, inform product development and improve the customer experience.

Traditional sentiment analysis approaches involved rule-based systems, where a predefined set of rules or dictionaries were used to determine sentiment. However, the advent of machine learning (ML) has significantly advanced the capabilities of sentiment analysis, particularly for tasks involving large volumes of text data. Machine learning algorithms can learn from large datasets and adapt to nuances in language, making them highly effective at identifying sentiment even in complex or ambiguous text. This is especially useful for e-commerce clothing reviews, where language can vary widely, from enthusiastic descriptions of a product's features to detailed complaints about sizing or quality.

The use of machine learning for sentiment analysis has shown remarkable promise, especially in the context of e-commerce. Recent studies have demonstrated that machine learning models can outperform traditional rule-based systems in terms of accuracy, scalability, and adaptability. Some of the most commonly used machine learning techniques for sentiment analysis include Naive Bayes, Support Vector Machines (SVM), and deep learning models, such as neural networks. Each of these models has its own strengths and limitations, and their effectiveness can vary depending on the nature of the data and the complexity of the task at hand.

Naive Bayes, for example, is a simple and efficient probabilistic model that assumes the features in the dataset are independent of one another. Despite its simplicity, Naive Bayes often performs well on text classification tasks, particularly when dealing with smaller datasets. Support Vector Machines (SVM) are another popular choice for sentiment analysis due to their ability to classify text in high-dimensional spaces. SVM works by finding a hyperplane that best separates the classes of data, making it particularly effective for binary classification tasks, such as distinguishing between positive and negative sentiments. On the other hand, deep learning

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models, particularly Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), have revolutionized sentiment analysis by offering superior performance on complex tasks involving large datasets. Deep learning models can automatically learn features from raw data and capture complex relationships within the text, making them highly effective for more intricate sentiment analysis tasks.

The use of these machine learning techniques requires careful consideration of several factors, such as data pre-processing, feature extraction, and model evaluation. In the case of e-commerce clothing reviews, the text data can often be noisy, containing spelling errors, slang, and informal language, which can pose challenges for sentiment analysis models. As such, pre-processing steps such as tokenization, stop word removal, and stemming are critical for cleaning the text data and ensuring that the models can effectively learn from the content. Additionally, feature extraction methods such as Term Frequency-Inverse Document Frequency (TF-IDF) and word embedding (e.g., Word2Vec) are commonly used to convert textual data into numerical representations that machine learning models can understand.

Furthermore, evaluating the performance of sentiment analysis models is an essential step in ensuring their reliability and effectiveness. Common evaluation metrics include accuracy, precision, recall, and F1-score, all of which provide insights into the model's ability to correctly classify sentiment. Precision and recall are particularly important in sentiment analysis tasks, as they measure how well the model identifies positive or negative sentiments without misclassifying them as neutral, and vice versa. The F1-score, which is the harmonic mean of precision and recall, is a good indicator of overall model performance, especially when the data is imbalanced.

This study aims to contribute to the growing body of knowledge on sentiment analysis in e-commerce by applying machine learning techniques to analyze clothing reviews from e-commerce platforms. Specifically, we will explore the effectiveness of different machine learning algorithms—Naive Bayes, SVM, and deep learning models—in classifying sentiment in clothing-related reviews. By conducting a comprehensive analysis of these models' performance, we aim to provide valuable insights for e-commerce retailers, helping them understand customer sentiment more effectively and improve their business strategies.

In summary, sentiment analysis plays a crucial role in modern e-commerce, enabling businesses to tap into the wealth of data provided by customer reviews. With the power of machine learning, automated sentiment analysis can provide valuable, actionable insights into customer opinions on clothing products, ultimately enhancing customer experience, driving sales, and fostering brand loyalty.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

The field of sentiment analysis, particularly in e-commerce, has been a topic of growing interest for several years due to the increasing amount of user-generated content available on digital platforms. With the expansion of e-commerce, the volume of customer reviews has surged, making manual analysis of such data practically impossible. Sentiment analysis, which automatically identifies and extracts subjective information from text, has emerged as a promising solution to handle this vast amount of data. While traditional methods for sentiment

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classification, such as rule-based systems, were initially used, the application of machine learning (ML) has significantly advanced the field, enabling more accurate, scalable, and efficient sentiment analysis.

Recent studies have demonstrated the effectiveness of machine learning techniques, particularly in the realm of e-commerce product reviews. Various ML algorithms, including Naive Bayes, Support Vector Machines (SVM), and deep learning models, have been applied to classify sentiment in customer reviews. These methods have shown significant improvements over older, rule-based systems, particularly in terms of handling the complexity of natural language and ambiguous expressions. Deep learning techniques, such as Recurrent Neural Networks (RNNs) and Convolutional Neural Networks (CNNs), have further enhanced sentiment analysis by enabling models to automatically learn features from raw text data, making them more adaptable to a variety of text forms.

Several studies have applied sentiment analysis to e-commerce reviews, with a focus on understanding consumer behavior and improving the customer experience. Research has explored sentiment analysis in various sectors, including electronics, books, and travel, with a few studies specifically examining clothing and fashion. For example, some research has focused on identifying key attributes in clothing reviews, such as material quality, sizing, fit, and design. Such insights are valuable for both businesses and consumers, as they can guide product development, marketing strategies, and personalized recommendations.

Despite the progress in sentiment analysis research, challenges remain, especially when applied to the clothing sector in e-commerce. One key challenge is the informal and subjective nature of clothing reviews. These reviews often contain nuanced language, slang, and mixed sentiments, which can complicate the sentiment classification task. While deep learning models, particularly those using pre-trained word embeddings like Word2Vec and BERT (Bidirectional Encoder Representations from Transformers), have improved sentiment analysis accuracy, they still face challenges in handling certain language complexities, such as irony, sarcasm, and context-dependent sentiments. Furthermore, the clothing sector is diverse, with reviews spanning various categories, such as casual wear, formal wear, and activewear, each with unique linguistic patterns.

Another area of active research is the handling of imbalanced datasets, which are common in sentiment analysis tasks. In e-commerce clothing reviews, there may be a large number of neutral or positive reviews compared to negative ones, which could lead to skewed model predictions. Researchers are exploring techniques such as data augmentation, over-sampling, and under-sampling to address this issue and ensure that sentiment analysis models are trained on balanced datasets, thus improving their performance.

Moreover, research has also focused on improving the interpretability and explainability of sentiment analysis models. In e-commerce, businesses and consumers alike are interested not only in the sentiment classification but also in understanding the reasons behind the sentiment. This has led to the development of explainable AI (XAI) methods, which aim to make machine learning models more transparent and interpretable. For example, attention mechanisms in deep learning models have been used to highlight specific words or phrases in reviews that contributed to the sentiment classification. Such techniques can provide valuable insights to businesses, enabling them to pinpoint specific product features that influence customer

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opinions.

In terms of practical applications, several e-commerce platforms and retailers have begun integrating sentiment analysis into their customer service and marketing strategies. By automatically analyzing customer feedback, these platforms can respond quickly to emerging trends, address product issues, and tailor marketing efforts to specific customer needs. For example, sentiment analysis can be used to identify potential quality control issues in clothing products or detect customer dissatisfaction with sizing, leading to improvements in inventory management or product design. Additionally, sentiment analysis is increasingly being used in personalized recommendation systems, where customer feedback helps generate more accurate product recommendations.

While significant progress has been made in sentiment analysis of e-commerce clothing reviews, there remains a need for further research to address the remaining challenges. The application of more advanced machine learning models, along with innovative techniques for dealing with noisy, subjective data and imbalanced classes, will continue to improve the accuracy and reliability of sentiment analysis systems. Furthermore, future research could explore how sentiment analysis can be integrated with other data sources, such as customer demographics and purchase history, to enhance business decision-making and provide more personalized experiences for consumers.

In conclusion, the current research in sentiment analysis of e-commerce clothing reviews demonstrates substantial progress, particularly in the adoption of machine learning and deep learning techniques. However, challenges related to language complexity, data imbalance, and model interpretability persist. By addressing these challenges, future research can further enhance the effectiveness of sentiment analysis systems and improve their application in the clothing sector of e-commerce. This study aims to build upon existing research by evaluating the effectiveness of different machine learning models in classifying sentiment in clothing reviews, offering new insights that can benefit both retailers and consumers alike.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1.To Evaluate and Compare the Performance of Different Machine Learning Algorithms for Sentiment Analysis

2.To Develop a Data Preprocessing Pipeline for E-commerce Clothing Reviews

3.To Investigate the Impact of Imbalanced Data on Model Performance and Propose Solutions

4.To Analyze the Sentiment Trends in E-commerce Clothing Reviews and Provide Business Insights

5.To Explore the Effectiveness of Advanced Deep Learning Models for Sentiment Analysis in Clothing Reviews

6. Significance of the proposed study: (300 words)

The proposed study on sentiment analysis of e-commerce clothing reviews using machine

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learning holds significant value for both businesses and consumers. With the increasing volume of customer reviews in e-commerce, especially in the clothing sector, it becomes challenging for businesses to manually analyze and extract meaningful insights from this vast data. Automating sentiment analysis through machine learning will provide businesses with an efficient and scalable method to understand customer opinions, ultimately leading to improved customer satisfaction and loyalty.

The study aims to enhance the customer experience by enabling e-commerce platforms to swiftly identify and respond to issues raised in reviews, such as product quality, sizing, or delivery concerns. By analyzing customer sentiment, businesses can make informed decisions to refine product offerings, adjust sizing guidelines, and improve quality control, ensuring that customer preferences are met. Additionally, identifying positive and negative sentiment trends allows businesses to adjust their marketing strategies, focusing on product features that resonate with consumers and addressing areas that may lead to dissatisfaction.

Furthermore, this research will contribute to the advancement of sentiment analysis in natural language processing (NLP), particularly in the context of e-commerce clothing reviews. The study will explore and compare the effectiveness of various machine learning models, including deep learning approaches, in classifying sentiment accurately. By improving the accuracy and robustness of sentiment analysis models, the study will help e-commerce platforms generate more reliable insights from customer feedback.

In addition to benefiting businesses, this study will also contribute to personalized recommendation systems, allowing e-commerce platforms to offer tailored suggestions based on customer sentiment. Overall, the proposed research will provide valuable insights for enhancing business strategies, improving customer experience, and advancing sentiment analysis techniques in the e-commerce industry.

7. Relevance of the proposed study to Gujarat: (200 words)

The relevance of the proposed study lies in its ability to address key challenges faced by e-commerce businesses, particularly in the clothing sector, by leveraging machine learning for sentiment analysis of customer reviews. In today's digital marketplace, customer reviews are a critical source of feedback, influencing purchasing decisions and shaping brand perceptions. However, the sheer volume of reviews makes it difficult for businesses to manually analyze and extract actionable insights. Sentiment analysis, particularly using machine learning, offers a solution by automating this process and enabling businesses to quickly understand customer feelings and opinions on their products.

For e-commerce platforms, understanding customer sentiment is highly relevant to improving customer experience. With clothing products, where fit, quality, and design are paramount concerns, customer reviews provide essential information. By analyzing sentiment, businesses can identify product strengths and weaknesses and make data-driven decisions to improve product offerings, marketing strategies, and customer support. Moreover, sentiment analysis can help detect trends or recurring issues related to product sizing, material quality, or customer service, allowing businesses to address them proactively.

The study's relevance extends beyond business operations. In the context of increasing reliance

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on personalized shopping experiences, sentiment analysis can enhance recommendation systems by incorporating customer feedback into product suggestions. This creates a more tailored shopping experience, improving customer satisfaction and increasing sales. Furthermore, this research contributes to the advancement of machine learning in natural language processing (NLP), specifically in e-commerce, where reviews contain informal, often complex language that poses challenges for traditional methods of analysis.

Overall, the proposed study is highly relevant as it addresses the evolving needs of the e-commerce sector, helping businesses make informed decisions and stay competitive in a dynamic marketplace.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The proposed research on sentiment analysis of e-commerce clothing reviews using machine learning holds significant potential to benefit society, particularly in the state of Gujarat, known for its thriving textile and apparel industry. The expected findings of this study can have a far-reaching impact on multiple aspects of the local economy, consumer behavior, and business practices in Gujarat.

1. Empowering Local E-commerce and Clothing Businesses

Gujarat is home to numerous small and medium-sized clothing businesses, both traditional and digital. The implementation of sentiment analysis can help these businesses better understand customer preferences, allowing them to refine their product offerings and enhance their customer service. By automating the analysis of customer reviews, local businesses can swiftly identify issues related to product quality, sizing, or design, leading to improvements in product development and marketing strategies. This, in turn, can increase customer satisfaction and brand loyalty, helping local businesses remain competitive in a rapidly evolving digital marketplace.

2. Boosting the Textile Industry's Growth

Gujarat's textile industry is a major contributor to the state's economy. By integrating sentiment analysis into e-commerce platforms, textile and apparel manufacturers can gain valuable insights into consumer sentiment and market trends, allowing them to better align their products with consumer demand. This will foster innovation, improve product quality, and ultimately drive growth in the textile sector, creating more job opportunities and strengthening the state's economic position in the national and global markets.

3. Improved Consumer Awareness and Satisfaction

The proposed research will help consumers make more informed decisions by providing more accurate and reliable product insights. Sentiment analysis can also highlight specific product attributes that align with consumer preferences, ensuring a better shopping experience. This increased transparency in e-commerce will empower consumers in Gujarat to make more confident and satisfying purchases.

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4. Promoting Data-Driven Decision Making

The study will encourage the adoption of data-driven practices in businesses across Gujarat. By utilizing machine learning models to analyze customer feedback, local businesses can make more informed decisions, leading to improved products and services. This transition to data-driven decision-making can improve the overall efficiency of Gujarat's e-commerce sector, supporting the state's growth as a key player in the digital economy.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The methodology of the proposed study involves a systematic approach to achieve the objectives of sentiment analysis of e-commerce clothing reviews using machine learning techniques. This section outlines the key research activities, hypothesis, sampling plan, data collection, and data analysis procedures.

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Hypothesis

The core hypothesis of this study is:
"Machine learning algorithms can effectively classify the sentiment of e-commerce clothing reviews, and deep learning models will outperform traditional models in terms of accuracy and robustness."
This hypothesis will be tested by comparing the performance of various machine learning models in classifying sentiment in customer reviews from e-commerce clothing platforms.

Research Activities

1. **Literature Review**

   An in-depth literature review will be conducted to explore the existing methods in sentiment analysis, specifically applied to e-commerce and clothing reviews. This review will help in understanding the state-of-the-art techniques and identifying gaps in existing research, especially in the context of the clothing industry.

2. **Data Preprocessing**

   A critical activity in sentiment analysis is the preprocessing of text data. The collected reviews will be cleaned to remove noise such as irrelevant information, special characters, and duplicates. Natural language processing (NLP) techniques such as tokenization, stop-word removal, and stemming/lemmatization will be applied to transform the raw text data into a structured format suitable for machine learning models.

3. **Model Selection and Training**

   The study will employ a range of machine learning models, including traditional algorithms like Naive Bayes and Support Vector Machines (SVM), and deep learning techniques such as Recurrent Neural Networks (RNN) and Convolutional Neural Networks (CNN). The models will be trained using labeled datasets of clothing reviews and tested using a separate test dataset to ensure their generalizability and effectiveness in sentiment classification.

4. **Evaluation and Comparison**

   The performance of each model will be evaluated using standard evaluation metrics such as accuracy, precision, recall, and F1-score. Cross-validation techniques will be employed to validate model performance and prevent overfitting. The results of various models will be compared to identify the most effective approach for sentiment analysis in the context of clothing reviews.

Sampling Plan

The dataset will be drawn from publicly available reviews on popular e-commerce platforms like Amazon, Flipkart, and Myntra, specifically focusing on clothing products. Reviews will be filtered to include only those in English, and ratings will be balanced across positive, negative, and neutral sentiments. A random sample of these reviews will be selected, with 70% used for

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training the models and 30% reserved for testing.

Data Collection

Data will be collected using web scraping techniques or through publicly available APIs from e-commerce platforms. The data will include review text, product ratings, and additional metadata such as the product category, brand, and review date. The dataset will consist of thousands of reviews to ensure diversity and robustness.

Data Analysis

1. **Feature Extraction**

   Reviews will be transformed into numerical features using text vectorization methods like TF-IDF (Term Frequency-Inverse Document Frequency) or word embeddings (e.g., Word2Vec or GloVe). This will allow the machine learning models to process the text data effectively.

2. **Sentiment Classification**

   The machine learning models will classify the sentiment of each review into three categories: positive, negative, or neutral. Sentiment analysis will be based on the patterns and linguistic features extracted from the review text.

3. **Model Evaluation**

   The models will be evaluated based on their classification accuracy, precision, recall, and F1-score. The results will provide insight into which model is most effective for sentiment analysis of clothing reviews.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The proposed research will be carried out in a phased manner, ensuring systematic progress and efficient achievement of the study's objectives.

Phase 1: Literature Review and Framework Development (Weeks 1-3)

The research will begin with an extensive review of existing literature on sentiment analysis in e-commerce, focusing on the clothing sector. This will help identify gaps in current methodologies and shape the theoretical framework for the study.

Phase 2: Data Collection and Preprocessing (Weeks 4-6)

A dataset of clothing reviews will be collected from e-commerce platforms using web scraping or APIs. The data will include reviews, ratings, and product metadata. Data preprocessing will follow, involving text cleaning, tokenization, stopword removal, and stemming/lemmatization to prepare the data for analysis.

Phase 3: Model Training and Evaluation (Weeks 7-10)

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Various machine learning models, such as Naive Bayes, SVM, and deep learning techniques (RNN, CNN), will be trained on the preprocessed data. These models will then be evaluated based on accuracy, precision, recall, and F1-score, using a 70-30 training-test split.

Phase 4: Results Analysis and Final Report (Weeks 11-12)

After model comparison, the results will be analyzed to determine the best performing algorithm. A final report will be drafted, summarizing the findings, conclusions, and recommendations for businesses in the e-commerce clothing industry.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review and Framework Development	Month 1	2022	Month 2	2022
2.	Data Collection and Preprocessing	Month 2	2022	Month 3	2022
3.	Model Selection, Training, and Evaluation	Month 3	2022	Month 4	2022
4.	Results Analysis and Model Comparison	Month 4	2022	Month 5	2022
5.	Final Report Drafting and Submission	Month 5	2022	Month 6	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	-	-	200000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	-	-	10000
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	30000

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4.	Stationery and Printing (With justification)	-	-	10000
5.	Any other special requirement	-	-	70000
6.	Overhead (10% of recurring)	-	-	-
	TOTAL	**-**	**-**	**320000**

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Subscription**	-	-	200000
2.	**Travel**	No. of Times in a month	-	-
	a) Conference	-	3 day	50000
	b) Paper Publication	2	-	50000
3.	**Stationery and printing**	-	-	-
	a) Thesis	-	-	10000
	b) Stationery	-	-	10000
	Grand Total	-	-	320000

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Part -A

(General Information)

1.	Title of the proposal	The Role of Limit and Continuity in Mathematics
2.	Broad area of proposal	Mathematics
3.	Sub Area of proposal	Definition and Basic Concepts, Techniques for Evaluating Limits, Types of Continuity, Advanced Theorems and Results
4.	Details of Principal Investigator (PI)	

	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Dr. Neha P. Jamvecha	Assistant Professor-Mathematics	9016422762
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	-	-	-
6.	Whether the proposal is transdisciplinary?	Yes / No	
7.	Date of Birth of PI (DD/MM/YYYY)	30/07/1993	
8.	Date of joining the Department of PI (DD/MM/YYYY)	15/03/2021	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	-	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Mathematics	Saurashtra University	2020	-
ii.	Post Graduation	Mathematics	Saurashtra University	2015	91.2
iii.	Under Graduation	Mathematics	Saurashtra University	2013	78.10
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	✓YES	• NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	• short-term fellowship (vizProject fellow, Project assistant, etc.)	
		✓ pre-doctoral fellowship (vizCSIR/UGC JRF or any other)	
		• post-doctoral fellowship (vizD S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	Fellowship from department of science and technology	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (3.5 Year)
		Research Experience: (4 Year)
7.	No. of Publication (Research articles - UGC Approved only)	National: 3
		International: 4
8.	No. of Publication (Book Chapters)	-
	Books Published	-
(Please enclose the list of papers and books published and/or accepted during last five years)		

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

The Role of Limit and Continuity in Mathematics

2. Abstract (Provide a summary of your research proposal in 300 words)

The purpose of this study is to investigate the basic ideas of limit and continuity in mathematics, with an emphasis on their theoretical underpinnings, real-world applications, and connections to other mathematical ideas. A key idea in calculus, the limit concept characterizes how functions behave as they get closer to certain locations, whereas continuity defines functions that are continuous and do not change suddenly. The foundation for comprehending derivatives, integrals, and convergence in sequences and series, these ideas are essential to genuine analysis.

The study will look at how these concepts have evolved over time, starting with Cauchy's early ideas and ending with Weierstrass' formalization of them. It will analyze important theorems like the Intermediate Value Theorem and Extreme Value Theorem, as well as their involvement in more sophisticated domains like functional analysis and complex analysis. It will also look at their importance in calculus, real analysis, and topology. Furthermore, the study will explore real-world applications in a variety of disciplines, such as computer science, physics, engineering, and economics, where limits and continuity aid in the modeling and resolution of real-world issues.

Computational tools, case studies, and theoretical analysis will all be part of the methodology. We will examine important subjects including L'Hopital's Rule, the Bolzano-Weierstrass theorem, and the ε-δ definition of limits. To demonstrate the usefulness of these ideas in practice, real-world applications will also be looked at, including thermodynamics and optimization issues.

A greater theoretical grasp of boundaries and continuity, an awareness of their application in many fields, and improved comprehension of how these ideas might be taught more successfully are among the anticipated results. This research will contribute to both scholarly and instructional breakthroughs in the comprehension of core mathematical concepts.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Many people refer to mathematics as the language of the cosmos because it contains basic ideas that serve as the basis for both practical application and abstract thought. Two such crucial ideas that form the basis of calculus and analysis are limit and continuity. In addition to serving as the foundation for sophisticated mathematical disciplines like differential equations, real analysis, and topology, these concepts have numerous applications in physics, engineering, economics, and other domains.

A framework for comprehending how functions behave as they get closer to particular points, either in terms of inputs or outputs, is provided by the limit concept. Functions that do not show abrupt jumps or breaks within their domain are described by the concept of continuity, which is closely related to limits. These concepts are essential to mathematical analysis and to gaining a deeper understanding of how mathematical models and functions behave.

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With an emphasis on their theoretical significance, real-world applications, and connections to other mathematical concepts, this study attempts to investigate the function of limits and continuity in mathematics.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Beginning with the early work of Cauchy, Weierstrass, and Bolzano, the study of limit and continuity in mathematics has a long and illustrious history. With rigorous definitions and theorems that support a large portion of contemporary mathematics, the fundamental ideas of limit and continuity are essential to calculus, real analysis, and topology. However, the field's research has developed to investigate increasingly sophisticated applications, including differential equations, complex analysis, and functional analysis.

Applications of limit and continuity outside of traditional calculus are becoming more and more prominent in current research. These ideas are used, for instance, in applied mathematics in fields like computational modeling, optimization, and numerical analysis, where it is essential to comprehend how functions behave in a continuous domain. In quantum mechanics, control systems, and machine learning, where limits and continuous functions are essential to algorithmic development and system stability, research has also increased.

However, more multidisciplinary research is needed, particularly in fields like econometrics and environmental modeling where continuity and limits can improve modeling techniques. Additionally, pedagogical research on effective teaching methods for these concepts is still essential, especially in regions like Gujarat where improving students' mathematical literacy can boost their academic achievement.

Overall, even though the theoretical underpinnings of limits and continuity are solid, there is still room for innovation in their real-world applications.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To look into the mathematical underlying principles and historical evolution of limit and continuity.
2. To investigate the theoretical ramifications of continuity and limit in mathematical analysis, particularly in real analysis and calculus.
3. To investigate how limit and continuity are used in other areas of mathematics, including complex analysis, differential equations, and topology.
4. To examine practical applications in domains such as computer science, physics, engineering, and economics where the ideas of limit and continuity are used.
5. To determine how continuity, differentiability, and integrability are related to one another and how limits are important in these relationships.

6. Significance of the proposed study: (300 words)

Academic Contribution: It will deepen our understanding of the ways in which limits and continuity support a variety of complex mathematical ideas and their uses.

Educational Value: It will promote a deeper understanding of calculus and real analysis by providing fresh pedagogical insights into how these fundamental ideas can be taught and comprehended by

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students.

Practical Relevance: By highlighting their relevance in science, technology, and economics, the study will draw attention to the significance of boundaries and continuity in resolving real-world issues.

7. Relevance of the proposed study to Gujarat: (200 words)

Given Gujarat's emphasis on industry, education, technology, and economic development, the proposed study on the role of limit and continuity in mathematics is highly relevant to the state. With significant industries in engineering, pharmaceuticals, textiles, chemicals, and information technology, Gujarat boasts a thriving industrial sector. The design and optimization of processes in these industries heavily relies on the ideas of limits and continuity. Understanding continuous functions and limits, for example, aids in the optimization of production systems, increases productivity, and improves the quality of the final product in engineering and manufacturing.

A better-trained workforce can also result from enhancing the teaching and learning of basic mathematical concepts, as the state places a strong emphasis on STEM education. The study will shed light on more efficient teaching methods for calculus and help students gain a deeper comprehension of mathematical concepts, especially in domains like technology, engineering, and economics.

Furthermore, a strong mathematical foundation is necessary for Gujarat's expanding technology sector, especially in fields like machine learning and data analytics. The development of algorithms, statistical models, and simulations relies heavily on ideas like limits and continuity, which have a direct influence on innovation and the expansion of the state's technology-driven industries.

This study is therefore extremely pertinent to Gujarat's objectives of improving the quality of its education, promoting technological innovation, and fostering industrial growth.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

There could be substantial societal benefits from the proposed study on the function of limit and continuity in mathematics, especially for the state of Gujarat. The results can benefit different facets of Gujarat's economy and society by improving the theoretical comprehension and real-world application of these core ideas.

1. Education: The enhancement of mathematics instruction is one of the main advantages. Students who want to work in the fields of science, technology, engineering, and mathematics (STEM) must have a solid understanding of boundaries and continuity. The study will give teachers fresh perspectives on how to better teach these abstract ideas, which will improve student performance and comprehension. A more mathematically literate populace can help Gujarat develop a skilled labor force, which is necessary to spur innovation and expansion across a range of industries.
2. Technology and Innovation: Gujarat is renowned for having a robust industrial base, especially in fields like information technology, petrochemicals, and engineering. Research can have a direct impact on technological innovations and advancements by expanding mathematical understanding, especially in fields like computational methods, optimization, and system modeling. In fields like algorithm development, numerical simulations, and machine learning—all of which are essential to Gujarat's manufacturing and IT sectors—limits and continuity are crucial.
3. Economic Development: More effective economic strategies may result from the application of these ideas in economics, especially in modeling and optimization. For example, supply chain management and the development of stable fiscal policies can both benefit from an

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4.	understanding of the continuity of economic models. Additionally, by fostering the growth of new industries and technologies, the research will help Gujarat's economy and job market. Scientific Research and Industry Applications: The results can also improve research in areas like engineering, environmental science, and pharmaceuticals, leading to more effective problem-solving methods and procedures that benefit the public sector as well as regional businesses.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	
2.	Agriculture	
3.	Health and wellness	
4.	Nutrition	
5.	Development of Industrial Problem Solutions	✓
6.	Resources management and sustainable development	
7.	High Impact Teaching	✓
8.	Imparting corporate responsibility, ethics, accountability and values in society	
9.	Social entrepreneurship	
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

A theoretical and applied approach will be used in this study, which will include:

Mathematical Analysis: We will examine the definitions, characteristics, and theorems pertaining to limits and continuity using exacting proof-based techniques. We will examine important findings like the Heine-Borel theorem, Bolzano-Weierstrass theorem, and the ε-δ definition of limits.

Case Studies and Applications: We will examine the real-world applications of limit and continuity concepts by looking at case studies from the fields of economics (such as optimization problems) and physics (such as thermodynamics or quantum mechanics). Limit-based approximations will be used in real-world scenarios, such as fluid dynamics and control systems, where model stability is guaranteed by continuity.

Computational Tools: With an emphasis on numerical techniques such as Newton's method for root-finding and finite differences, we will examine the function of computational approaches in approximating limits and determining continuous functions in mathematical modeling.

Interviews and Surveys: In order to comprehend the usefulness of these ideas in instruction and real-world applications, the research will, where appropriate, involve informal interviews or surveys with mathematicians, educators, and practitioners in related fields.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The following is the recommended course of action for this study on the function of limit and

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continuity in mathematics:
Book Review (1 year): Start by going over the foundational literature and current research on limit and continuity, paying particular attention to their theoretical underpinnings, historical evolution, and important mathematical theorems. This will encompass the writings of Weierstrass and Cauchy as well as more recent developments in topology and real analysis.
(2nd year) Theoretical Analysis Examine the mathematical ideas of limits and continuity in detail, taking note of their properties, rigorous definitions (such as the ε-δ definition of limits), and relationships to other ideas like differentiability and integrability. We'll go into great detail about important theorems like the Bolzano-Weierstrass theorem and the Intermediate Value Theorem.
Application Exploration (3rd year): Examine the applications of limits and continuity in practical issues in disciplines such as computer science, physics, engineering, and economics. Practical applications like fluid dynamics, optimization, and numerical techniques will be demonstrated through case studies.
Analysis of the Data and Conclusion (4th year): Examine the results of the investigation, both theoretical and practical. Compile the findings into a thorough final report that emphasizes the theoretical importance of limit and continuity concepts as well as their practical applications.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Book Review	June	2022	June	2023
2.	Theoretical Analysis	June	2023	June	2024
3.	Application Exploration	June	2024	June	2025
4.	Analysis of the Data and Conclusion	June	2025	June	2026
5.	Final Reserach Conclusion	June	2026	June	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Travelling (viz. sample collection, should be Minimum and with justification)	95,000		95,000
2.	Contingency (Upto maximum for Rs. 3000/-)			
3.	Stationery and Printing (With justification)	Books: 90000 Printings: 35000		1,25,000

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4.	Any other special requirement	Laptop: 1 Lakh Software: 2 Lakh Publication Charges: 3 Lakh Paper subscription: 2 Lakh		8,00,000
	TOTAL			10,20,000

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	Travel	No. of Times in a month		
	a) Purpose 1	Workshop/ Seminar /Conferences (Rs. 95000)	5 Years	
	b) Purpose 2			
2.	Stationery and printing			
	a) Purpose 1	Books (90,000)	5 Years	
	b) Purpose 2	Printing (35000)	5 Years	
3.	Any other special requirement	Laptop: 1 Lakh Software: 2 Lakh Publication Charges: 3 Lakh Paper subscription: 2 Lakh	5 Years	
	Grand Total	10,20,000		

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Application form

Part -A

(General Information)

1.	Title of the proposal	The Influence of Financial Literacy on Working Capital Management and Profitability: A Study of SMEs in Urban and Semi-Urban India	
2.	Broad area of proposal	Commerce, Accounting, and Finance	
3.	Sub Area of proposal	Financial Literacy, Working Capital Management, Profitability, SME Operations in Urban and Semi-Urban India and SDGs	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Ms. Nirali Rameshbhai Shah	Assistant Professor	9429706130 nirali.shah@atmiyauni.ac.in
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	NA	NA	NA
6.	Whether the proposal is transdisciplinary?	Yes / No	
7.	Date of Birth of PI (DD/MM/YYYY)	05/10/1997	
8.	Date of joining the Department of PI (DD/MM/YYYY)	01/03/2021	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university		

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Commerce	Saurashtra University	Pursuing	-
ii.	Post Graduation	Commerce (M.Com.)	Saurashtra University	2020	84.5%
iii.	Under Graduation	Commerce (B.Com.)	Saurashtra University	2018	79.09%
iv.	CSIR/UGG-NET/ SLET/GATE	UGG-NET (Commerce)	National Testing Agency (NTA)	December 2019, June 2020, December 2020 – June 2021	NA

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	☐ ✓NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐ short-term fellowship (viz Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	NA	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	NA	NA	NA	NA	NA

6.	Total Experience	Teaching Experience: 1 Year + 4 Months

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		Research Experience: NA
7.	No. of Publication (Research articles - UGC Approved only)	National:0
		International:0
8.	No. of Publication (Book Chapters)	0
	Books Published	0
(Please enclose the list of papers and books published and/or accepted during last five years)		

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

The Influence of Financial Literacy on Working Capital Management and Profitability: A Study of SMEs in Urban and Semi-Urban India

2. Abstract (Provide a summary of your research proposal in 300 words)

Small and Medium Enterprises (SMEs) form the backbone of India's economy, contributing significantly to GDP and employment. Despite their importance, many SMEs face persistent challenges in managing their working capital, which adversely impacts their profitability and sustainability. Financial literacy, the ability to understand and effectively apply financial knowledge, has emerged as a critical factor in enhancing financial decision-making. This research explores the influence of financial literacy on working capital management and its subsequent impact on the profitability of SMEs operating in urban and semi-urban India.

The study aims to assess the financial literacy levels of SME owners, examine their working capital management practices, and evaluate how these factors correlate with profitability. Using a descriptive and causal research design, data will be collected from 200 SMEs through structured questionnaires and interviews. The analysis will employ statistical techniques such as regression and correlation to identify relationships between financial literacy, working capital management, and profitability.

The findings of this study are expected to offer actionable insights into the role of financial literacy in improving business performance. It will also identify key barriers and enablers for implementing financial literacy-driven financial practices. By addressing the knowledge gaps in the Indian SME sector, this research will provide policy recommendations and practical strategies for fostering sustainable growth.

This study contributes to the existing literature by integrating financial literacy, working capital management, and profitability into a unified framework. It emphasises the critical need for capacity-building initiatives and financial education tailored to the unique needs of SMEs in urban and semi-urban India. The outcomes of this research could help entrepreneurs, policymakers, and financial institutions collaborate to enhance the financial sustainability of SMEs, ultimately driving economic development.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Small and Medium Enterprises (SMEs) are recognized globally as significant contributors to

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economic development and job creation. In India, SMEs account for approximately 30% of the GDP and 48% of the country's exports. Despite their vital role, these enterprises often face challenges in sustaining operations, primarily due to financial mismanagement and a lack of structured approaches to working capital management. These issues are exacerbated in urban and semi-urban areas, where access to financial resources, advisory services, and training remains limited. The proposed study seeks to address these challenges by examining the influence of financial literacy on working capital management and its subsequent impact on the profitability of SMEs.

Financial literacy is defined as the ability to understand and effectively apply various financial skills, including personal financial management, budgeting, and investing. It plays a critical role in empowering entrepreneurs to make informed decisions about resource allocation, debt management, and operational efficiency. This study aims to assess the current levels of financial literacy among SME owners in urban and semi-urban India, analyse their working capital management practices, and evaluate the extent to which financial literacy affects profitability.

The research will pursue several specific activities during the project period to achieve its objectives. First, a comprehensive literature review will be conducted to identify existing gaps in the study of financial literacy and its impact on SMEs. This will involve analysing national and international studies, government reports, and industry surveys to establish a theoretical framework for the research.

Second, primary data collection will be undertaken using a mixed-methods approach. Structured questionnaires will be distributed to SME owners to assess their financial literacy levels and working capital management practices. Qualitative interviews will also be conducted to capture in-depth insights into the challenges faced by these enterprises in managing their finances. The data collected will provide a robust foundation for understanding the interplay between financial literacy and SME performance.

Third, statistical tools will be employed to analyse the collected data. Techniques such as correlation, regression analysis, and factor analysis will be used to identify relationships between financial literacy, working capital efficiency, and profitability. This will enable the research to quantify the impact of financial literacy on business outcomes and uncover any mediating factors that may influence this relationship.

The importance of the proposed study lies in its potential to address a critical gap in existing literature and practice. While financial literacy has been extensively studied in the context of personal finance, its role in business management, particularly for SMEs in developing economies like India, remains underexplored. The findings of this research will contribute to a deeper understanding of how financial literacy can be leveraged as a tool for improving financial management and enhancing profitability in SMEs.

Moreover, the study has significant implications for policy and practice. It will provide

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actionable insights for policymakers to design targeted financial literacy programs tailored to the unique needs of SME owners. These programs could focus on practical skills such as cash flow management, debt financing, and investment planning, enabling entrepreneurs to navigate financial challenges more effectively.

For financial institutions, the study could serve as a guide to develop customised products and advisory services that align with the financial literacy levels and requirements of SME clients. This alignment would not only support SMEs in improving their financial health but also reduce the risks associated with lending to these enterprises.

The proposed research also aligns with the broader objectives of sustainable development. By empowering SME owners with financial knowledge and tools, the study aims to foster financial inclusion, reduce inequalities, and promote economic growth in urban and semi-urban regions. This, in turn, supports India's efforts to achieve the United Nations' Sustainable Development Goals (SDGs), particularly Goal 8 (Decent Work and Economic Growth) and Goal 9 (Industry, Innovation, and Infrastructure).

Furthermore, the research adopts a region-specific focus on urban and semi-urban SMEs, recognising the unique challenges and opportunities in these areas. Urban SMEs often operate in competitive markets with higher costs, while semi-urban SMEs may face infrastructural and logistical constraints. By analysing these dynamics, the study will provide nuanced recommendations for addressing the diverse needs of SMEs across different contexts.

In conclusion, the proposed study on the influence of financial literacy on working capital management and profitability among SMEs in urban and semi-urban India is both timely and relevant. It addresses a pressing issue faced by a critical segment of the economy, offering practical solutions to enhance their financial sustainability. By bridging the gap between financial knowledge and business performance, this research has the potential to create a significant impact at the individual, organizational, and policy levels. The findings will not only benefit SME owners but also contribute to the broader goal of strengthening India's economic foundation and driving inclusive growth.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research on financial literacy and its impact on business performance has gained prominence globally, particularly in the context of developed economies. Studies by Lusardi and Mitchell (2014) and Atkinson and Messy (2012) have demonstrated the positive correlation between financial literacy and financial decision-making, emphasizing its importance for personal and business financial outcomes. However, the application of these findings to the SME sector in developing countries like India remains limited.

In India, SMEs face unique challenges, including constrained access to credit, inadequate

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financial training, and limited adoption of financial management tools. Existing research predominantly focuses on general working capital management practices, as explored by Deloof (2003), or the broader impact of financial inclusion. While a few studies, such as those by Mahapatra and Panda (2020), highlight the importance of financial literacy for SMEs, most lack empirical evidence specific to urban and semi-urban regions.

There is a clear research gap in understanding how financial literacy influences working capital management and profitability in Indian SMEs. This study aims to address this gap by integrating financial literacy, operational efficiency, and profitability into a unified framework, supported by primary data from SMEs in diverse settings. This will provide valuable insights into enhancing SME sustainability in India.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To evaluate the financial literacy levels of SME owners in urban and semi-urban India.
2. To investigate the working capital management practices adopted by SMEs and their alignment with financial literacy.
3. To analyse the impact of financial literacy on the profitability of SMEs using key financial indicators.
4. To explore the mediating factors influencing the relationship between financial literacy, working capital management, and profitability.
5. To develop policy recommendations aimed at enhancing financial literacy and improving financial practices among SME owners.
6. To support sustainable development goals by promoting financial inclusion and sustainable economic growth through improved financial literacy and management practices.

6. Significance of the proposed study: (300 words)

The proposed study is significant for several reasons, particularly in the context of the Indian economy, where SMEs play a crucial role in fostering economic growth and employment generation. SMEs in urban and semi-urban areas face unique challenges, such as limited access to formal financial services, high competition, and inadequate financial knowledge. By examining the influence of financial literacy on working capital management and profitability, this research addresses critical issues affecting the sustainability and growth of this vital sector.

Financial literacy empowers business owners to make informed decisions regarding resource allocation, cash flow management, and debt financing. However, the existing literature on this topic lacks a focused analysis of how financial literacy directly impacts working capital efficiency and profitability in the Indian SME context. This study bridges that gap by providing empirical evidence, helping to understand the role of financial knowledge in improving business performance.

The findings of this research will be valuable for multiple stakeholders. SME owners can benefit from actionable insights into enhancing their financial management practices. Policymakers can

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design targeted financial literacy programs and interventions to support SMEs, while financial institutions can develop products tailored to the needs of financially literate entrepreneurs.

Moreover, this study aligns with national priorities like "Make in India" and global sustainable development goals (SDGs), such as promoting inclusive economic growth and financial inclusion. By equipping SMEs with the knowledge and tools needed to thrive, the research has the potential to contribute to economic resilience and community development in urban and semi-urban India.

In summary, the study holds significant potential to address pressing challenges, support evidence-based policymaking, and enhance the overall competitiveness and sustainability of SMEs in the dynamic Indian business environment.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat is one of India's most industrially advanced states, known for its dynamic entrepreneurial spirit and thriving Small and Medium Enterprises (SMEs) sector. SMEs in Gujarat contribute significantly to the state's economy, particularly in industries such as textiles, chemicals, engineering, and pharmaceuticals. However, despite their prominence, many SMEs in Gujarat face challenges in financial management, primarily due to limited financial literacy and suboptimal working capital practices.

The proposed study holds significant relevance to Gujarat as it addresses these challenges by exploring the influence of financial literacy on working capital management and profitability. SMEs in the state, especially in urban and semi-urban regions, often operate in highly competitive markets, where efficient financial practices are critical for sustainability. The research will provide insights into how financial literacy can empower SME owners to optimize cash flow, reduce financial risks, and enhance profitability.

Additionally, Gujarat's strategic focus on initiatives like "Make in India" and its robust infrastructure make it an ideal setting to implement policy recommendations derived from this study. The findings can guide state-level interventions, such as financial literacy programs and SME-focused financial products, further strengthening Gujarat's position as a hub of economic growth and innovation.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings of the proposed research project hold significant potential to benefit society, especially in Gujarat, where SMEs form the backbone of the state's industrial and economic framework. These benefits can drive socioeconomic development and foster a more resilient

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SME ecosystem in the region.

Enhanced Financial Management Practices: The study will provide actionable insights into how financial literacy influences efficient working capital management. SME owners and managers can adopt better practices, improving operational efficiency and profitability, which directly contributes to the economic stability of the state.

Strengthened SME Sector: By addressing challenges specific to urban and semi-urban SMEs in Gujarat, the research will enable these businesses to sustain themselves in competitive markets. A robust SME sector generates employment opportunities, ensuring better livelihoods and reducing urban-rural disparities.

Informed Policy Interventions: The study will equip policymakers with evidence-based insights to design targeted financial literacy programs for SMEs in Gujarat. Such initiatives can bridge knowledge gaps, especially in semi-urban areas, and support regional economic growth.

Improved Access to Financial Resources: Financial institutions can utilize the findings to create tailored financial products and services, enabling SMEs to manage cash flow, inventory, and credit more effectively, reducing financial distress.

Socioeconomic Growth: A financially literate and efficient SME sector will boost Gujarat's industrial output, contribute to higher state revenue, and enhance the overall quality of life for its residents through job creation and improved economic conditions.

By addressing the unique challenges faced by Gujarat's SMEs and promoting sustainable practices, the study has the potential to drive long-term socioeconomic benefits, strengthening the state's position as a leader in India's economic landscape.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐ ☐

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6.	Resources management and sustainable development	☐ ☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The proposed study will follow a structured approach to explore the influence of financial literacy on working capital management and profitability among SMEs in Gujarat. The methodology involves several stages, including hypothesis development, sampling plan, data collection, and data analysis.

Research Activities

The study will first focus on assessing the level of financial literacy among SME owners and managers in urban and semi-urban regions of Gujarat. A comprehensive survey will be conducted to understand their knowledge of key financial concepts such as cash flow management, budgeting, and credit utilization. In parallel, the study will explore the working capital management practices of SMEs, examining areas like inventory control, accounts receivable, and cash management. Finally, the study will assess profitability using financial performance indicators, such as return on assets (ROA), net profit margin, and operating cash flow.

Hypothesis

The following hypotheses will be tested:

1. H1: There is a positive relationship between financial literacy and the efficiency of working capital management in SMEs in Gujarat.
2. H2: Efficient working capital management has a positive impact on the profitability of SMEs in Gujarat.
3. H3: Financial literacy positively influences the profitability of SMEs in Gujarat, mediated by working capital management.

Sampling Plan

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The target population for this study will consist of SME owners and managers in urban and semi-urban regions of Gujarat, including cities such as Ahmedabad, Surat, Vadodara, and Rajkot. A stratified random sampling technique will be used to ensure representation from different industry sectors (e.g., textiles, manufacturing, food processing). A sample size of 300-350 SMEs will be surveyed, with 15-20 interviews conducted for in-depth qualitative insights.

Data Collection

Primary data will be collected using a structured questionnaire, designed to assess financial literacy, working capital management practices, and profitability. The questionnaire will include both closed-ended and Likert-scale questions to quantify financial knowledge, practices, and performance. Secondary data will be gathered from company reports and financial statements to verify profitability measures.

Data Analysis

Quantitative data will be analysed using SPSS software. Descriptive statistics will be employed to summarize data, and inferential statistics, including regression analysis and correlation tests, will be used to assess the relationships between financial literacy, working capital management, and profitability. Qualitative data from interviews will be analysed thematically to provide deeper insights into financial decision-making processes.

By combining both quantitative and qualitative methods, the research will provide a comprehensive understanding of the role of financial literacy in shaping SME financial performance in Gujarat.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The proposed study will be carried out over a period of 6 to 8 months, following a systematic approach to ensure timely and effective execution of research activities. The plan of action is outlined as follows:

1. Phase 1: Literature Review and Framework Development (Month 1-2)
   Conduct an extensive review of existing literature on financial literacy, working capital management, and profitability in SMEs. Develop a conceptual framework based on the research gaps identified and finalize the hypotheses to be tested.
2. Phase 2: Questionnaire Design and Pilot Testing (Month 2-3)
   Develop a structured questionnaire to assess financial literacy, working capital practices, and profitability. The questionnaire will undergo pilot testing with a small group of SMEs to ensure clarity, reliability, and validity.
3. Phase 3: Data Collection (Month 3-5)
   Administer the finalized questionnaire to a sample of 300-350 SMEs across urban and semi-urban areas of Gujarat. Collect qualitative data through in-depth interviews with SME owners and managers to complement the survey results.
4. Phase 4: Data Analysis (Month 5-6)

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Analyse the collected data using SPSS for statistical analysis and thematic analysis for qualitative data. Evaluate the relationships between financial literacy, working capital management, and profitability.

5. Phase 5: Report Writing and Recommendations (Month 6-8)
   Compile the research findings, provide actionable recommendations for policymakers and SME owners, and prepare the final report, including conclusions and implications for SMEs in Gujarat.

This structured plan ensures comprehensive data collection, analysis, and timely delivery of results.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature Review & Secondary Data Collection	June	2022	August	2022
2.	Designing & Piloting the Questionnaire/Survey	September	2022	October	2022
3.	Primary Data Collection (Surveys/Interviews)	November	2022	January	2023
4.	Data Analysis (Statistical Tools & Interpretation)	February	2023	April	2023
5.	Report Writing & Presentation of Findings	May	2023	June	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	NA	NA	NA
2.	Travelling (viz. sample collection, should be Minimum and with justification)	13,200/-	10	1,32,000/-
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	3,000/-

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4.	Stationery and Printing (With justification)	-	-	1,45,000/-
5.	Any other specialrequirement (Book, Journals, Seminar , Conference and Hospitality) – [Justification given in 13b.]	-	-	1,50,000/-
6.	Overhead (10% of recurring)	-	-	20,000/-
	TOTAL			4,50,000/-

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	A. Chemicals	NA	NA	NA
2.	B. Glassware	NA	NA	NA
3.	C. Any other consumable items (like wires/ electric items etc)	NA	NA	NA
4.	Travel	No. of Times in a month		
	a) Travel for data collection in urban areas (5 trips)	66,000	2-4	Transportation, accommodation, and travel expenses for field trips
	b) Travel for data collection in semi-urban areas (5 trips)	66,000	2-4	Travel to semi-urban areas for sample collection
5.	Contingency	3,000	12M	-
6.	Stationery and printing			
	a) Printing and Photocopy	1,45,000	12M	Printing Documents, In case of requirement, arise anytime outside of campus
7.	Any Other			
	a) Field visit and Work	60,000	12M	Interview and Survey
	b) Seminar and Conferences	40,000		Books, Conference and Seminar.

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	and accommodation			
	c) Books and Publications in UGC CARE/WoS/Scopus	40,000		Books and Publication
	d) Hospitality	10,000		Hospitality
8.	Overhead	20,000		10% of above all
	Grand Total	4,50,000/-		

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	A Study on Factors Affecting Retail Investors Trading Strategies in Gujarat	
2.	**Broad area of proposal**	Behavioural Finance	
3.	**Sub Area of proposal**	Factors Influencing Retail Investors' Trading Strategies	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Ms. Nishita Thakrar	Assistant Professor, Department of Commerce	Mob No.: 8460145670 Email Id: Nishita.thakrar@atmiyauni.ac.in
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	----------	----------	----------
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	18/12/1998	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	22/01/2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**		

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	UGC NET	Commerce	-	2020	-
ii.	GSET	Commerce	-	2020	-
iii.	M.Com	Accounting & Finance	Saurashtra University	2020	85.15%
iv.	B.Com	Accounting & Finance	Saurashtra University	2018	81.205%

2.	**Have you previously received any Fellowship from any funding agency?**	☐ **YES**	[✓] **NO**
3.	**If yes, please indicate whether it was a (✓ tick appropriate)**	☐ **Short-term fellowship (*viz* Project fellow, Project assistant, etc.)**	
		☐ **pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)**	
		☐ **post-doctoral fellowship (*viz* D S Kothari PDF, or any other)**	
4.	**If yes, mention the details of fellowship and tenure**	**NA**	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	**Title**	**Project Cost**	**Sponsoring Agency**	**Duration (Start – End – MM/YYYY)**
		NA			
		NA			

6.	**Total Experience**	**Teaching Experience: (2Years)**
		Research Experience: (2 Years)
7.	**No. of Publication (Research articles - UGC Approved only)**	**National: 1**
		International: 0
8.	**No. of Publication (Book Chapters)**	**0**

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	Books Published	**1**
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Technological adoption and its impact on trading habits of retail investors in Gujarat.

2. Abstract (Provide a summary of your research proposal in 300 words)

This research examines the impact of technological adoption on the trading habits of retail investors in Gujarat, a state with a vibrant history of financial activity. The study explores the extent and patterns of technology usage, its influence on investment behavior, and the challenges faced by investors. Using a mixed-methods approach, the research will analyze data from 500 retail investors across Gujarat. Key objectives include understanding demographic factors influencing adoption, evaluating changes in decision-making, and identifying potential risks. The findings will contribute to behavioral finance literature, guide financial institutions, and support policymakers in fostering an inclusive and efficient financial ecosystem. By addressing the unique socio-economic context of Gujarat, the study aims to empower retail investors and promote sustainable financial growth.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Retail investors play a pivotal role in the financial markets, contributing significantly to trading volumes and market liquidity. Their trading strategies are shaped by a myriad of factors, including personal, socio-economic, psychological, and market dynamics. Gujarat, renowned for its entrepreneurial spirit and financial acumen, has a substantial base of retail investors actively participating in various asset classes.

This proposed study aims to explore the factors influencing the trading strategies of retail investors in Gujarat. The research will investigate:

Socio-demographic characteristics (age, income, education, etc.) and their impact on trading decisions.

Psychological factors such as risk tolerance, overconfidence, and herding behavior.

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The influence of market conditions, including volatility, trends, and news events.

The role of financial literacy and access to information in shaping strategies.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Existing research in behavioral finance has extensively studied the impact of psychological biases and market dynamics on investment behavior. However, studies focusing specifically on retail investors in Gujarat remain limited. The unique socio-cultural and economic characteristics of the region provide an untapped opportunity to understand how these factors interact locally. This research will bridge the gap by providing a focused analysis of Gujarat's retail investors, addressing both theoretical and practical aspects

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

To identify the key socio-economic and demographic factors influencing trading strategies of retail investors in Gujarat.

To examine the role of psychological factors such as risk perception, overconfidence, and behavioral biases.

To analyze the impact of market dynamics and news events on trading decisions.

To evaluate the influence of financial literacy and information accessibility on investment practices.

To assess the effect of technological adoption on retail investors' strategies.

6. Significance of the proposed study: (300 words)

Understanding the factors that drive retail investors' trading strategies is crucial for multiple stakeholders. For financial institutions, the insights can guide the design of customized products and services. For policymakers, the findings can inform initiatives to enhance financial literacy and safeguard investor interests. For retail investors, the study will offer strategies to optimize decision-making and achieve better financial outcomes. Furthermore, the research will contribute to behavioral finance literature by providing a localized perspective on investor behavior in Gujarat.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat's vibrant trading culture and its large base of retail investors make it an ideal setting for this research. The state's unique blend of traditional investment practices and rapid technological adoption presents an opportunity to study the evolution of trading strategies. By addressing the specific needs

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and challenges of Gujarat's investors, the study will support the development of an inclusive and robust financial ecosystem.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The research findings will have several societal benefits, particularly for Gujarat:

Empower retail investors with knowledge to make informed trading decisions.

Assist financial institutions in tailoring products and advisory services to meet investor needs.

Enhance financial literacy programs by highlighting critical areas of improvement.

Provide policymakers with insights to mitigate risks like market manipulation and behavioral biases.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	[✓]
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

The researcher will adopt a mixed-methods approach to ensure a comprehensive analysis.

Hypothesis: Retail investors' trading strategies are influenced by a combination of socio-economic, psychological, and market factors.

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Sampling Plan: A stratified random sampling method will be employed to select 500 retail investors across Gujarat, ensuring diversity in age, income, education, and trading experience.

Data Collection:

Primary Data: Structured surveys, in-depth interviews, and focus group discussions.

Secondary Data: Reports from financial institutions, trading platforms, and market studies.

Data Analysis:

Quantitative data will be analyzed using statistical methods such as regression analysis and factor analysis.

Qualitative data will be analyzed thematically to capture nuanced insights into investor behavior.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The study will be conducted in the following stages:

Year 1 (2021-2022):

1. Conduct a comprehensive literature review to establish theoretical foundations and refine the research hypothesis.
2. Develop and pilot test research instruments, including surveys and interview guides.
3. Collect preliminary data through pilot studies and focus groups to validate research tools.

Year 2 (2022-2023):

1. Conduct large-scale data collection from 500 retail investors across Gujarat, ensuring diversity in demographics and regions.
2. Analyze quantitative data using statistical techniques to identify patterns and correlations.
3. Conduct qualitative analysis of interview and focus group data to explore behavioural and contextual insights.

Year 3 (2023-2024):

1. Synthesize findings from both quantitative and qualitative analyses.
2. Draft a comprehensive research report with actionable recommendations.
3. Disseminate findings through academic publications, workshops, and presentations to stakeholders, including policymakers and financial institutions.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year

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1.	literature review, Pilot Study and Collection of preliminary data through pilot studies	July	2022	June	2023
2.	Collection of Data and Analysis of the Data	July	2023	June	2024
3.	Findings, Suggestions and Calculation of the research work and publication	July	2024	June	2025

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (Software and Tools)	----------	----------	---------- 45,000
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	5	14500 total KM	72,500
3.	Contingency (Upto maximum for Rs. 3000/-)	----------	----------	2,500
4.	Stationery and Printing (With justification)	----------	----------	50,000
5.	Any other special requirement	----------	----------	1,80,000
6.	Overhead (10% of recurring)	----------	----------	----------
	TOTAL			**3,50,000**

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Part -A

(General Information)

1.	**Title of the proposal**	Interactive Real-Time Polling and Feedback platform for Lectures	
2.	**Broad area of proposal**	Computer Science	
3.	**Sub Area of proposal**	Educational Technology, Artificial Intelligence, and Scalable Software Systems	
4.	**Details of Principal Investigator (PI)**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Dr. Prakash Prafulbhai Gujarati	Assistant Professor Computer Science	prakash.gujarati@atmiyauni.ac.in 9601026377 1114
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Dr. Hitendra Nanjibhai Donga	Professor Computer Science	hitendra.donga@atmiyauni.ac.in 9925022399 5011
6.	**Whether the proposal is transdisciplinary?**	No	
7.	**Date of Birth of PI (DD/MM/YYYY)**	25/07/1990	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	01-03-2015	
9.	**Whether the PI is registered for Ph.D. on the same topic**	YES	
10.	**If yes then name of university**	Saurashtra University	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Computer Science	Saurashtra University	2021	-
ii.	Post Graduation	M.C.A.	Gujarat Technological University	2015	88
iii.	Under Graduation	B.C.A.	Saurashtra University	2013	86.3
iv.	CSIR/UGG-NET/ SLET/GATE	-	-	-	-

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	✓NO
3.	If yes, please indicate whether it was a (✓ tick appropriate)	☐ short-term fellowship (*viz* Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure	NA	

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	-	-	-	-	-
	-	-	-	-	-

6.	Total Experience	Teaching Experience: (9 Year + 9 Months)
		Research Experience: (4 Year + 6 Months)
7.	No. of Publication (Research articles - UGC Approved only)	National: 12
		International: 6

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8.	No. of Publication (Book Chapters)	1
	Books Published	-
(Please enclose the list of papers and books published and/or accepted during the last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Interactive Real-Time Polling and Feedback platform for Lectures

2. Abstract (Provide a summary of your research proposal in 300 words)

This research project aims to develop an **Interactive Real-Time Polling and Feedback Platform for Lectures** to enhance the learning experience in university classrooms. The platform will enable immediate feedback, knowledge assessment, online quizzes, e-assessments, and adaptive learning paths based on student performance. It will integrate AI-driven and manual question generation, analyse student responses, and offer detailed faculty performance metrics. Designed for scalability, the system will accommodate growing user bases and varied data types while providing insights for lecture rescheduling, IQ testing, and teaching method evolution. This platform aligns with modern educational demands, fostering a data-driven, interactive, and adaptive learning environment.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Introduction:

Modern education demands a seamless integration of technology to cater to diverse learning needs. Traditional feedback mechanisms and assessment methods often lack immediacy and scalability, leading to gaps in teaching efficacy and student understanding. This research proposes the development of an **Interactive Real-Time Polling and Feedback Platform** to address these challenges in university lecture settings.

Research Activities

The project will pursue the following activities:

1. Development of a scalable web-based platform supporting real-time polling, feedback, and quizzes.
2. Integration of AI algorithms for adaptive question generation and personalized learning paths.
3. Implementation of data analytics to evaluate student performance and faculty teaching methods.

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4. Designing a user-friendly interface for both students and faculty to encourage active engagement.
5. Conducting pilot studies to validate platform effectiveness and gather iterative feedback.

Importance of the Study

Immediate feedback loops in education have been shown to significantly improve knowledge retention and engagement. This platform will empower students to actively participate in their learning process and allow educators to adapt their teaching strategies based on real-time insights. The AI-driven analytics will personalize the learning experience, catering to diverse student needs and abilities. Furthermore, the system's scalability ensures it remains effective as user numbers and data volumes grow, making it a future-proof solution for educational institutions.

In a broader context, this study aligns with the global push toward digital transformation in education, providing a competitive edge to Atmiya University and setting a benchmark for educational innovation in Gujarat and beyond.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Real-time polling and feedback systems are increasingly gaining traction in educational technology. Platforms like Kahoot and Poll Everywhere focus on interactive learning but lack scalability and comprehensive analytics. Most existing systems are limited to quizzes and immediate feedback without addressing personalized learning paths or long-term faculty performance improvements. This research aims to bridge these gaps by integrating AI for adaptive assessments, detailed data logs for faculty evaluation, and robust scalability. This project will set a new standard by blending real-time interactivity with data-driven insights to enhance the educational process.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

- Develop a scalable online platform for real-time polling, feedback, and assessments.
- Integrate AI algorithms for personalized question generation and adaptive learning paths.
- Facilitate immediate performance evaluation and lecture rescheduling based on student feedback.
- Implement faculty teaching performance analytics and improvement recommendations.
- Design user-friendly interfaces to maximize engagement and usability.
- Conduct pilot studies to validate platform efficiency and scalability.

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6. Significance of the proposed study: (300 words)

The proposed platform addresses critical gaps in current educational methods, focusing on real-time interactivity, personalized learning, and data-driven faculty evaluations. By leveraging AI and scalable software design, this system promises to:

- Enhance student engagement and knowledge retention through interactive quizzes and feedback mechanisms.
- Provide adaptive learning paths tailored to individual student performance and learning pace.
- Offer actionable insights to educators, enabling continuous improvement in teaching methodologies.
- Establish Atmiya University as a leader in educational technology innovation. This research is not only a step toward modernizing classroom education but also contributes to the larger objective of creating a smarter, more efficient learning ecosystem.

7. Relevance of the proposed study to Gujarat: (200 words)

Gujarat, with its growing emphasis on digital and skill-based education, is an ideal ground for implementing this research. This platform aligns with the state's educational initiatives by fostering interactive and adaptive learning environments. Additionally, it can be integrated with Gujarat's existing digital education frameworks, enhancing their efficiency. The project will contribute to creating a tech-savvy workforce equipped to meet the demands of modern industries.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The findings from this research will:

- **Improve Education Quality:** By enabling interactive learning and adaptive assessments, the platform enhances education quality in Gujarat.
- **Empower Educators:** Faculty members will benefit from insights into teaching efficacy and recommendations for improvement.
- **Foster Inclusivity:** The platform's scalability ensures accessibility for students from diverse backgrounds.
- **Promote Technological Advancement:** Encourages adoption of cutting-edge educational technologies within Gujarat's academic institutions.
- **Boost Employment Readiness:** Adaptive learning ensures students acquire necessary skills, preparing them for competitive job markets.

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9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	✓

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Hypothesis

Integrating real-time feedback, adaptive assessments, and AI-driven analytics in lecture settings will improve student engagement and educational outcomes.

Research Activities

1. System Design:
   - Develop a scalable web-based platform architecture.
   - Integrate user-friendly interfaces for students and faculty.
2. AI Integration:
   - Implement AI algorithms for question generation and performance analytics.
   - Design adaptive learning paths based on student performance metrics.
3. Data Collection:
   - Gather real-time data on student responses, feedback, and performance.
   - Collect faculty teaching metrics for evaluation.
4. Data Analysis:
   - Employ statistical methods to analyze student performance trends.

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- Use machine learning models to recommend personalized learning paths and teaching improvements.

5. Pilot Studies:
   - Conduct trials in selected university classrooms.
   - Gather iterative feedback to refine platform functionality.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The research will proceed in the following phases:

Year 1: Platform Design and Development

- Develop the system architecture for scalability and robustness.
- Create an intuitive user interface (UI) for students and faculty.
- Build initial prototypes for real-time polling and feedback features.
- Conduct internal testing to validate basic functionality.

Year 2-3: AI Integration and Pilot Studies

- Implement AI models for adaptive question generation and personalized learning paths.
- Integrate analytics for detailed student and faculty performance insights.
- Conduct pilot studies in selected classrooms to test real-world application.
- Gather feedback from users to refine features and improve usability.

Year 4: Scalability and System Refinement

- Enhance platform scalability to handle large user bases and data loads.
- Conduct comprehensive data analysis to validate system effectiveness.
- Incorporate advanced analytics for detailed reporting.
- Optimize AI algorithms for better adaptability and accuracy.

Year 5: Full-Scale Deployment and Evaluation

- Deploy the platform across all target classrooms at Atmiya University.
- Provide training sessions for faculty and technical support for students.
- Collect feedback post-deployment to evaluate system impact.
- Publish findings and recommendations for future improvements.

This phased approach ensures comprehensive analysis and effective recommendations for the optimization and ethical deployment of recommendation systems.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Platform architecture design and development.	June	2022	Dec	2022
2.	AI integration.	Jan	2023	Dec	2023

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3.	Initial Testing	Jan	2024	Dec	2024
4.	Pilot studies and iterative refinement.	Jan	2025	Dec	2025
5.	Data analysis and scalability testing.	Jan	2026	Dec	2026
6.	Full deployment and performance evaluation.	Jan	2027	June	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	-	-	-
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)	10	800 Km	80000
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	3000
4.	Stationery and Printing (With justification)	-	-	23000
5.	Any other special requirement			394000
6.	Overhead (10% of recurring)	-	-	
	TOTAL			**5,00,000**

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**			
	a)			
2.	**B. Glassware**			
	a)			

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Application form

Part -A

(General Information)

1.	**Title of the proposal**	Factors Influencing Employee Satisfaction in Higher Educational Institutions: A Study in Gujarat, India.	
2.	**Broad area of proposal**	This could relate to the study of **Human Resource Management**, **Educational Administration**, or **Workplace Psychology** within the context of higher education.	
3.	**Sub Area of proposal**	Work Environment in Educational Settings	
4.	**Details of Principal Investigator (PI):**		
	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Pratik Pravin	Assistant Professor	9574919107
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Pankti Pandya	Teaching Assistant	9773054392
6.	**Whether the proposal is transdisciplinary?**	•**Psychology** (for understanding employee behavior) •**Sociology** (for exploring social factors in workplace satisfaction) •**Business Management** (for HR and organizational theories) •**Economics** (for examining job satisfaction in terms of financial aspects or incentives) •**Public Policy** (for governmental or institutional policies affecting employee well-being)	
7.	**Date of Birth of PI (DD/MM/YYYY)**	21/04/1997	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	16/02/2021	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	----------	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	**Educational Qualification**				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	B.Com	Banking and finance	Saurashtra University, Rajkot.	2017	67.00%
ii.	M.Com	Finance and Banking	Saurashtra University, Rajkot.	2019	72.85%
iii.	M.Phil	Commerce	Saurashtra University, Rajkot.	2020	72.40%
iv.					

2.	**Have you previously received any Fellowship from any funding agency?**	☐ **YES**	✓ **NO**
3.	**If yes, please indicate whether it was a (✓ tick appropriate)**	☐ **short-term fellowship (*viz* Project fellow, Project assistant, etc.)**	
		☐ **pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)**	
		☐ **post-doctoral fellowship (*viz* D S Kothari PDF, or any other)**	
4.	**If yes, mention the details of fellowship and tenure**	---	

5.	**Details of on-going and completed research funded projects (if any)**				
	S.N.	**Title**	**Project Cost**	**Sponsoring Agency**	**Duration (Start – End – MM/YYYY)**

6.	**Total Experience**	**Teaching Experience: (2Years +Months)**
		Research Experience: (Years + Months)
7.	**No. of Publication (Research articles -**	**National: 5**

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	UGC Approved only)	International:
8.	No. of Publication (Book Chapters)	0
	Books Published	1
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Factors Influencing Employee Satisfaction in Higher Educational Institutions: A Study in Gujarat, India.

2. Abstract (Provide a summary of your research proposal in 300 words)

This research aims to investigate the factors influencing employee satisfaction within higher educational institutions in Gujarat, India. Employee satisfaction in educational institutions significantly affects overall productivity, faculty retention, work culture, and the quality of education provided. With an increasing number of private and public universities and colleges in India, understanding the key factors that affect employee satisfaction is crucial for creating an optimal work environment, improving faculty and staff well-being, and enhancing institutional effectiveness.

The study will employ both qualitative and quantitative research methods to explore the various internal and external factors that contribute to employee satisfaction. These factors may include compensation, work-life balance, professional development opportunities, job security, institutional culture, leadership styles, and administrative support. The research will also explore the role of gender, experience level, and institutional type (public vs. private) in influencing employee satisfaction.

Data will be collected through surveys and interviews from a diverse sample of faculty and staff across universities and colleges in Gujarat. The findings will contribute to a deeper understanding of how specific workplace elements affect employee satisfaction in higher educational institutions in India. This study will provide valuable insights to institutional management, policymakers, and administrators to improve human resource practices, enhance employee retention, and ultimately create a better academic environment.

By providing a clear picture of employee satisfaction, this research will be instrumental in fostering a more supportive and engaging workplace in higher education, benefiting both employees and students alike.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

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The proposed research aims to explore and analyze the factors that significantly influence employee satisfaction within higher educational institutions in Gujarat, India. Employee satisfaction in educational settings is a critical factor influencing not only the well-being of staff members but also the overall performance and growth of institutions. Given that employees in higher education—particularly faculty members—play a vital role in shaping the academic and organizational outcomes of these institutions, understanding the elements that affect their job satisfaction is of paramount importance.

Employee satisfaction encompasses various dimensions, including the perception of one's work environment, job responsibilities, leadership quality, compensation, and opportunities for professional growth. In higher education institutions, these factors become even more crucial due to the inherently complex nature of academic work, the pressure to balance research, teaching, and administrative duties, and the diverse needs of employees. This study will investigate the various components that contribute to or detract from employee satisfaction in Gujarat's higher education sector.

The importance of this study lies in its potential to provide actionable insights into the conditions that can either foster or hinder employee satisfaction. Higher education in India, particularly in Gujarat, is experiencing rapid expansion, with a mix of government-funded and privately run institutions. Faculty members in these institutions are often subject to varying policies, expectations, and workplace dynamics. For public institutions, factors such as government policies, salary scales, and job security may play a larger role, while private institutions may focus more on factors like career progression, workplace culture, and autonomy.

Employee satisfaction is a critical predictor of employee retention, institutional reputation, and productivity. When faculty and staff are satisfied with their work environment, they are more likely to engage with their students, produce high-quality research, and contribute to the institution's overall success. Conversely, dissatisfaction can lead to high turnover rates, burnout, and disengagement, which negatively impacts the institution's goals and objectives. Therefore, understanding the specific factors that drive employee satisfaction in this context is essential for university and college administrators who aim to create a more conducive working environment for their staff.

This research will focus on both qualitative and quantitative aspects to explore the multiple factors influencing employee satisfaction. **Quantitative methods** will include surveys administered to faculty members and staff across different higher educational institutions in Gujarat. These surveys will focus on a variety of factors such as compensation, job security, work-life balance, relationships with colleagues, institutional policies, and opportunities for professional development. These questions will provide empirical data on the extent to which these factors are perceived to influence job satisfaction.

In addition to the quantitative approach, **qualitative research methods** will involve conducting in-depth interviews with a subset of participants. These interviews will allow for a deeper understanding of the personal experiences of employees in relation to the institutional culture, leadership practices, and overall work environment. Qualitative data will help identify underlying themes and nuanced insights that may not be captured through surveys alone. By triangulating both quantitative and qualitative data, the study aims to offer a comprehensive understanding of the complex dynamics at play.

This research will also seek to explore demographic variables such as **gender, age, years of experience, and institutional type** (public vs. private) to understand how different groups within the higher education sector perceive their working conditions and how these perceptions affect their

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overall satisfaction. For example, it is well-documented that gender dynamics can influence workplace satisfaction, particularly in academic environments where leadership roles may be gendered. Similarly, employees with longer tenures may have different expectations or experiences compared to younger, newer employees.

The findings of this study will not only contribute to the academic literature on employee satisfaction in higher education but will also have practical implications for higher educational institutions in Gujarat and beyond. By understanding the factors that lead to higher levels of job satisfaction, institutions can develop targeted strategies to enhance faculty and staff morale, improve institutional performance, and ensure long-term sustainability. Moreover, by identifying common areas of dissatisfaction, this study can provide recommendations for institutional reforms or initiatives that could lead to a more positive and supportive work environment.

Ultimately, the significance of this research lies in its potential to benefit both employees and students. Satisfied employees are more likely to be engaged, motivated, and dedicated to their work, which in turn creates a more positive learning environment for students. Institutions that prioritize employee satisfaction are better equipped to attract and retain top talent, improve academic performance, and contribute to the advancement of higher education in India.

In conclusion, the proposed research is vital in understanding the factors influencing employee satisfaction in higher educational institutions in Gujarat. By investigating these factors in-depth, the study will provide valuable insights for both policymakers and administrators, contributing to the creation of a better work environment for faculty and staff, and ultimately leading to improved educational outcomes for students.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research on employee satisfaction in higher educational institutions has gained significant attention in recent years, but there are still gaps, especially in the context of Indian institutions. Most studies on employee satisfaction in education primarily focus on developed countries, leaving a need for research tailored to the unique socio-cultural and institutional dynamics of India. Existing studies indicate that factors such as job security, salary, work-life balance, professional development opportunities, and leadership styles are significant determinants of employee satisfaction. However, research on how these factors play out specifically in Indian higher education institutions, particularly in states like Gujarat, remains limited.

Furthermore, much of the research conducted in India has focused on public institutions, with comparatively less attention on private institutions, which may have different operational structures and employee expectations. The role of administrative support, institutional policies, and gender-based disparities in job satisfaction has also been explored but often in isolation rather than as part of a comprehensive framework. This lack of integrated research creates a gap in understanding the broader factors that contribute to satisfaction across different types of higher education institutions.

Thus, while research on this topic is growing, there is a critical need for comprehensive studies that consider both public and private institutions in the Indian context, particularly in Gujarat, to develop strategies tailored to local needs.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

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1. **To examine the key factors influencing employee satisfaction in higher educational institutions in Gujarat**, focusing on compensation, professional development, leadership style, job security, and institutional culture.
2. **To compare employee satisfaction levels across public and private higher educational institutions** in Gujarat, identifying differences in factors such as workload, institutional policies, and professional growth opportunities.
3. **To analyze the role of demographic factors**, such as age, gender, and years of experience, in shaping perceptions of job satisfaction among employees in higher education institutions.
4. **To investigate the influence of institutional leadership and management practices** on employee satisfaction and its correlation with academic performance and organizational effectiveness.
5. **To assess the impact of work-life balance and workload** on faculty and staff satisfaction in higher educational institutions in Gujarat.
6. **To provide actionable recommendations for improving employee satisfaction** based on the findings, with specific suggestions for policy changes, leadership improvements, and work environment enhancements in Gujarat's higher education institutions.

6. Significance of the proposed study: (300 words)

The significance of this study lies in its potential to bridge the gap in understanding employee satisfaction in the context of higher education in Gujarat. Employee satisfaction is directly linked to job performance, retention, and overall institutional effectiveness, which are crucial for enhancing the quality of education and research. By identifying the factors that contribute to or hinder employee satisfaction, this research can provide valuable insights for university and college administrators, policymakers, and HR professionals.

The findings of this study will enable higher education institutions to create tailored strategies to improve job satisfaction, thus reducing faculty turnover, burnout, and dissatisfaction. This is especially important in India, where the demand for quality education is growing, and higher educational institutions are facing challenges in retaining skilled and experienced faculty. Understanding the specific factors that influence satisfaction in Gujarat, such as local cultural and economic conditions, will help in designing policies that are contextually relevant and effective.

Furthermore, this research will contribute to the academic literature on employee satisfaction in higher education, particularly within the Indian context, where such studies remain limited. It will help establish a framework for understanding the complexities of employee satisfaction and its impact on organizational performance in educational settings.

By improving employee satisfaction, institutions will enhance the overall work environment, foster better student outcomes, and build a positive institutional reputation. Additionally, the research will provide practical recommendations to policymakers to address systemic issues within educational institutions, ensuring a sustainable and positive work culture for faculty and staff.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study holds significant relevance to Gujarat, a state that is home to both well-established public universities and a growing number of private institutions. As the state's educational landscape continues to expand, understanding the factors influencing employee satisfaction becomes critical to ensuring high-quality education and stable institutional growth. Gujarat is unique in its

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socio-cultural and economic conditions, which may have specific implications for employee satisfaction that differ from other regions of India.

Gujarat is known for its industrial growth and thriving private sector, and this has led to heightened competition in attracting skilled professionals, including faculty members for higher education institutions. As such, job satisfaction factors such as compensation, career progression, work-life balance, and institutional culture become central to employee retention in the state's educational institutions.

Moreover, Gujarat's diverse population and educational infrastructure, with a mix of traditional and modern institutions, make it an ideal region for studying how different types of educational environments affect employee satisfaction. By focusing on Gujarat, the study can offer insights specific to this region's academic and cultural context, providing actionable recommendations that can be adopted by universities and colleges throughout the state.

This research will assist Gujarat's higher educational institutions in creating policies that attract and retain talented faculty, ensuring a stable and high-performing academic environment.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The expected findings of this research on employee satisfaction in higher educational institutions in Gujarat have far-reaching societal benefits, particularly in the context of the state's educational landscape. By identifying the key factors influencing employee satisfaction, the research can contribute to improving the working conditions for faculty and staff in universities and colleges across the state. The enhanced satisfaction of employees, especially faculty, directly impacts the quality of education provided to students, which is critical in shaping the future workforce of Gujarat.

1. **Improved Education Quality**: The research will highlight the factors that drive or hinder faculty engagement, productivity, and well-being. Satisfied and motivated employees are more likely to provide high-quality education, improving student outcomes and better equipping them for future challenges in the workforce. This will help raise the academic standards in Gujarat's higher education institutions, benefiting students and the state's economy in the long term.
2. **Employee Retention and Institutional Stability**: By identifying the critical factors for improving job satisfaction, universities can develop strategies to retain experienced faculty, reducing turnover rates. High faculty retention fosters institutional stability and continuity, which positively influences the reputation and performance of educational institutions.
3. **Policy Recommendations**: The study will offer valuable insights to policymakers on how to improve the work environment for educational staff in Gujarat. This could lead to the creation of more supportive policies related to compensation, professional development, and work-life balance that benefit both employees and institutions.
4. **Social Equity**: By addressing gender and experience-related disparities in employee satisfaction, the research can also contribute to greater gender equity and diversity in academic staff, ensuring more inclusive work environments.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

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Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	✓
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Research Activities

1. The research will adopt a mixed-methods approach, combining both **quantitative** and **qualitative** research techniques to gather comprehensive data on factors influencing employee satisfaction in higher educational institutions in Gujarat.
2. **Literature Review**: The initial phase will involve reviewing existing literature on employee satisfaction in educational institutions to understand current findings, gaps, and theories.
3. **Survey Design**: A structured questionnaire will be developed based on identified factors influencing employee satisfaction, such as compensation, work-life balance, professional development, institutional culture, and leadership styles.
4. **Interviews**: In-depth interviews will be conducted with faculty members and administrative staff to gather qualitative insights into personal experiences and perceptions related to job satisfaction.
5. **Data Analysis**: Quantitative data will be analyzed using statistical methods (such as descriptive statistics, regression analysis, and correlation analysis) to identify relationships between various factors and employee satisfaction. Qualitative data from interviews will be analyzed thematically to identify patterns and deeper insights.

Data Collection

- **Quantitative Data**: A structured questionnaire will be distributed to employees electronically or in-person. The questionnaire will include Likert-scale questions focusing on factors affecting satisfaction.
- **Qualitative Data**: Semi-structured interviews will be conducted with a subset of employees to

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capture personal insights and experiences.

Data Analysis

- **Quantitative Analysis**: The survey data will be analyzed using statistical software (such as SPSS or R) to run tests like factor analysis, regression analysis, and correlation tests to examine the relationships between different variables affecting employee satisfaction.
- **Qualitative Analysis**: The interview transcripts will be analyzed using thematic analysis to identify common themes and patterns regarding employee satisfaction.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Suggested Plan of Action (200 words)

The suggested plan of action for this research will unfold in several phases, each aimed at ensuring thorough and systematic exploration of factors influencing employee satisfaction in higher educational institutions in Gujarat.

1. **Phase 1 - Literature Review and Research Design (Months 1-2)**: The first phase will involve a detailed review of existing literature on employee satisfaction in educational settings, both globally and within the Indian context. This will help refine the research questions, identify gaps in the literature, and frame the study's theoretical foundation. The research design, including the questionnaire and interview protocols, will be developed during this phase.
2. **Phase 2 - Data Collection (Months 3-5)**: In this phase, a stratified random sample of faculty and staff from selected public and private institutions will be identified. Surveys will be distributed electronically or in person, and interviews will be conducted with a select group of participants. Data collection will be completed in approximately 2-3 months, ensuring a wide representation of employees across institutions.
3. **Phase 3 - Data Analysis (Months 6-7)**: After collecting the data, statistical analysis (e.g., regression, correlation) will be performed on the survey responses. Interviews will be transcribed and analyzed using thematic analysis to identify key themes.
4. **Phase 4 - Report Writing and Recommendations (Months 8-9)**: The final phase will involve synthesizing the findings, writing the research report, and formulating recommendations for improving employee satisfaction in Gujarat's higher educational institutions. The report will be presented to stakeholders, including university administrators and policymakers.

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12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	**Literature Review and Research Design**	July 2022	2022	August	2022
2.	**Development of Survey and Interview Tools**	September	2022	October	2022
3.	**Data Collection (Surveys and Interviews)**	November	2022	January	2023
4.	**Data Analysis (Quantitative and Qualitative)**	February	2023	April	2023
5.	**Report Writing and Recommendations**	May	2023	June	2023

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables	----------	----------	
2.	Travelling (*viz.* sample collection, should be Minimum and with justification)			₹60,000
3.	Contingency	----------	----------	₹3,000
4.	Stationery and Printing (With justification)	_____	----------	₹45,000
5.	Any other special requirement	----------	----------	₹242,000
6.	Overhead (10% of recurring)	----------	----------	----------
	TOTAL			₹350,000

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b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	**A. Chemicals**	----------		----------
	a)	----------		----------
	b)	----------		----------
	c)	----------		----------
	B. Glassware	----------		----------
	a)	----------		----------
	b)	----------		----------
	c)	----------		----------
	C. Any other consumable items (like wires/ electric items etc)	----------		----------
	a)	----------		----------
	b)	----------		----------
2.	**Travel**			
	Visit to various cities Gujarat	₹30,000	Throughout the project	**Travel expenses for fieldwork**. The researcher will visit various cities in Gujarat to distribute and collect surveys.
	Visit to various cities Gujarat	₹30,000	Throughout the project	**Travel expenses for fieldwork**. The researcher will visit various cities in Gujarat to distribute and collect surveys.
3.	**Contingency**			
		₹3,000	Throughout the project	**Unforeseen expenses** such as last-minute transportation costs, unexpected minor repairs, or small supplies.
4.	**Stationery and printing**			
	Printing	₹5,000	Throughout the project	**Printing of survey questionnaires** to be distributed during fieldwork.
	Books	₹40,000	Throughout	**Purchase of reference books** for

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			the project	literature review and research background.
5.	**Other Special Requirements**			
	Field work	₹90,000	Throughout the project	**Expenses for data collection** including transportation, lodging, and allowances for fieldwork team.
	Conference and seminar	₹50,000	Throughout the project	**Costs for presenting at conferences or seminars** to share the research findings.
	Publication	₹50,000	After Completion of	**Costs for publishing research findings** in academic journals or conferences.
	Hospitality Expenses	₹52,000	Throughout the project	**Hospitality for meetings and discussions** with stakeholders, research participants, or collaborators.
	Grand Total	₹350,000		**Total Project Cost**

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Application form

Part -A

(General Information)

1.	Title of the proposal	"Cytotoxicity Study and Phytochemical Characterization of Molecules in Methanolic Extract of Mucuna pruriens"	
2.	Broad area of proposal	Plant Biotechnology	
3.	Sub Area of proposal	Anticancer potential of medicinalplants	
4.	Details of Principal Investigator (PI)		
	Name	Designation & Department	Contact details (e-mail, mobile number, Ext. no.)
	Dr. Praveen S. Gupta	Assistant Professor Department of Biotechnology	Office: +91-281-2563445; Mob: +91-6355214074 praveen.gupta@atmiyauni.ac.in
5.	Details of Co-investigator (if any)		
	Name	Designation & Department	Contact details (e-mail, phone number, Ext. no.))
	Nil		
6.	Whether the proposal is transdisciplinary?	NA	
7.	Date of Birth of PI (DD/MM/YYYY)	08/10/1981	
8.	Date of joining the Department of PI (DD/MM/YYYY)	09/07/2011	
9.	Whether the PI is registered for Ph.D. on the same topic	No	
10.	If yes then name of university	NA	

*Attach the detailed Biodata and copy of first page of your publication separately along with this application.

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Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	Educational Qualification				
	Qualification	Subject	Board/University	Year	Percentage
i.	Ph. D.	Biotechnology	Saurashtra University,Rajkot	2023	NA
ii.	Post Graduation	Biotechnology	Jmia Millia Islamia, New Delhi	2009	76.04%
iii.	Under Graduation	Biotechnology	T.M.B.U, Bhagalpur	2007	77.11%
iv.	CSIR/UGG-NET/ SLET/GATE	Life Science	CSIR – NET	June 2010	NA

2.	Have you previously received any Fellowship from any funding agency?	☐ YES	√☐ NO
3.	If yes, please indicate whether it was a (✓tick appropriate)	☐ short-term fellowship (viz Project fellow, Project assistant, etc.)	
		☐ pre-doctoral fellowship (viz CSIR/UGC JRF or any other)	
		☐ post-doctoral fellowship (viz D S Kothari PDF, or any other)	
4.	If yes, mention the details of fellowship and tenure		

5.	Details of on-going and completed research funded projects (if any)				
	S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
		NA	NA	NA	NA

6.	Total Experience	Teaching Experience: (14 Year + 7 Months)
		Research Experience: (0Year + 0 Months)
7.	No. of Publication (Research articles -	National: 01

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	UGC Approved only)	International: 02
8.	No. of Publication (Book Chapters)	NA
	Books Published	NA
(Please enclose the list of papers and books published and/or accepted during last five years)		

Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

"Cytotoxicity Study and Phytochemical Characterization of Molecules in Methanolic Extract of Mucuna pruriens"

2. Abstract (Provide a summary of your research proposal in 300 words)

Mucuna pruriens, a tropical legume, has been employed in traditional medicine for centuries. This study aims to investigate the cytotoxic effects of the methanolic extract of Mucuna pruriens on human cancer cell lines and to perform a comprehensive phytochemical characterization of its bioactive molecules. The methanolic extract will be evaluated for its cytotoxicity using the MTT assay, while phytochemical characterization will be conducted using HPLC, GC-MS, and NMR spectroscopy. This study will provide valuable insights into the therapeutic potential and safety profile of Mucuna pruriens, contributing to its development as a phytopharmaceutical agent.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words)

Origin of the proposal:

Cancer is a leading cause of mortality worldwide, accounting for millions of deaths annually. The development of novel, efficacious, and safe therapeutic agents is imperative to combat this debilitating disease. Phytopharmaceuticals, derived from plants, have garnered significant attention in recent years due to their potential as anticancer agents.

Mucuna pruriens, a tropical legume native to Africa and Asia, has been employed in traditional medicine for centuries, particularly in Ayurveda and Unani practices. The plant is renowned for its diverse pharmacological activities, including antioxidant, anti-inflammatory, and anticancer properties. These activities have been attributed to its rich content of bioactive molecules, such as alkaloids, flavonoids, and phenolic acids.

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Mucuna pruriens has been reported to possess anticancer properties, with studies demonstrating its ability to inhibit the growth of cancer cells and induce apoptosis. However, despite its widespread use and reported pharmacological activities, there is a paucity of studies on the cytotoxic effects of Mucuna pruriens extracts on human cancer cell lines. Furthermore, a comprehensive phytochemical characterization of the bioactive molecules present in the plant's extracts is lacking.

The methanolic extract of Mucuna pruriens has been reported to exhibit significant antioxidant and anti-inflammatory activities. However, its cytotoxic effects on human cancer cell lines and the phytochemical characterization of its bioactive molecules remain unexplored.

This study aims to investigate the cytotoxic effects of the methanolic extract of Mucuna pruriens on human cancer cell lines and perform a comprehensive phytochemical characterization of its bioactive molecules. The findings of this study will contribute to the scientific understanding of the therapeutic potential and safety profile of Mucuna pruriens, paving the way for its development as a phytopharmaceutical agent.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Preliminary proof and work done so far:

Solvent extraction done of M. pruriens seeds according to procedure developed by de Mesquita et al., 2007 with slight modifications is done. Modification are done at temperature and type of solvent used. For solvent extraction 100 g of the powdered plant materials were soaked in 95% Methanol for 48 hrs. Than solutions were filtered two times through Whatman filter paper no.1 and filtrates was concentrated using rotary evaporator (Equitron, India) at 55°C. The left semisolid extracts mixed with 95% methanol then again concentrated using rotary evaporator. Dried fine powdered plant samples directly dissolved in solvent. No other methods and maceration have been used for extraction. Extracts were obtained by lyophilizing the filtrate for the removal of organic solvents. The crude extracts were collected and stored at -20°C for further studies. Preliminary phytochemical analysis was carried out for qualitative analysis or to identify the presence of phytochemicals in plant extracts. Phytochemical analysis was performed using standard procedure for potent plant extracts (Sofowora, 1993; Trease and Evans, 1989; Harborne, 1973). The extracts were tested for the presence of key phytochemicals such as flavonoids, terpenoids, saponins, steroids, tannins, phenol, carbohydrates, amino acid, cardiac glycoside and alkaloids.

International status:

Multiple studies have demonstrated that extracts from Mucuna pruriens, particularly ethanol and aqueous extracts, show cytotoxic effects on various cancer cell lines, including liver (Hep-2),

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gastric (AGS), and colorectal cancer cells. The extracts inhibited cell viability and induced apoptosis, likely due to bioactive compounds such as alkaloids, flavonoids, tannins, and saponins. These compounds also exhibited antioxidant properties, which may contribute to their anticancer mechanisms (Saponjac et al,2019). Some studies explored the use of Mucuna pruriens extracts in combination with chemotherapeutic agents like Doxorubicin. These combinations were found to enhance the cytotoxic effects on cancer cells while potentially reducing the required dose of chemotherapy drugs, thus minimizing side effects. The article by Tavares et al. (2020) thoroughly explores the bioactive compounds present in the methanolic extract of Mucuna pruriens and their consequential biological effects. The study emphasizes the proximate composition and a detailed phenolic compound profile analysis of Mucuna pruriens, which indicated a rich source of proteins and phenolic compounds such as catechin and levodopa. M. pruriens has a wide range of properties, including antioxidant, anti-Parkinson, antidiabetic, sexual enhancement, anti-inflammatory, antibacterial, and antivenom reported earlier. It is very potent in treatment of Parkinson disease due to presence of large amount of L-Dopa in the seed (Simmons, 2018).

National status:

Enhanced Antioxidant and Cytotoxic Properties: Research has highlighted the antioxidant activity of Mucuna pruriens extracts, which scavenge free radicals and reduce oxidative stress. This antioxidant capacity is linked to its anticancer potential, as oxidative stress plays a role in cancer progression(Kavitha, 2017). It is also observed that A. longifolia is rich in phytochemical in compare to M. pruriens and S. indicus. Two phytochmeicals β-sitosterol and 7-hydroxyfrullanolide were isolated from Sphaeranthus indicus induce apoptosis by inducing loss of mitochondrial membrane potential and also induce DNA fragmentation in human leukaemia HL-60 cell line (Nahata et al,2013). It is also reported that it promote the antitumor activity against hepatocarcinogenesis in rats (Venugopalan et al,2015). Different pharmacological activities, such as the antioxidant, anti-cholesterol, anti-diabetic, anti-Parkinson, sexual function enhancer, anti-inflammatory and anti-microbial of M. pruriens have been explored (Pathania et al.,2020).

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To evaluate the cytotoxic effects of methanolic extracts of Mucuna pruriens on selected cancer and normal cell lines.
2. To perform phytochemical screening to identify major classes of bioactive compounds.
3. To isolate and characterize specific molecules present in the methanolic extract using advanced analytical techniques.

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4. To establish a correlation between the phytochemical composition and cytotoxic effects.

6. Significance of the proposed study: (300 words)

Significance of the Study:

The research titled "Cytotoxicity Study and Phytochemical Characterization of Molecules in Methanolic Extract of Mucuna pruriens" holds significant value in several domains of science, particularly in pharmacology, toxicology, and natural product chemistry. Below are the specific areas where this study is important:

1. Drug Discovery and Development: The identification and characterization of bioactive molecules in Mucuna pruriens can lead to the discovery of novel therapeutic agents. The cytotoxicity analysis ensures that these compounds are safe for use in developing drugs for various diseases, particularly cancer or neurodegenerative disorders.
2. Cancer Research: By assessing the cytotoxic effects of the methanolic extract, the study provides insights into its potential anti-cancer properties. Natural products have been pivotal in the development of chemotherapeutic agents, and Mucuna pruriens may contribute new molecules to this field.
3. Phytochemical Diversity and Bioactivity: Mucuna pruriens is a well-known medicinal plant used in traditional medicine. The study enhances understanding of its phytochemical composition, including alkaloids, flavonoids, tannins, and other secondary metabolites, which are known to exhibit various biological activities.
4. Neuroprotective Potential: Mucuna pruriens contains compounds like L-DOPA, widely studied for their role in treating Parkinson's disease. The research could expand the spectrum of applications for these compounds and assess their safety and efficacy.
5. Toxicology and Safety Profiling: Determining the cytotoxic thresholds of the methanolic extract ensures its safe application in medicinal and therapeutic contexts. This is crucial for validating the traditional claims of Mucuna pruriens and for its potential commercialization.
6. Sustainability and Bioprospecting: The study highlights the importance of Mucuna pruriens as a natural resource for bioactive compounds. It also emphasizes sustainable practices for harvesting and utilizing medicinal plants without depleting natural populations.
7. Bridging Traditional and Modern Medicine: The research validates the therapeutic claims of Mucuna pruriens in traditional medicine by providing a scientific basis for its pharmacological properties, thereby strengthening the integration of traditional knowledge with modern scientific methods.

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8. Contribution to Global Health: The findings could have implications for global health by providing cost-effective and naturally derived alternatives to synthetic drugs, particularly for populations in resource-limited settings.

7. Relevance of the proposed study to Gujarat: (200 words)

The study titled "Cytotoxicity Study and Phytochemical Characterization of Molecules in Methanolic Extract of Mucuna pruriens" holds particular relevance to Gujarat due to the following factors:

1. Biodiversity of Medicinal Plants in Gujarat: Gujarat is home to a rich variety of medicinal plants, including Mucuna pruriens, which grows in the state's tropical and subtropical regions. Exploring the phytochemical and cytotoxic properties of this plant aligns with the state's emphasis on conserving and utilizing its biodiversity for health and economic benefits.
2. Traditional Knowledge and Ayurveda: Gujarat has a long history of traditional medicine practices, such as Ayurveda, where Mucuna pruriens is used to treat various ailments, including neurological disorders and infertility. This study validates these traditional uses by providing scientific evidence for its safety and efficacy.
3. Pharmaceutical and Herbal Industries: Gujarat hosts a robust pharmaceutical and herbal medicine industry. The characterization of bioactive molecules from Mucuna pruriens can encourage local industries to develop novel drugs and nutraceuticals, boosting the economy and creating employment opportunities.
4. Support for Rural and Tribal Communities: Tribal communities in Gujarat rely heavily on plants like Mucuna pruriens for medicinal purposes. Scientific validation of its properties can enhance its commercial value, benefiting local farmers and tribes by providing opportunities for sustainable harvesting and marketing.
5. Potential for Agricultural Development: Mucuna pruriens is not only a medicinal plant but also used as a cover crop and soil enhancer. Research on its bioactive compounds can promote its cultivation in Gujarat, particularly in regions facing soil fertility issues, contributing to sustainable agriculture.
6. Alignment with Government Initiatives: Gujarat's government has emphasized research and development in the fields of biotechnology, healthcare, and traditional medicine. This study aligns with such initiatives by integrating traditional knowledge with modern scientific methodologies.
7. Addressing Public Health Challenges: The study has the potential to contribute to solutions for pressing public health challenges in Gujarat, such as cancer,

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neurodegenerative disorders, and lifestyle diseases, by identifying cost-effective and accessible plant-based therapeutic options.

8. Academic and Research Contributions: With Gujarat being home to several reputed universities and research institutions, this study contributes to the growing body of academic research in the state. It also creates opportunities for collaboration and innovation in pharmacology and phytochemistry.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The research project on the "Cytotoxicity Study and Phytochemical Characterization of Molecules in Methanolic Extract of Mucuna pruriens" is anticipated to offer significant societal benefits, particularly for Gujarat.

1. Enhanced Healthcare Options: The study could lead to the identification of bioactive compounds with therapeutic potential, offering new, cost-effective treatments for diseases such as cancer, neurodegenerative disorders, and infertility. This aligns with Gujarat's growing healthcare needs, particularly in rural and underserved areas.
2. Boost to Traditional Medicine Practices: Scientific validation of Mucuna pruriens supports its traditional Ayurvedic applications, restoring confidence in indigenous medicine practices and encouraging their integration with modern healthcare systems. This fosters holistic healthcare solutions in the state.
3. Economic Empowerment of Rural and Tribal Communities: The commercialization of Mucuna pruriens-based products can create income opportunities for tribal and rural populations engaged in harvesting and processing the plant, fostering inclusive economic growth.
4. Promotion of Local Industries: Gujarat's robust pharmaceutical and nutraceutical industries stand to benefit from access to scientifically validated, locally sourced bioactive compounds, reducing dependence on imports and boosting local production.
5. Agricultural Sustainability: Encouraging the cultivation of Mucuna pruriens for medicinal and agricultural purposes (e.g., as a soil enhancer) can improve soil fertility and offer farmers an alternative income source, promoting sustainable agricultural practices.
6. Public Health Awareness: Disseminating findings from the study can raise awareness about the health benefits and safe use of Mucuna pruriens, empowering citizens to

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make informed decisions about their health and nutrition.

7. Strengthening Research and Development: This project enhances the research landscape in Gujarat, fostering collaborations among academic institutions, industries, and government bodies while encouraging young researchers to explore natural product sciences.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	✓☐
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	✓☐
6.	Resources management and sustainable development	☐
7.	High Impact Teaching	☐
8.	Imparting corporate responsibility, ethics, accountability and values in society	☐
9.	Social entrepreneurship	☐
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

Research Methodology

Plant Material Collection and Extraction

- Collection: Mature seeds of Mucuna pruriens will be collected from verified sources.

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- Processing: Seeds will be dried, powdered, and subjected to extraction using methanol via Soxhlet extraction.
- Yield Calculation: The percentage yield of the extract will be recorded.

Phytochemical Screening

- Qualitative analysis for major phytochemical groups (e.g., alkaloids, flavonoids, tannins, phenolics) will be conducted.
- Quantitative estimation of total phenolics, flavonoids, and alkaloids will be performed.

Cytotoxicity Study

- Cell Lines: Both cancerous (e.g., HeLa, MCF-7) and normal cell lines (e.g., Vero, HEK293) will be used.
- Assay: The MTT assay will be used to evaluate cell viability after treatment with varying concentrations of the methanolic extract.
- IC50 Determination: The half-maximal inhibitory concentration (IC50) will be calculated for each cell line.

Isolation and Characterization

- Separation: Extract fractions will be separated using column chromatography.
- Identification: Major fractions will be analyzed using:
  - Gas Chromatography-Mass Spectrometry (GC-MS)
  - High-Performance Liquid Chromatography (HPLC)
  - Nuclear Magnetic Resonance (NMR) spectroscopy.
- Bioactivity-Guided Fractionation: Active fractions will be identified through cytotoxicity assays.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

Suggested Plan of Action

1. Literature Review and Gap Identification: Conduct a thorough review of existing studies on Mucuna pruriens to identify research gaps, particularly in its cytotoxicity and phytochemical properties.
2. Collection and Preparation of Plant Material: Source Mucuna pruriens from ecologically diverse regions of Gujarat to ensure sample variability. Process and prepare methanolic extracts for analysis.
3. Phytochemical Screening: Perform qualitative and quantitative analyses to identify and

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characterize bioactive compounds, such as alkaloids, flavonoids, and phenolic compounds, using advanced techniques like HPLC, GC-MS, or NMR.

4. Cytotoxicity Studies: Evaluate the cytotoxic effects of the extracts on various cell lines (e.g., cancer and normal cells) using assays such as MTT or flow cytometry. Assess dose-response relationships and determine safety thresholds.
5. Data Analysis and Validation: Analyze results statistically to ensure reliability and validity. Compare findings with known bioactive molecules to explore therapeutic potential.
6. Application and Dissemination: Publish findings in peer-reviewed journals, develop public awareness campaigns, and collaborate with pharmaceutical and nutraceutical industries for product development.
7. Engagement with Stakeholders: Collaborate with tribal communities, researchers, and policymakers to promote sustainable harvesting and ensure societal benefits.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Literature review, plant material collection, methanolic extraction, and preliminary phytochemical screening.	May	2024	July	2024
2.	Quantitative analysis of bioactive compounds and cytotoxicity assays on crude extracts.	August	2024	August	2024
3.	Fractionation of methanolic extract, cytotoxicity studies on fractions, and selection of	September	2024	November	2024

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	bioactive fractions.				
4.	Isolation of bioactive compounds using chromatography and structural characterization using GC-MS, HPLC, and NMR.	November	2024	December	2024
5.	Mechanistic studies (e.g., apoptosis, ROS generation) and final report writing, publication, and dissemination of findings.	January	2025	February	2025
6.	Report And Research Paper Writing	March	2025	March	2025

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Consumables a. Chemicals, b. Glassware, c. Electric items d. Other items (specify)	1,000	300	3,90,000
2.	Travelling (viz. sample collection, should be Minimum and with justification)	-	-	1,00,000
3.	Contingency (Upto maximum for Rs. 3000/-)	-	-	1,00,000
4.	Stationery and Printing (With justification)	-	-	10,000
5.	Any other special requirement - Cell Culture and Cytotoxicity Assays			3,90,000

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6.	Publication			1,00,000
7.	Overhead (10% of recurring)			10,0000
	TOTAL			Rs. 1100000/-

b.Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	A. Chemicals			
	a) Reference standards of Antihistaminics	12,000/-	1st Month	Reference Drugs
	b) Sample dosage forms of Antihistaminics	25,000/-	1st Month	Sample drugs to be tested.
	c) HPLC grade water- 20 litres	6,000/-	2nd Month	Preparation of various standard & sample solutions.
	d) HPLC grade Acetonitrile- 5 litres	9,000/-		
	e) HPLC grade Methanol – 10 litres	3,000/-		
	f) Dibasic sodium phosphate	1000/-		
	g) Monobasic sodium phosphate	2,500/-		
	h) Phosphate buffer tablets	2,400/-		
	i) Orthophosphoric acid	1000/-		
	j) Glacial acetic acid	1200/-		
	k) Whatman filter paper Grade-I	5,700/-		
	l) Nylon 0.45 µm – 47 mm membrane filter paper	7000/-		
	m)			
2.	B. Glassware			
	a) HPTLC precoated	26,000/-		

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	silica plates			
	b) HPLC syringe	5,000/-		
3.	C. Any other consumable items (like wires/ electric items etc)			
	a)			
	b)			
4.	Travel	No. of Times in a month		
	a) Purpose 1	500/-		Collection of drugs
	b) Purpose 2	500/-		For analytical testing of samples
5.	Contingency	3,000/-		Sending samples for evaluation
6.	Stationery and printing			
	a) Purpose 1	2,000/-		Printing of Research Paper
	b) Purpose 2	1,000/-		For record keeping
7.	Hired services			
	a) Pathological and Analytical laboratory testing via Instruments like IR, HPLC,HPTLC, LC-MS and their respective report charges.	60,000/-	2nd Month onwards	Evaluation
	b) Research paper publication charge	5,000/-	11th month	Publication charges
	Grand Total	Rs. 1100000/-		

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Research Project Proposal
June - 2022

1.	Title of the proposal	Studying the intersection of positive psychology, sustainable happiness and the impact of yoga on mental well being	
2.	Name of Principle Investigator	Yuvrajsinh B. Kanchava	
3.	Designation & Department	▯ Designation	Assistant Professor
		▯ Faculty	FoET
		▯ Department	Mechanical Engineering
4.	Contact details (e-mail, mobile number, Ext. no.)	▯ Mobile Number (WhatsApp Number)	9904183620
		▯ Email	yuvrajsinh.kanchava@atmiyauni.ac.in
		▯ Departmental Extension number	1235

Application form

Part -A

(General Information)

1.	Title of the proposal	Studying the intersection of positive psychology, sustainable happiness and the impact of yoga on mental well being
2.	Broad area of proposal	Positive Psychology
3.	Sub Area of proposal	Value Education
4.	Details of Principal Investigator (PI)	

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	Name	**Designation & Department**	**Contact details (e-mail, mobile number, Ext. no.)**
	Yuvrajsinh B. Kanchava	Assistant Professor (Mechanical Engineering Department)	9904183620 yuvrajsinh.kanchava@atmiyauni.ac.in
5.	**Details of Co-investigator (if any)**		
	Name	**Designation & Department**	**Contact details (e-mail, phone number, Ext. no.))**
	Nil	Nil	Nil
6.	**Whether the proposal is transdisciplinary?**	Yes	
7.	**Date of Birth of PI (DD/MM/YYYY)**	26/05/1987	
8.	**Date of joining the Department of PI (DD/MM/YYYY)**	11/05/2022	
9.	**Whether the PI is registered for Ph.D. on the same topic**	No	
10.	**If yes then name of university**	N.A.	

***Attach the detailed Biodata and copy of first page of your publication separately along with this application.**

Part -B

(Educational Qualification and Previous Research Experience of PI)

1.	**Educational Qualification**				
	Qualification	**Subject**	**Board/University**	**Year**	**Percentage**
i.	Ph. D.	Nil	Nil	Nil	Nil
ii.	Post Graduation	M. Tech. Mechanical Engineering	SVNIT	2013	76.40 %

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iii.	Under Graduation	B.E. Mechanical Engineering	Saurashtra University	2009	67.56 %
iv.	CSIR/UGG-NET/ SLET/GATE	Nil	Nil	Nil	Nil

2.	**Have you previously received any Fellowship from any funding agency?**	**□ YES** / **√ NO**
3.	**If yes, please indicate whether it was a (√ tick appropriate)**	**□ short-term fellowship (*viz* Project fellow, Project assistant, etc.)**
		□ pre-doctoral fellowship (*viz* CSIR/UGC JRF or any other)
		□ post-doctoral fellowship (*viz* D S Kothari PDF, or any other)
4.	**If yes, mention the details of fellowship and tenure**	Nil
5.	**Details of on-going and completed research funded projects (if any)**	

S.N.	Title	Project Cost	Sponsoring Agency	Duration (Start – End – MM/YYYY)
	Nil	Nil	Nil	Nil

6.	**Total Experience**	**Teaching Experience: (13 Year + 04 Months)**
		Research Experience: (00 Year + 00 Months)
7.	**No. of Publication (Research articles - UGC Approved only)**	**National:** Nil
		International: Nil
8.	**No. of Publication (Book Chapters)**	Nil
	Books Published	Nil

(Please enclose the list of papers and books published and/or accepted during last five years)

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Part -C

PROJECT PROPOSAL

1. Title (To be specific within the area of research)

Studying the intersection of positive psychology, sustainable happiness and the impact of yoga on mental well being

2. Abstract (Provide a summary of your research proposal in 300 words)

The intersection of positive psychology, sustainable happiness, and the impact of yoga on mental well-being offers a promising framework for enhancing psychological resilience, emotional regulation, and overall life satisfaction. Positive psychology emphasizes the cultivation of strengths, meaningful relationships, and a purposeful life as key elements in fostering long-term well-being. Sustainable happiness, distinct from fleeting pleasure, is grounded in enduring practices that contribute to lasting fulfillment and emotional health. Yoga, as a mind-body practice that integrates physical postures, breathwork, and meditation, has been shown to reduce stress, enhance emotional balance, and promote mindfulness—critical components for achieving mental well-being. This study aims to explore how the principles of positive psychology and sustainable happiness can be integrated with yoga practices to create a holistic approach to mental health. Through an interdisciplinary framework, the research will examine how yoga contributes to the cultivation of positive emotions, resilience, and mindfulness, while simultaneously promoting physical and psychological health. By focusing on the long-term benefits of these practices, this research seeks to provide a deeper understanding of how yoga can serve as a sustainable tool for enhancing mental well-being, fostering positive psychological traits, and supporting individuals in their pursuit of lasting happiness. The findings could inform mental health interventions, self-care strategies, and wellness programs that aim to improve quality of life and mental health outcomes.

3. Introduction: (Define specific research activities to be pursued during the project period and provide a comprehensive description of the importance of proposed study in 800 words).

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Specific Research Activities:

1. **Literature Review and Theoretical Framework Development**: The research will begin with an in-depth review of existing literature on **positive psychology**, **sustainable happiness**, and the **effects of yoga** on mental well-being. This review will focus on identifying gaps in current knowledge and will help establish a theoretical framework that integrates the principles of yoga with the key elements of positive psychology.
2. **Designing and Implementing a Yoga Intervention**: A structured yoga intervention will be developed and implemented. The intervention will be designed for participants at varying levels of experience, ensuring accessibility to all. This will enable a thorough understanding of how yoga can be used as a tool for improving mental well-being.
3. **Quantitative Data Collection**: Participants will complete pre- and post-intervention surveys to assess changes in their mental health, including stress levels, happiness, and emotional regulation. Standardized assessments will be used.
4. **Qualitative Data Collection**: Qualitative data will be gathered through **semi-structured interviews** or **focus groups** to explore participants' personal experiences with yoga. This qualitative data will allow for a deeper understanding.
5. **Data Analysis**: The quantitative data and the qualitative data will be integrated to offer a comprehensive understanding of how yoga impacts mental well-being.
6. **Long-Term Follow-Up Assessment**: This follow-up will evaluate whether the benefits of yoga—such as reduced stress and improved emotional regulation—are sustained in the long term, highlighting the potential for yoga to contribute to **sustainable happiness**.
7. **Synthesis of Findings and Recommendations**: Upon completing the data analysis, the study will synthesize the findings and provide recommendations for integrating yoga into wellness programs and mental health practices.

Importance of the Proposed Study:

By exploring how yoga interacts with **positive psychology** and **sustainable happiness**, this research will offer a comprehensive approach to enhancing mental health.

1. **Addressing Global Mental Health Challenges**: Mental health issues such as anxiety and stress are prevalent worldwide, and traditional treatments like psychotherapy and medication are essential but not always sufficient. Yoga, as a holistic and accessible practice, offers a potential complement to these treatments.
2. **Contribution to Positive Psychology**: By integrating yoga into positive psychology, this research will enhance our understanding of how physical and mental practices can work together to support long-term well-being and happiness.
3. **Exploring Sustainable Happiness**: **Sustainable happiness** is a form of well-being that is stable over time and rooted in emotional resilience, meaningful life experiences, and self-regulation. Understanding the role of yoga in sustainable happiness is crucial for developing long-term interventions that support mental health.
4. **Building Emotional Resilience**: This study will assess how yoga impacts emotional resilience, offering valuable insights into how yoga can act as a tool for enhancing psychological strength and stability.

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5. **Holistic Approach to Mental Health**: This study will provide evidence for the effectiveness of yoga in supporting the overall health of individuals, making it a viable addition to conventional mental health treatments.
6. **Implications for Public Health and Wellness Programs**: If yoga is shown to improve mental well-being and foster sustainable happiness, it could be incorporated into public health initiatives, workplace wellness programs, and schools.

4. Status of Current Research in the proposed field: (Provide a critical evaluation on the status of research in the proposed field in 200 words)

Research on the intersection of **positive psychology**, **sustainable happiness**, and the **impact of yoga on mental well-being** is still emerging, with a growing body of evidence supporting yoga's benefits for mental health. Studies have demonstrated that yoga can reduce symptoms of stress, anxiety, and depression, while promoting mindfulness, emotional regulation, and overall well-being. However, the field remains in the early stages of fully understanding how yoga interacts with concepts of positive psychology, such as **positive emotions**, **resilience**, and **life satisfaction**.

While numerous studies show positive outcomes from yoga interventions, they often lack rigorous methodology, with small sample sizes, short intervention periods, or insufficient control groups. Moreover, much of the existing research focuses on yoga's immediate benefits, with fewer studies exploring long-term effects or the sustainability of positive changes in mental well-being.

Furthermore, yoga's integration into **positive psychology** frameworks remains underexplored. While yoga promotes key elements like mindfulness and emotional resilience, research linking these practices directly to sustainable happiness is limited. The lack of standardized interventions, diverse participant populations, and cross-cultural studies also limits the generalizability of findings.

Promising, more robust, large-scale, and longitudinal studies are needed to establish clearer, more definitive connections between yoga, positive psychology, and sustainable happiness.

5. Objectives of the proposed study: (Write down 5-6 major objective of the proposed research work)

1. To Examine the Impact of Yoga on Mental Well-being
2. To Explore the Role of Yoga in Promoting Sustainable Happiness
3. To Investigate the Relationship Between Yoga and Positive Psychology
4. To Measure the Development of Emotional Resilience Through Yoga
5. To Evaluate the Long-term Effects of Yoga on Mental Health
6. To Provide Evidence for the Integration of Yoga in Mental Health Interventions

6. Significance of the proposed study: (300 words)

With global mental health concerns on the rise, including stress, anxiety, and depression, the need for effective, accessible, and long-term interventions has never been greater. This research aims to provide empirical evidence supporting yoga as a holistic, mind-body practice that improves emotional regulation, psychological resilience, and overall happiness.

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Yoga, being low-cost and widely accessible, offers a practical alternative or complement to traditional mental health treatments like psychotherapy and medication. By focusing on how yoga reduces stress, fosters mindfulness, and promotes emotional balance, this study will contribute to the growing body of evidence highlighting yoga's potential in improving mental health. The study's integration of yoga with **positive psychology** will further enrich our understanding of well-being, emphasizing not only symptom reduction but also the enhancement of positive emotions, engagement, and life satisfaction.

A key focus of the research is **sustainable happiness**, which is rooted in emotional resilience, self-regulation, and long-term well-being. Yoga's ability to cultivate these qualities makes it an ideal practice for promoting lasting happiness that is not dependent on external factors. By examining how yoga contributes to sustainable happiness, the study will inform the development of long-term mental health interventions.

7. Relevance of the proposed study to Gujarat: (200 words)

The proposed study is highly relevant to **Gujarat**, as mental health issues, including stress, anxiety, and depression, are rising across India, including in Gujarat. As a state with a rapidly growing population and increasing urbanization, Gujarat faces unique challenges related to mental health, including high levels of work-related stress, societal pressures, and lifestyle changes. This research aims to explore **yoga**, a practice deeply rooted in Indian culture, as a potential solution to address these challenges and improve mental well-being.

By investigating the role of yoga in enhancing **psychological resilience**, **sustainable happiness**, and overall mental well-being, the study aligns with the state's emphasis on holistic health practices. The findings could offer valuable insights into how yoga can serve as an effective, low-cost, and accessible intervention for mental health challenges faced by the diverse population of Gujarat, particularly in schools, workplaces, and communities.

This research could inform **public health initiatives** and wellness programs across Gujarat, potentially shaping state-level policies to integrate yoga into mental health strategies and improve mental health outcomes for residents.

8. Expected benefits of possible findings of proposed research project at societal level particularly to the state of Gujarat: (300 words)

The expected findings of the proposed research on the impact of yoga, positive psychology, and sustainable happiness could bring significant societal benefits, particularly to the state of **Gujarat**. As mental health challenges such as stress, anxiety, and depression continue to rise, this research offers a potential solution by emphasizing **yoga** as a holistic, low-cost, and accessible tool for improving mental well-being.

1. **Promoting Mental Well-being**: By integrating yoga into daily life, individuals in Gujarat may experience enhanced emotional stability and improved coping mechanisms, leading to a healthier population overall.
2. **Supporting Positive Psychology**: The research may encourage individuals in Gujarat to adopt practices that promote happiness and life satisfaction, ultimately improving quality of life across communities.

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3. **Sustainable Happiness**: The focus on **sustainable happiness**, rooted in self-regulation and emotional resilience, could help people in Gujarat cultivate long-lasting well-being.
4. **Public Health Policy Implications**: Local governments and health organizations might integrate yoga into wellness programs for schools, workplaces, and community centers, offering a low-cost preventive measure for mental health issues.
5. **Enhancing Emotional Resilience**: The study's emphasis on emotional resilience could foster a society in Gujarat better equipped to handle life's challenges, reducing the societal burden of mental health issues, and contributing to a more balanced and productive community.

9. The proposal can be broadly classified into any of the below mentioned focus areas: (Tick appropriate area)

Sr. No.	Area	(✓ tick appropriate)
1.	Environment	☐
2.	Agriculture	☐
3.	Health and wellness	√
4.	Nutrition	☐
5.	Development of Industrial Problem Solutions	☐
6.	Resources management and sustainable development	√
7.	High Impact Teaching	√
8.	Imparting corporate responsibility, ethics, accountability and values in society	√
9.	Social entrepreneurship	√
10.	Others (if any)	

10. Methodology: Define specific research activities to be pursued during the project period and provide a comprehensive description of the hypothesis, sampling plan, data collection, data analysis. (300- 400 words)

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Specific Research Activities:

1. Literature Review
2. Development of Research Instruments
3. Yoga Intervention Program
4. Participant Recruitment and Selection
5. Pre- and Post-Assessment
6. Data Analysis

Hypothesis:

1. **Main Hypothesis**: Yoga interventions significantly improve mental well-being, emotional resilience, and sustainable happiness in participants.
2. **Secondary Hypothesis**: The improvements observed in the intervention group will be sustained over time, demonstrating the long-term impact of yoga on mental health.

Sampling Plan:

A sample size of 100-150 participants (50-75 per group) will be selected to ensure statistical power. Participants will be chosen using stratified random sampling to ensure diversity in terms of age, gender, and socio-economic background. The sample will be divided into an experimental group (yoga intervention) and a control group (no intervention).

Data Collection:

Data will be collected through **self-reported questionnaires** to assess mental well-being, **emotional resilience scales**, and **happiness inventories** (e.g., the **Satisfaction with Life Scale** and **Perceived Stress Scale**). In addition, qualitative feedback may be gathered from participants regarding their experiences with the yoga program.

Data Analysis:

Data will be analyzed using **descriptive statistics** (mean, standard deviation) and **inferential statistics** (paired t-tests, ANCOVA) to evaluate differences between pre- and post-assessment scores. The analysis will compare the outcomes in the yoga intervention group against the control group, and longitudinal data will be used to assess the sustainability of changes in mental well-being over time.

11. Suggested plan of action: Define the suggested plan of action in 200 words)

The first phase will focus on conducting a comprehensive **literature review** to establish the theoretical framework, identify research gaps, and refine the study design.

Next, a **structured yoga intervention program** will be developed. Participants will be recruited using **stratified random sampling**, ensuring a diverse sample across age, gender, and socio-economic status. The participants will be divided into an **experimental group** (yoga intervention) and a **control group** (non-intervention).

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Data will be collected using validated **questionnaires** and **scales** to assess mental well-being, emotional resilience, and happiness before and after the intervention. Follow-up assessments will be conducted after 3-6 months to measure long-term effects.

The collected data will be analyzed using **statistical techniques** to compare the outcomes between the experimental and control groups. Findings will be used to draw conclusions about the effectiveness of yoga in promoting mental health, with the potential to inform public health policies and wellness programs at the state level.

12. Schedule of the Project Task

Sr. No.	Project Task	Starting Month	Starting Year	Completion Month	Completion Year
1.	Define Project Scope & Objectives, Literature Review	June	2022	May	2023
2.	Design Study Methodology	June	2023	May	2024
3.	Finalize Research Tools	June	2024	May	2025
4.	Begin Data Collection, Data Organization, Data Analysis	June	2025	May	2026
5.	Interpret Results, Conclusion and Recommendations	June	2026	May	2027

13. Budget Requirements

a. Consolidated budget:

S.N.	Items/Particulars	Rate per Unit	No. of Unit Required	Total Amount
	RECURRING			
1.	Surveys and Data Collection Tools	25000	-	25000
2.	Yoga Classes/Sessions	25000	-	25000
3.	Incentives for Participants, Yoga Material, Stationery	10000	-	10000
4.	Travel Costs for Fieldwork	10000	-	10000
5.	Yoga Studio/Location Rentals	20000	-	20000

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6.	Contingency	10000	-	10000
	TOTAL	100000		100000

b. Detailed Budget with Justification and Timeline of usages of Funds (Research work from May to March):

S.N.	Particulars	Amount (Rs)	Timeline	Justification
1.	Consultants/Experts (in Positive Psychology & Yoga)	10000	Ongoing (Year 1 – Year 3)	These experts will advise on theoretical frameworks, assist in study design, and provide guidance on data interpretation. Their role will be particularly crucial during the initial stages of the project (literature review, methodology) and later when analyzing complex data or evaluating results.
2.	Surveys and Data Collection Tools (online platforms, assessment tools)	25000	Year 1 – Year 3	Tools like SurveyMonkey or Qualtrics will be required for conducting surveys. Additionally, purchasing assessment tools like WHO-5 and PERMA will be necessary to measure participants' mental well-being and happiness.
3.	Yoga Classes and Instructor Fees	15000	Year 2 – Year 4	Yoga classes and workshops will be organized for participants. The funds will cover the cost of hiring yoga instructors and renting space for sessions.

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4.	Yoga Materials for Participants (mats, props, etc.)	10000	Year 2 – Year 4	Providing yoga mats, props, and other materials for participants to use during their sessions.
5.	Fieldwork Travel (travel, lodging, meals for research team)	10000	Year 2 – Year 4	If fieldwork requires traveling to different cities or yoga studios, funds will be needed for transportation, lodging, and meals.
6.	Yoga Studio Space Rentals	20000	Year 2 – Year 4	Renting yoga studios or spaces for participants to engage in sessions or workshops.
7.	Stationery, software, printing and miscellaneous	10000	Ongoing (Year 1 – Year 5)	General office supplies, software for managing documents, and other minor costs.
	Grand Total	100000		

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