भारतीय सांकेतिक विज्ञान संस्थ हैदराबाद
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

CENTER FOR INTERDISCIPLINARY PROGRAMS

DOCTORAL PROGRAMS – ADMISSIONS 2025

RESEARCH VERTICALS

- Artificial Intelligence, Computing, Communications & Networks
- Bioengineering & Healthcare
- Energy, Environment, Creative Design & Management
- Novel Materials & Computational Techniques
- Soft and Active Matter & Mechanics of Materials
- Robotics, Biomimetics & Instrumentation

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The **Centre for Interdisciplinary Programs (CIP)** at IIT Hyderabad invites applications from bright and motivated students for its Interdisciplinary PhD (ID PhD) program. This program provides students with the opportunity to pursue interdisciplinary research under the guidance of two supervisors from different departments. The ID PhD program is similar to any other PhD program and the selected students are provided a fellowship at the MoE norms. Additionally, MoE-funded ID PhD students receive a contingency grant of **₹50,000 per year** for research-related consumables.

The document below presents 38 research proposals spanning a wide range of topics, broadly categorized into six verticals. There is no fixed quota for any vertical. Interested students are expected to review the faculty proposals and apply accordingly. For convenience, all proposal titles on pages 3-5 are hyperlinked to their respective details.

IMPORTANT

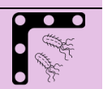
1. On the admissions portal, applicants must enter the ID proposal number in the format "IDPHD2025XXX". Failure to provide the specific proposal number may result in application rejection.
2. All PhD degrees at IIT Hyderabad are awarded against an original thesis written by the student, with no department name mentioned on the thesis certificate. Hence ID PhD students will also receive a PhD degree like any other PhD student of IIT Hyderabad.

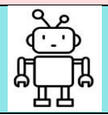
ADMISSION PROCESS

Applications will be shortlisted by faculty members associated with each proposal. Shortlisted candidates will be invited for an online interview with the ID PhD Admissions Panel. Interview dates and times will be communicated only to selected applicants.

LIST OF PROPOSALS

Proposal No.	Proposal Title
IDPHD2025001	AI-Driven Consensus and Blockchain-Based Monitoring for Road Safety
IDPHD2025002	Physics-Informed Neural Networks for solving Inhomogeneous wave equations
IDPHD2025003	Study of Biomolecular Docking Using Velocity Map Imaging Technology
IDPHD2025004	Development of adhesive conductive supramolecular biomaterials leveraging peptide-self-assembly toward functional cardiac patches
IDPHD2025005	Indigenous Flexible Dry Electrodes for continuous, non-invasive, and long-term epidermal biopotential monitoring
IDPHD2025006	Micropatterned bacterial cellulose dressings for scar-free wound healing
IDPHD2025007	Investigating Neurophysiological Signatures using Cognitive and Somatosensory Integration in the traditional dance form of Bharatanatyam
IDPHD2025008	Quantitative Magnetic Resonance Imaging and Artificial-Intelligence-enabled radiotherapy planning
IDPHD2025009	Dynamic uptake and transport of endocrine-disrupting chemicals and microplastics in aquatic and biological systems: In vitro and in vivo studies
IDPHD2025010	Accurate Neuronal Cell Segmentation and Classification based on Machine-Generated Annotations: Information-theoretic Analysis of Neuronal Responses
IDPHD2025011	Development of novel mRNA vaccine platform for infectious and chronic diseases by highly interdisciplinary approach of mRNA engineering and nanoengineering of delivery system
IDPHD2025012	Advancing Raindrop Microphysics with Cutting-Edge Experiments and Machine Learning
IDPHD2025013	Synthesis of Novel Organic Relaxor Ferroelectric Polymers for Energy Storage
IDPHD2025014	Integrated Carbon Capture & Utilization By Electrochemical Methods
IDPHD2025015	Development of nanostructured high-entropy alloys for hydrogen storage/utilization applications

IDPHD2025016	Investigation on coal-biomass blends as reductant and fuel in rotary kiln DRI making towards CO2 mitigation		
IDPHD2025017	Machine learning-enabled multi-fidelity computational fluid dynamics simulations of wind farm flows		
IDPHD2025018	Development of process intensified zero-discharge process for extraction of rare earth elements from secondary sources (coal ash, overburden, red mud etc).		
IDPHD2025019	Development of Chemical Combustion Kinetics of Coal Water Slurry and Its Effect on Combustion		
IDPHD2025020	Stories, Camera, Traction: Can the Subaltern film?		
IDPHD2025021	To design an operational system for Urban Air Mobility (UAM)		
IDPHD2025022	Gasification of low-grade coal and biomass in a fluidized bed gasifier to produce synthesis gas		
IDPHD2025023	Development of Efficient Electrodes for High Temperature Alkaline Electrolysis		
IDPHD2025024	Development of an AI, Blockchain and Hybrid Cloud Enabled Sustainable Digital Twin Cloud Service for the Built Environment		
IDPHD2025025	Micro and Nanoplastic Pollution in the Musi River: Distribution, Degradation, and Bioremediation Potential		
IDPHD2025026	Optimal transportation service network design considering shipper behaviour characteristics		
IDPHD2025027	Development and feasibility study of Garnet-based electrolyte materials for all-solid-state Li-battery (ASSLBs)		
IDPHD2025028	Physics-Informed Machine Learning for Accelerating Process-Structure-Property Predictions in Advanced Materials		
IDPHD2025029	Synthesis and fabrication of self-healing, organic semiconductor devices.		
IDPHD2025030	Floquet engineering for molecular systems		
IDPHD2025031	Computational Modelling of Molecular Magnets on Surfaces		

IDPHD2025032	Developing Atomistically Informed TCAD Modelling of Semiconductor Flash Memory Transistors	
IDPHD2025033	Fusion of machine learning and Bayesian inference for reliability-based design optimization of crashworthiness	 
IDPHD2025034	Multi-phase CFD and Coupled CFD-DEM models for flow of complex suspensions with an application for 3D Concrete Printing	 
IDPHD2025035	Development of Nanostructured Perovskite Halides for multifunctional applications	 
IDPHD2025036	Advancing electrospinning technologies to produce polymeric nanofibers for high-performance applications	 
IDPHD2025037	Impact performance of cold-formed steel sheathed wall panels subjected to wind-borne debris	 
IDPHD2025038	Design and development of insect-size microrobot with multi-locomotion capabilities	

PROPOSAL No. - IDPHD2025001	
Title of the Proposal	**AI-Driven Consensus and Blockchain-Based Monitoring for Road Safety**
Supervisor-1	Dr. Abhinav Kumar, *Electrical Engineering*
Supervisor-2	Dr. Kotaro Kataoka, *Computer Science and Engineering*
Email IDs	abhinavkumar@ee.iith.ac.in kotaro@cse.iith.ac.in
Abstract	This project aims to develop a framework for integrating Artificial Intelligence and Blockchain for road safety. The proposed framework shall detect hazards like fallen pedestrians, alerts nearby drivers, and records incidents on the blockchain. We also plan field trials to confirm its feasibility, highlighting key insights for real-world deployment.
Keywords	Artificial Intelligence, Blockchain, Machine Learning, 6G, Road Safety
Background and Motivation	Emerging technologies like AI, onboard sensors, and mobile communications enhance road safety by enabling early hazard detection. However, challenges like visibility, geolocation, and data integrity persist. Fraudulent alerts and unverifiable evidence further complicate reliability. Ensuring cooperative verification and auditability among multiple stakeholders is crucial for trustworthy and effective road safety solutions.
Relevant publications	[1] R. Verma, V. V. S and K. Kataoka, "Verifiable and Robust Monitoring and Alerting System for Road Safety by AI based Consensus Development on Blockchain," 2023 IEEE Intelligent Vehicles Symposium (IV), Anchorage, AK, USA, 2023, pp. 1-8, doi: 10.1109/IV55152.2023.10186676. [2] N. Hasan, A. Kumar and K. Kataoka, "Adaptive Numerology-based Rate Optimization for enhanced-Vehicle-to-Everything Use Cases in Beyond 5G Networks," 2025 17th International Conference on COMmunication Systems and NETworks (COMSNETS), Bengaluru, India, 2025, pp. 308-315, doi: 10.1109/COMSNETS63942.2025
Essential qualifications	BTech in AI/CSE/ECE/CSP/Comm/Telecom
Desirable qualifications	MTech in AI/CSE/ECE/CSP/Comm/Telecom
Broad proposal objectives	https://drive.google.com/open?id=1R0dila6sXT72ZvY0N6VwGIeV0GBlDSKc

PROPOSAL No. - IDPHD2025002	
Title of the Proposal	**Physics-Informed Neural Networks for solving Inhomogeneous wave equations**
Supervisor-1	Dr. P. K. Srijith, *Computer Science and Engineering*
Supervisor-2	Dr. B. Venkatesham, *Mechanical & Aerospace Engineering*
Email IDs	srijith@cse.iith.ac.in venkatesham@mae.iith.ac.in
Abstract	Solving inhomogeneous wave equations (second-order partial differential equations) is a fundamental field of study with applications ranging from mobility to industrial and environmental sciences, for instance aircraft engine noise, car side mirror noise, valve noise. Traditional numerical solvers, such as Computational Fluid Dynamics (CFD) methods, including Finite Element Methods (FEM), Boundary Element Methods (BEM), and Finite Volume Methods (FVM), often require significant computational resources and struggle with high-dimensional or complex domains. Recent advancements in deep learning, particularly Physics-Informed Neural Networks (PINNs), provide an alternative approach to solving inhomogeneous wave equation problems by embedding physical laws associated with multi-domain systems directly into the learning process. This proposal outlines the development and application of PINNs for solving acoustic wave equations with source estimations from fluid and structural dynamics efficiently and accurately.
Keywords	Deep Learning, Physics-Informed Neural Networks (PINNs), Partial differential equations, Inhomogeneous wave equation.
Background and Motivation	Physics-informed neural networks leverage both data and governing physical laws, such as the continuity equation and Navier-Stokes equations for aerodynamic sources and the equation of motion for structure-borne noise, to ensure physically consistent solutions. Unlike purely data-driven models, PINNs require fewer data points as they rely on differential equations to guide learning, making them advantageous in scenarios where data collection is expensive or limited. This helps to develop low-fidelity models into high-fidelity ones. Traditional CFD and FEM/BEM methods suffer from dimensionality and high computational costs, particularly for turbulent flows and unsteady simulations. PINNs offer a promising solution by using neural networks to approximate solutions to partial differential equations (PDEs) efficiently while incorporating physics-based constraints to improve generalizability and robustness. Solving the acoustic wave equation due to airborne noise sources creates a major challenge in scaling and order of magnitude while solving the equations simultaneously. This challenge needs to be addressed by leveraging transfer learning techniques as part of this research work.
Relevant publications	1. A Majumdar, A Krishna, P. K. Srijith, Neural Wave Equations, International Conference on Learning Representations (ICLR), 2025. 2. S Anumasa, G Gunapati, P. K. Srijith, Continuous Depth Recurrent Neural Differential Equations, European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML-PKDD), 2023. 3. Srinivas Anumasa and P. K. Srijith, Latent Time Neural Ordinary Differential Equations, Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI), 2022. 4. Golla ST, Venkatesham B. Prediction of splash noise in a rectangular tank under longitudinal periodic excitation. Proceedings of the Institution of Mechanical Engineers, Part D. 2024;0(0). doi:10.1177/09544070241292853

	5. Sree, N K Vijaya; Venkatesham, B. Optimization methods for acoustic material selection in interior spaces, INTER-NOISE and NOISE-CON Congress and Conference Proceedings, InterNoise23, Chiba, Japan, pages 1995-2994, pp. 2846-2856(11). Doi: 10.3397/IN_2023_0414
Essential qualifications	BE/B.Tech with valid GATE score in any discipline, ME/M.Tech with valid GATE score in any discipline
Desirable qualifications	Programing in PyTorch, Tensorflow Deep learning models, Fluid Mechanics, Finite element modelling (FEM)
Broad proposal objectives	https://drive.google.com/open?id=1yhsGgmr3JZmSQgL0soK3QIPRfagBVFOa

PROPOSAL No. - IDPHD2025003

Title of the Proposal	**Study of Biomolecular Docking Using Velocity Map Imaging Technology**
Supervisor-1	Dr. Surajit Maity, *Chemistry*
Supervisor-2	Dr. Vandana Sharma, *Physics*
Email IDs	surajitmaity@chy.iith.ac.in vsharma@phy.iith.ac.in
Abstract	We propose to develop an advance experimental methodology to accurately determine energies associated to the molecular docking present in biological system. The proposed quantitative measurements can be directly correlated to the docking of small molecules on aromatic rings of nucleic acids. In this project, docking sites of multifunctional biomolecules will be investigated using state-of-the-art R2PI, VMI and computational calculations. The proposal aims to develop an indigenous experimental tool to accurately characterize biomolecular docking relevant to drug delivery and design.
Keywords	biomolecular docking, velocity map imaging, spectroscopy
Background and Motivation	The docking of molecular species on the biologically relevant molecules has been widely studied because of their immense applications in drug-delivery and drug-designing.1,2 Starting from the micro to macro levels, the docking of small molecules on the aromatic surface is mainly governed by weak non-covalent interactions. In recent years, the use of small molecules, such as rare-gases, O2 and N2, has been explored for the structure–function relationship of proteins.3,4 and have shown a diverse range of biological activity.1–4 The reversible nature of these weak interaction with the aromatic molecule makes them a suitable candidate for the biological process such as the analgesia, anesthesia, drug delivery and a varied range of other clinical effects.5,6
Relevant publications	1. Sanket Sen, S Mandal, Arnab Sen, R Gopal et al. J. Phys. B: At. Mol. Opt. Phys., 2024, 57, 015201 2. Sugumar, R., Venugopal, H., Sen, S. et al. Appl. Phys. B 130, 183 (2024). 3. B. Kalal, S. Baweja, S. Maity, J. Phys. Chem. A, 2024 4. A. Sen, S. Khodia, R. Jarupula, S. Baweja, B. Kalal, S. Maity*, Phys. Chem. Chem. Phys. 2024, 26, 25697 5. S. Baweja, B. Kalal, S. Maity, J. Phys. Chem. A, 2024, 128, 3329. P52
Essential qualifications	MSc in Physics or Chemistry or related areas.
Desirable qualifications	Knowledge in Lasers, Optics, molecular spectroscopy and related topics
Broad proposal objectives	https://drive.google.com/open?id=1hSmUuti28zMlOQqmY_YZJRuz_8CapVBI

PROPOSAL No. - IDPHD2025004	
Title of the Proposal	**Development of adhesive conductive supramolecular biomaterials leveraging peptide-self-assembly toward functional cardiac patches**
Supervisor-1	Dr. Priyadarshi Chakraborty, *Chemistry*
Supervisor-2	Dr. Falguni Pati, *Biomedical Engineering*
Email IDs	priyadarshi@chy.iith.ac.in falguni@bme.iith.ac.in
Abstract	We aim to develop conductive, antimicrobial, adhesive scaffolds composed of peptide self-assembled fibers and conductive polymers, resembling the characteristics of the native extracellular matrix with self-healing properties, mechanical rigidity, and biocompatibility. Cardiomyocytes will be seeded on the scaffolds, and their biocompatibility and cell attachment properties will be assessed. Finally, the scaffolds will be utilized for tissue engineering applications.
Keywords	Cardiac tissue engineering, cardiac patch, peptides, RGD, Dopa
Background and Motivation	The project proposes the development of cardiac tissue patches exploiting supramolecular chemistry, peptide chemistry, conductive polymers, and tissue engineering. The proposed approach has great potential for clinical implementation, given the state of cardiovascular illnesses today and the dearth of cardiac tissue engineering research in India.
Relevant publications	1. A. K. Bera, Y. Sriya, F. Pati, Macromolecular Bioscience 2022, 22 (8), 2200109 2. S. Sasikumar, S. Chameettachal, P. Kingshott, B. Cromer, and F. Pati, ACS Biomater. Sci. Eng. 2022. 8(2), 834–846 3. A. Bhavsar, F. Pati, P. Chakraborty, ChemBioChem, 2024, DOI: 10.1002/cbic.202400733 4. I. Sahu, Y. Tang, Z. Wang, S. Naskar, T. Vijayakanth, V. Vishwanath Adole, G. Wei, P. Chakraborty, J. Mater. Chem. A 2024, 12, 4169. 5. I. Sahu, J. Verma, A. K. Bera, S. Pande, A. Bhavsar, F. Pati, P. Chakraborty, ACS Appl. Mater. Interfaces 2024, 16, 34141
Essential qualifications	MSc in Biotechnology MSc in Chemistry
Desirable qualifications	Experience in peptide synthesis, cell culture
Broad proposal objectives	https://drive.google.com/open?id=1pvWiGENLXJSl7OVV6VfFcKWmWro5tsg8
******Please Note that this proposal is for a Project-funded position from the research funds of the supervisors. For more information, please contact the supervisors directly.***	

PROPOSAL No. - IDPHD2025005	
Title of the Proposal	**Indigenous Flexible Dry Electrodes for continuous, non-invasive, and long-term epidermal biopotential monitoring**
Supervisor-1	Dr. Suresh Kumar Garlapati, *Materials Science and Metallurgical Engineering*
Supervisor-2	Dr. Nagarajan Ganapathy, *Biomedical Engineering*
Email IDs	gsuresh@msme.iith.ac.in gnagarajan@bme.iith.ac.in
Abstract	This proposal aims to develop stretchable, self-adhesive electrodes fabricated from biocompatible polymers to ensure skin compatibility. We characterise these electrodes by optimizing polymer blends for conductivity, stretchability, and adhesion to assess their performance. The outcome enables efficient real-time sensing and diagnosis of vital signs in patients, enhancing healthcare monitoring.
Keywords	Dry electrodes, 3D printing, flexible, bendable, physiological signals
Background and Motivation	This research develops advanced dry electrodes for biosignal acquisition, overcoming limitations of traditional gel-based electrodes like skin irritation and poor stability. Using a biocompatible polymer blend, these self-adhesive, stretchable, and reusable electrodes enhance comfort and reliability. Integrating microneedles for transdermal drug delivery, the study optimizes electrode design for ECG, EEG, and EMG, improving wearable health monitoring and personalized healthcare.
Relevant publications	1. Shaswata Chowdhury, Syed Jalaluddeen A, Avinash Eranki*, Suresh Kumar Garlapati*, "Low-Cost Desktop Printed Sensors for Therapeutic Ultrasound Applications", accepted by IEEE Sensors Journal, 2024, (DOI: 10.1109/JSEN.2024.3470223). 2. Rao KT, Gangwar R, Bhagavathi A, Khatun S, Sahu PK, Rengan AK, Subrahmanyam C, Garlapati SK*, Vanjari SR*. Development and Characterization of Biocompatible Cellulose Acetate Substrate for Flexible Electrochemical Biosensors. IEEE Journal on Flexible Electronics. 2024 Jul 30. 3. SK Garlapati*, Firman Mangasa Simanjuntak, Spyros Stathopoulos, Syed Jalaluddeen A, Mari Napari, Themis Prodromakis*, “Compliance-free, analog RRAM devices based on SnOx”, Scientific Reports, 2024, 14(1), 14163. 4. Kang MH, Nasrallah I, Faraji S, Garlapati SK, Rahmanudin A, Tate DJ, Saez GS, Persaud KC, Turner ML, Sirringhaus H. A Flexible Smart Sensor System based on Hybrid Integration of Organic and Metal Oxide Transistors. IEEE Sensors Journal. 2024 Apr 19. 5. Emre Ozer, Jedrzej Kufel, John Biggs, Anjit Rana, Francisco Rodriguez, Thomas Lee-Clark, Antony Sou, Catherine Ramsdale, Scott White, Suresh Kumar Garlapati, Palaniappan Valliappan, Aiman Rahmanudin, Venukrishnan Komanduri, Glenn Sunley-Saez, Sankara Gollu, Gavin Brown, Piotr Dudek, Krishna Persaud, Michael Turner, Stephanie Murray, Susan Bates, Robert Treloar, Brian Newby, and Jane Ford, "Malodour Classification with Low-cost Flexible Electronics", Nature Communications, 2023 Feb 11;14(1):777. Impact factor: 17.69 6. Nagarajan G., Diana Baumgartel and Thomas M. Deserno. 2021. “Automated Detection of Atrial Fibrillation in ECG signals Using Dynamic Symbol Assignment based Co-occurrence Patterns and Ensemble Learning”, Sensors, 21(10),3542 7. Nagarajan G. and Ramakrishnan S. 2021. “Emotion recognition using electrodermal activity signals and multiscale deep convolution neural network”, J Med Syst 45, 49 (2021). https://doi.org/10.1007/s10916-020-01676-6] 8. Nagarajan G., Ramakrishnan S. and Thomas M. Deserno. 2021. “Adaptive learning and cross training improves R-wave detection in ECG”, Comput Methods Programs Biomed, 200,105931 9. Nagarajan G. and Ramakrishnan S. 2020. “Convolution Neural Network based Emotion Recognition using Electrodermal Activity Signals and Time-Frequency Features”, Expert Syst. Appl., 159, 113571, https:doi.org/10.1016/j.eswa.2020.11357

	10.Nagarajan G, Ramakrishnan S and Thomas M. Deserno, 2018 " Deep learning on 1D biosignals: a taxonomy-based survey", Yearb Med Inform; 27(1):98-109. https://doi.org/10.1055/s-0038- 1667083.
Essential qualifications	Biomedical engineering, Materials Science, Metallurgical Engineering, Electrical Engineering, Mechanical Engineering, Polymer Science, Ceramic Engineering, and related disciplines.
Desirable qualifications	Biomedical engineering, Materials Science, Metallurgical Engineering, Electrical Engineering, Mechanical Engineering, Polymer Science, Ceramic Engineering, and related disciplines.
Broad proposal objectives	https://drive.google.com/open?id=1xbBaLiexV81U9BQItdzDcHNz-Gj9FBdD

PROPOSAL No. - IDPHD2025006	
Title of the Proposal	**Micropatterned bacterial cellulose dressings for scar-free wound healing**
Supervisor-1	Dr. Mudrika Khandhelwal, *Materials Science and Metallurgical Engineering*
Supervisor-2	Dr. Falguni Pati, *Biomedical Engineering*
Email IDs	mudrika@msme.iith.ac.in falguni@bme.iith.ac.in
Abstract	Engineered bacterial cellulose (BC) films, with their unique 3D nanostructure and favorable biological properties, offer a promising approach to scarless wound healing. By modulating cell attachment and regulating fibroblast proliferation and collagen deposition, these films facilitate an organized healing process. The incorporation of therapeutic and antimicrobial agents enhances their efficacy, preventing infection and promoting uninterrupted healing. BC's biocompatibility and structural resemblance to the extracellular matrix support optimal cell attachment, while its physicochemical properties make it ideal for wound dressings, facilitating rapid healing and tissue regeneration. This innovative strategy combines surface patterning techniques with the addition of therapeutic agents into BC to create a simple yet effective tool for enhanced wound repair.
Keywords	Scarless wound repair, Surface engineering, Patterned bacterial cellulose, Antimicrobial, Biocompatible
Background and Motivation	Current wound management protocols require local wound care as well as oral or intravenous intake of antibiotics and painkillers. Medicated wound dressings are key to alleviating the suffering and expediting the recovery. Most commercially available wound dressings are simply barriers from the external environment augmented with antimicrobial activity. Thus, current dressings need improvements in three aspects: a) incorporation of multiple drugs (analgesic and antimicrobial), b) increase in the drug loading capacity and c) provide painless and scar-free wound healing. Furthermore, the dressing must not produce traumas when removed and must also be cost-effective and preferably biodegradable and environment friendly.
Relevant publications	1. Kiranmai, G., Alam, A., Chameettachal, S., Khandelwal, M., & Pati, F. (2024). Engineering a Biomimetic Glomerular Filtration Barrier: Coculturing Endothelial Podocytes on Kidney ECM-Bacterial Cellulose Membrane Hybrid. ACS Applied Materials & Interfaces, 16(39), 52008-52022.
Essential qualifications	Masters in Polymer Science, Material Science, Microbiology, Biomedical Engineering, Nanotechnology and similar disciplines
Desirable qualifications	experience with handling bacteria and cells. exposure to materials characterisation techniques
Broad proposal objectives	https://drive.google.com/open?id=12-QriOfn7z7CGMDxAGcyre13zLd7Dclp

PROPOSAL No. - IDPHD2025007

Title of the Proposal	**Investigating Neurophysiological Signatures using Cognitive and Somatosensory Integration in the traditional dance form of Bharatanatyam**
Supervisor-1	Dr. Nagarajan Ganapathy, *Biomedical Engineering*
Supervisor-2	Dr. Sai Sidhardh, *Mechanical & Aerospace Engineering*
Email IDs	gnagarajan@bme.iith.ac.in sidhardh@mae.iith.ac.in
Abstract	This project explores how Indian dance formats, especially Bharatanatyam, influence brain activity, cognitive function, and neural connectivity, with implications for neurological interventions. It examines cognitive load and brain function using physiological signals, emotion recognition, and movement tracking. The study aims to reveal Bharatanatyam's role in cognitive enhancement, neuroplasticity, and potential therapeutic applications
Keywords	multi-modal learning, physiology, Deep learning, hybrid architecture, Electroencephalography
Background and Motivation	Bharatanatyam integrates complex motor coordination, rhythm, and expression, engaging brain regions linked to cognition and emotion. There is limited research on the rehabilitative and therapeutic effects of traditional dance forms in treating neurological disorders. This project uses EEG, physiological signals, and AI-based analysis to explore its impact on brain function. Insights could inform cognitive interventions for neurological disorders, bridging neuroscience, movement science, and AI-driven cognitive research
Relevant publications	**Publications – Dr. Nagarajan Ganapathy** 1. Nagarajan G., Diana Baumgartel and Thomas M. Deserno. 2021. "Automated Detection of Atrial Fibrillation in ECG signals Using Dynamic Symbol Assignment based Co-occurrence Patterns and Ensemble Learning", Sensors, 21(10),3542 2. Nagarajan G. and Ramakrishnan S. 2021. "Emotion recognition using electrodermal activity signals and multiscale deep convolution neural network", J Med Syst 45, 49 (2021). https://doi.org/10.1007/s10916-020-01676-6] 3. Nagarajan G., Ramakrishnan S. and Thomas M. Deserno. 2021. "Adaptive learning and cross training improves R-wave detection in ECG", Comput Methods Programs Biomed, 200,105931 4. Nagarajan G. and Ramakrishnan S. 2020. "Convolution Neural Network based Emotion Recognition using Electrodermal Activity Signals and Time-Frequency Features", Expert Syst. Appl., 159, 113571, https:doi.org/10.1016/j.eswa.2020.11357 5. Nagarajan G, Ramakrishnan S and Thomas M. Deserno, 2018 " Deep learning on 1D biosignals: a taxonomy-based survey", Yearb Med Inform; 27(1):98-109. https://doi.org/10.1055/s-0038- 1667083. 6. Yedukondala Rao Veeranki, Nagarajan G., Ramakrishnan S. 2022. "Analysis of Fluctuation Patterns in Emotional States Using Electrodermal Activity Signals and Improved Symbolic Aggregate Approximation", Fluctuation and Noise Letters, 21(1), 2250013. 7. Yedukondala Rao Veeranki, Himanshu Kumar., Nagarajan G., Balasubramaniam N., Ramakrishnan S. 2021. "A Systematic Review of Sensing and Differentiating Dichotomous Emotional States Using Audio-Visual Stimuli", IEEE Access, vol. 9, pp. 124434-124451, 2021. 8. Himanshu K, Nagarajan G, Subha D, and Ramakrishnan S (2021) "EEG based emotion recognition using entropy features and Bayesian optimized random forest." Current Directions in Biomedical Engineering 7(2), 767-770, doi: 10.1515/cdbme-2021-2196 **Publications - Dr. Sai Sidhardh** 9. Padmaprabhan, A., Hari, S., Thomas, N. P., Chadha, K. S., Sidhardh, S., Chinthapenta, V., & Kumar, P. (2025). GO-GAN: Geometry Optimization Generative Adversarial Network for Achieving Optimized Structures with Targeted Physical Properties. arXiv preprint arXiv:2502.00416.

Essential qualifications	Biomedical engineering, Computer Science, Electrical Engineering, Mechanical Engineering
Desirable qualifications	Biomedical Engineering, Artificial Intelligence, Computer Science, Electrical Engineering
Broad proposal objectives	https://drive.google.com/open?id=1uo9AjwWp5zHEdWmXbXZRYBtpTBQyFnRv
******Please Note that this proposal is for a Project-funded position from the research funds of the supervisors. For more information, please contact the supervisors directly.***	

PROPOSAL No. - IDPHD2025008

Title of the Proposal	**Quantitative Magnetic Resonance Imaging and Artificial-Intelligence-enabled radiotherapy planning**
Supervisor-1	Dr. Jaladhar Neelavalli, *Biomedical Engineering*
Supervisor-2	Dr. Konda Reddy Mopuri, *Artificial Intelligence*
Email IDs	drjaladhar.n@bme.iith.ac.in krmopuri@ai.iith.ac.in
Abstract	MRI to CT image generation can play an important role in reducing radiation burden and shorten treatment times for cancer patients receiving radiotherapy. Optimal MR input image sets and deep neural network designs for accurate MRI ⊠ CT image generation and dose planning are the key research topics in this project.
Keywords	MRI to CT prediction, radiotherapy planning, quantitative MRI, Deep Learning, Artificial intelligence, Generative Models, Image-to-Image translation
Background and Motivation	Cancer burden in the subcontinent has been steadily increasing. Today, about 1 in 9 people in India are expected to face a cancer diagnosis within their lifetime. Radiotherapy treatment for cancer requires additional imaging investigations (MRI and CT) for planning treatment delivery. The goal of this project is to remove CT from this treatment path using AI, which will reduce radiation burden and shorten the treatment period for the patient.
Relevant publications	1. European Patent filing, April 2023. WO2024223339 (A1), EP4455707 (A1) . SYSTEM AND RELATED METHOD FOR 3D MULTI-VIEW PLANNING FOR MR IMAGING. Inventors: SHARMA SUMIT; P S VISWANATH; HEGDE AMRUTA VENKATRAMAN; SARASWATHY SUJA; ADHIKARY DHRUBA; ALI MATTATHODI RAZEEM AHMAD; NEELAVALLI JALADHAR*; VAZHAKUZHAKAL NARAYANAN PRASAD; VS VINEETH. 2. European Patent filing, Oct 2021, WO2023066950 (A1) . Magnetic resonance imaging with shim settings based on machine learning. NIELSEN TIM; WUELBERN JAN H; LIPS OLIVER; BOERNERT PETER U; NEHRKE KAY; TAZICKAR SHASHANK SURESH; SARASVUOTI SIMA; JAYAPALAN MURALI; SRINIVASAN ANAND; RUDRAPATNA UPPALA SRINIVASA; NEELAVALLI JALADHAR* 3. Yadav BK, Buch S, Krishnamurthy U, Jella P, Hernandez-Andrade E, Trifan A, Yeo L, Hassan SS, Mark Haacke E, Romero R, Neelavalli J*. Quantitative susceptibility mapping in the human fetus to measure blood oxygenation in the superior sagittal sinus. Eur Radiol. 2019 Apr;29(4):2017-2026. 4. Naveen George, Karthik D., Rutheesh Ch., Konda Reddy Mopuri*, "The Illusion of Unlearning: The Unstable Nature of Machine Unlearning in Text-to-Image Diffusion Models", IEEE CVF Conference on Computer Vision and Pattern Recognition (CVPR) 2025. 5. Harsh Rangwani, Konda Reddy Mopuri*, R. Venkatesh Babu, Class Balancing GAN with a Classifier in the Loop, Uncertainty in Artificial Intelligence (UAI), 2021.
Essential qualifications	● Strong mathematical foundations (linear algebra, probability, optimization) and programming experience (Python preferably) ● Strong enthusiasm to apply AI to critical problems in healthcare
Desirable qualifications	● Exposure to radiation physics in biological tissue ● Exposure to Computed tomography (CT) and or Magnetic resonance imaging (MRI)
Broad proposal objectives	https://drive.google.com/open?id=1Bb1FtdjXiazx9z6ETtMTmh5y1R97ONEQ

PROPOSAL No. - IDPHD2025009

Title of the Proposal	**Dynamic uptake and transport of endocrine-disrupting chemicals and microplastics in aquatic and biological systems: In vitro and in vivo studies**
Supervisor-1	Dr. Renu John, *Biomedical Engineering*
Supervisor-2	Dr. Seetha N, *Civil Engineering*
Email IDs	renujohn@bme.iith.ac.in seetha@ce.iith.ac.in
Abstract	This study envisages to provide a comprehensive understanding of uptake, transformation, accumulation, and toxicity of endocrine-disrupting chemicals and microplastics in water bodies, edible plants and fishes. It also involves developing biosensing technologies for detecting endocrine-disrupting chemicals for various applications. The project involves both in vitro and in vivo experimental and modeling studies.
Keywords	Endocrine-disrupting chemicals, microplastics, biosensing, toxicity, modeling
Background and Motivation	Microplastics and endocrine-disrupting chemicals are ubiquitous in many environmental waters and have serious health consequences to humans and the ecosystem. They are also uptaken by plants and fishes which may get metabolized and accumulate inside their system. Hence, it is important to understand the uptake, transport, and transformation of microplastics and endocrine-disrupting chemicals in water bodies, plants and fishes to minimize the impacts on ecology and human health.
Relevant publications	1. Vijay, A., Mohandas, J.L., Dutta-Gupta, S. and John, R., 2024. Label-free detection and characterization of secondary microplastics from tea bags. Optical Engineering, 63(1), pp.013101-013101. 2. Vijay, A., Galande, A.S. and John, R., 2023, June. Low-cost portable lens less digital holographic microscope for studying anemic RBCs. In European Conference on Biomedical Optics (p. 1263016). Optica Publishing Group. 3. Galande, A.S., Gurram, H.P.R., Kamireddy, A.P., Venkatapuram, V.S., Hasan, Q. and John, R., 2022. Quantitative phase imaging of biological cells using lensless inline holographic microscopy through sparsity-assisted iterative phase retrieval algorithm. Journal of Applied Physics, 132(24). 4. Horta, M.J., Seetha, N., 2024. Experimental and mathematical investigation of cotransport of clay and microplastics in saturated porous media. Science of the Total Environment, 954. 5. Seetha, N., Dibyanshu, Raychoudhury, T., 2024. Modeling the transport behavior of zinc oxide nanoparticles in soil under various environmental conditions. Water, Air, & Soil Pollution, 235 (55). 6. Jayaraj, J., Seetha, N., Hassanizadeh, S.M., 2023. Modeling the transport and retention of nanoparticles in a single partially-saturated pore in soil. Water Resources Research, 59, e2022WR034302.
Essential qualifications	BTech in Agricultural/Biomedical/Chemical/Civil/Environmental/Mechanical engineering Or MSc in Physics/Chemistry or MSc/MTech in Nanoscience and Technology or ME/MTech in Biomedical/Chemical/Environmental/Water Resources/Agricultural/Mechanical Engineering
Desirable qualifications	Previous experience in working with microplastics, plants, or fish/ imaging using light or electron microscopy/ sensing for contaminant detection/ developing physics-based models or numerical simulations
Broad proposal objectives	https://drive.google.com/open?id=1BWmCeG9wU7VdB38WSaAhqaoFhXTlFFRE

PROPOSAL No. - IDPHD2025010	
Title of the Proposal	**Accurate Neuronal Cell Segmentation and Classification based on Machine-Generated Annotations: Information-theoretic Analysis of Neuronal Responses**
Supervisor-1	Dr. Lopamudra Giri, *Chemical Engineering*
Supervisor-2	Dr. Soumya Jana, *Electrical Engineering*
Email IDs	giril@che.iith.ac.in jana@ee.iith.ac.in
Abstract	Automated analysis of high-throughput videos obtained from microscopy remains challenging during drug discovery studies, while being useful in brain-research. To address this, we propose a framework for AI-based solution for analysis of neuron structures based on machine-generated annotations. Subsequently, we shall estimate information-theoretic measures to draw inferences on neuronal network.
Keywords	Healthcare, Deep learning, computer vision, brain research, information theory
Background and Motivation	The supervised framework consisting of advanced deep learning tools for cell segmentation encounters challenges related to labor/time-intensive annotations, demanding substantial domain expertise and large-scale training data. In this backdrop, the aim is to develop a zero-label method for segmentation of images followed by information-theoretic analysis.
Relevant publications	1. SD Neelapala, S Gare, V Dhyani, D Srikanth, S Jana, L Giri, Improved Segmentation of Confocal Calcium Videos of Hela Cells Using Deep-Learning-Assisted Watershed Algorithm. In 2024 46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (pp. 1-4). IEEE. 2. A Mallick, A Shaiju, SD Neelapala, L Giri, R Sarkar, S Jana, AI-based 3-Lead to 12-Lead ECG Reconstruction: Towards Smartphone-based Public Healthcare, In IEEE International Conference on E-health Networking, Application & Services (HealthCom) 2024 . 3. SD Neelapala, S Jana, L Giri , U-Net-based HeLa Cell Segmentation with Zero Manual Labeling using DBSCAN-Generated Annotations. In IEEE International Conference on E-health Networking, Application & Services (HealthCom) 2024 . 4. Ande S, Avasarala S, Swain S, Karunarathne A, Giri L, Jana S. Robust entropy rate estimation for nonstationary neuronal calcium spike trains based on empirical probabilities. Journal of Neural Engineering. 2024 Oct 28;21(5):056038. 5. Gare, S., Chel, S., Abhinav, T.K., Dhyani, V., Jana, S. and Giri, L., 2022. Mapping of structural arrangement of cells and collective calcium transients: an integrated framework combining live cell imaging using confocal microscopy and UMAP-assisted HDBSCAN-based approach. Integrative Biology, 14(8-12), pp.184-203. Impact factor: 3.177
Essential qualifications	1. Knowledge of statistics, Regression, machine learning is preferred , Interest in mathematics and Biology, Interest in Brain research and Healthcare.
Desirable qualifications	B Tech/Masters in Electrical Engg/Computer Science/AI/Biomedical/Biotechnology/Chemical Engg
Broad proposal objectives	https://drive.google.com/open?id=1uAuvfVgrP0IMIEUOYimg5__11fR0CjK8

PROPOSAL No. - IDPHD2025011	
Title of the Proposal	**Development of novel mRNA vaccine platform for infectious and chronic diseases by highly interdisciplinary approach of mRNA engineering and nanoengineering of delivery system**
Supervisor-1	Dr. Jyotsnendu Giri, *Biomedical Engineering*
Supervisor-2	Dr. Indranil Malik, *Biotechnology*
Email IDs	jgiri@bme.iith.ac.in indranil@bt.iith.ac.in
Abstract	Traditional DNA or inactivated pathogen-based vaccines are often inefficient. Although mRNA vaccines with advanced delivery systems hold the promise to overcome many issues of traditional vaccines, there are still many unmet challenges. Objective of this project is to develop a novel platform by mRNA engineering and nanoengineering of novel deliver system for affordable and efficient mRNA vaccines.
Keywords	mRNA vaccine, mRNA engineering, mRAN delivery system, mRNA vaccine storage and transport, cold-chain free vaccine,
Background and Motivation	Background and Motivation: mRNA-based vaccination garnered rapid attention due to its flexibility and rapid processing/development time. Besides successful implications against COVID-19, many other viral diseases are currently under trial for targeting by mRNA-based vaccines. Despite these pressing needs, mRNA vaccine/therapeutics development faces potential limitations. These limitations can primarily be of two kinds, limitations related to the synthetic mRNAs (antigens), and second, limitations of the delivery system. Since mRNA vaccines are transient in nature and RNA molecules are prone to spontaneous degradation, a significant limitation is to maintain RNA stability during the preparation and delivery of the vaccine. Using existing mRNA vaccine candidates against SARS-CoV, this project will precisely address major concerns related to mRNA engineering and delivery systems.
Relevant publications	1. Jyotsnendu Giri, Nanostructure-hybrid lipid capsule system for delivery/co-delivery of nucleic-acid and active-pharmaceutical ingredient and its fabrication method, Patent Application No.: 202241054829 2. Jyotsnendu Giri, Sunil K Yadava, A system and method for fabricating dual pH/temperature-responsive nanostructure hybrid-lipid capsule for theragnostic application, Patent Application No.: 202341015865 3. Basu, S. M., Chauhan, M., & Giri, J. (2023). pH-Responsive Polypropylene Sulfide Magnetic Nanocarrier-Mediated Chemo-Hyperthermia Kills Breast Cancer Stem Cells by Long-Term Reversal of Multidrug Resistance and Chemotherapy Resensitization. ACS Applied Materials & Interfaces, 15(50), 58151-58165. 4. Malik, I., Tseng, Y.-J., Wright, S. E., Zheng, K., Ramaiyer, P., Green, K. M., & Todd, P. K. (2021). SRSF protein kinase 1 modulates RAN translation and suppresses CGG repeat toxicity. EMBO Molecular Medicine, 13(11), e14163. 5. Qiu, C., Arora, P., Malik, I., Laperuta, A. J., Pavlovic E. M., Ugochukwu. S., Naik. M., Kaplan, C. D. (2024 Thiolutin has complex effects in vivo but is a direct inhibitor of RNA polymerase II in vitro. Nucleic Acids Res, 2024 Jan 12:gkad1258. doi: 10.1093/nar/gkad1258. Online ahead of print. 6. Malik, I., Tseng, Y.-J., Wright, S. E., Zheng, K., Ramaiyer, P., Green, K. M., & Todd, P. K. (2021). SRSF protein kinase 1 modulates RAN translation and suppresses CGG repeat toxicity. EMBO Molecular Medicine, 13(11), e14163. 7. Malik, I., Tseng, Y.-J., Wieland, C. M., Green, K. M., Zheng, K., Calleja, K., & Todd, P. K. (2023). Dissecting the roles of EIF4G homologs reveals DAP5 as a modifier of CGG repeat-associated toxicity in a Drosophila model of FXTAS. Neurobiology of Disease, 184, 106212.

	8. Tseng, Y.-J., Krans, A., Malik, I., Deng, X., Yildirim, E., Ovunc, S., Tank, E. M. H., Jansen-West, K., Kaufhold, R., Gomez, N. B., Sher, R., Petrucelli, L., Barmada, S. J., & Todd, P. K. (2024). Ribosomal quality control factors inhibit repeat-associated non-AUG translation from GC-rich repeats. Nucleic Acids Research, gkae137. 9. Green, K. M., Miller, S. L., Malik, I., & Todd, P. K. (2022). Non-canonical initiation factors modulate repeat-associated non-AUG translation. Human Molecular Genetics, 31(15), 2521–2534. 10. Qiu, C., Arora, P., Malik, I., Laperuta, A. J., Pavlovic E. M., Ugochukwu. S., Naik. M., Kaplan, C. D. (2024 Thiolutin has complex effects in vivo but is a direct inhibitor of RNA polymerase II in vitro. Nucleic Acids Res, 2024 Jan 12:gkad1258. doi: 10.1093/nar/gkad1258. Online ahead of print.
Essential qualifications	M Pharm, M Tech Biotechnology, Nanoscience, Biochemistry
Desirable qualifications	Candidate should have knowledge on mRNA biology, nano formulation development
Broad proposal objectives	https://drive.google.com/open?id=1dla3fUBfIpLAgRiLJhtXYWcE9Cx-FedJ

PROPOSAL No. - IDPHD2025012	
Title of the Proposal	**Advancing Raindrop Microphysics with Cutting-Edge Experiments and Machine Learning**
Supervisor-1	Prof. Lakshmana Dora Chandrala, *Mechanical & Aerospace Engineering*
Supervisor-2	Prof. Kirti Chandra Sahu, *Chemical Engineering*
Email IDs	lchandrala@mae.iith.ac.in ksahu@che.iith.ac.in
Abstract	The project aims to study raindrop dynamics using a state-of-the-art raindrop research facility and machine learning-driven holography. It will combine fundamental research with applied studies, with the primary goal of developing a real-time, in-situ device to accurately measure rainfall in different regions. This project has a scope to develop a real-time device for accurate rainfall measurement mounted on drones to measure raindrop size distribution.
Keywords	Fluid dynamics, Droplets, Machine learning, experiments
Background and Motivation	Accurate rainfall measurement is vital for weather prediction and climate studies. This project seeks to develop a real-time, in-situ device for precise rainfall measurement, utilizing aerial vehicles, machine learning, and inline holography to capture high-resolution raindrop data at various altitudes, combining both fundamental and applied research.
Relevant publications	1. S. S. Ade, P. K. Kirar, L. D. Chandrala and K. C. Sahu, Droplet size distribution in a swirl airstream using in-line holography technique, Journal of Fluid Mechanics, 2023, 954, A39. 2. S. S. Ade, L. D. Chandrala and K. C. Sahu, Size distribution of a drop undergoing breakup at moderate Weber numbers, Journal of Fluid Mechanics, 2023, 959, A38. 3. S. S. Ade, P. K. Kirar, L. D. Chandrala and K. C. Sahu, Droplet breakup and size distribution in an airstream - effect of inertia, Physical Review Fluids, 2024, 9, 084004. 4. S. S. Ade, D. Gupta, L. D. Chandrala and K. C. Sahu, Application of deep learning and inline holography to estimate the droplet size distribution, International Journal of Multiphase Flow, 2024, 177, 104853. 5. P. Katre, S. Balusamy, S. Banerjee, L. D. Chandrala and K. C. Sahu, Evaporation dynamics of a sessile droplet of binary mixture laden with nanoparticles, Langmuir, 2021, 37(30), 6311-6321.
Essential qualifications	B-Tech/M-Tech in Mechanical, Aerospace, Chemical Engineering, and related fields
Desirable qualifications	B-Tech/M-Tech in Mechanical, Aerospace, Chemical Engineering, and related fields
Broad proposal objectives	https://drive.google.com/open?id=1OJWZ0L1ifUSLPLej-jYVKLytsh8u3qAV

PROPOSAL No. - IDPHD2025013	
Title of the Proposal	**Synthesis of Novel Organic Relaxor Ferroelectric Polymers for Energy Storage**
Supervisor-1	Dr. Mahesh Peddigari, *Physics*
Supervisor-2	Dr. Abhijit Sau, *Chemistry*
Email IDs	mahesh.p@phy.iith.ac.in asau@chy.iith.ac.in
Abstract	New chiral triazole difluoride and amide difluoride based organic polymers will be synthesized for relaxor ferroelectric materials. The chiral monomer difluoride azido alkyne and difluoride amino carboxylic acid will be introduced to cause local structural distortions and induce the relaxor behavior in ferroelectric polymers for use in energy storage applications.
Keywords	Organic Synthesis, Relaxor ferroelectric, Polymer, Energy storage, Polar nano regions
Background and Motivation	Relaxor ferroelectric (RFE) polymers exhibit exceptional properties such as high permittivity, high breakdown strength, slim hysteresis loops, and excellent mechanical flexibility, making them ideal for energy storage. With limited availability, a novel synthesis route becomes crucial for fabricating high-performance RFE polymers and enhancing their potential in energy storage technology.
Relevant publications	1. Mahesh Peddigari, Bo Wang, Rui Wang, Woon-Ha Yoon, Jongmoon Jang, et al., Giant Energy Density via Mechanically Tailored Relaxor Ferroelectric Behavior of PZT Thick Film, Advanced Materials, 2023, 35, 2302554. (I.F. factor 32.086). 2. R. Kumar, R. Meher, J. Sharma, A. Sau,* T. K. Panda*, Amidophosphine Boranes as Hydroboration Reagents for Nitriles, Alkynes, and Carboxylic Acids, Org. Lett., 2023, 25, 7923-7927 3. Seonhwa Park, Hyunsu Choi, Geon-Tae Hwang, Mahesh Peddigari, Cheol-Woo Ahn, et al., Molten-Salt Processed Potassium Sodium Niobate Single-Crystal Microcuboids with Dislocation-Induced Nanodomain Structures and Relaxor Ferroelectric Behavior, ACS Nano, 2022, 16, 9, 15328-15338. (I.F. factor: 18.03) 4. Mahesh Peddigari, Jung Hwan Park, Jae Hyun Han, Chang KyuJeong, Jongmoon Jang, et. al., Flexible Self-Charging, Ultrafast, High-Power-Density Ceramic Capacitor System, ACS Energy Letters, 2021, 6, 1383–1391. (I.F. factor: 23.99). 5. P. Chatelain, C. Muller, A. Sau, D. Brykczynska; M. Bahadori, C. Rowley, J. Moran “Desulfonative Suzuki-Miyaura Coupling of Sulfonyl Fluorides” Angew. Chem. Int. Ed., 2021, 60, 25307-25312.
Essential qualifications	M.Sc in Chemistry or Physics
Desirable qualifications	Experience of working in organic synthesis
Broad proposal objectives	https://drive.google.com/open?id=1tI68beE_YtY5XTk_IOCe3TThA0EW9NHc

PROPOSAL No. - IDPHD2025014	
Title of the Proposal	**Integrated Carbon Capture & Utilization by Electrochemical Methods**
Supervisor-1	Dr. Deepu J. Babu, *Materials Science and Metallurgical Engineering*
Supervisor-2	Dr. Pritha Chatterjee, *Civil Engineering*
Email IDs	deepu.babu@msme.iith.ac.in pritha@ce.iith.ac.in
Abstract	The project aims to develop a single step carbon capture and utilization technology by electrochemical approaches.
Keywords	Carbon capture, Electrochemistry, Porous materials, CO2 utilization
Background and Motivation	Carbon capture is a key mitigation strategy for combating global warming and its effects on climate change. To ensure sustainability, CO_2 capture technology must be highly energy-efficient to reduce its own carbon footprint. However, conventional methods such as absorption and pressure/temperature swing adsorption fall short in this aspect. Electrochemical swing carbon capture is a novel and energy-efficient CO2 capture technology wherein the adsorption/desorption is brought about by switching the polarity. In this project, we would like to explore the possibility of a combined capture-utilization pathway by combining CO2 capture with the CO2 conversion step in a single process.
Relevant publications	**Dr. Deepu** 1. Liu, Q.; Miao, Y.; Villalobos, L. F.; Li, S.; Chi, H.-Y.; Chen, C.; Vahdat, M. T.; Song, S.; Babu, D. J.; Hao, J.; et al. Unit-Cell-Thick Zeolitic Imidazolate Framework Films for Membrane Application. Nat. Mater. 2023, 22 (11), 1387–1393. 2. Villalobos, L. F.; Babu, D. J.; Hsu, K.-J.; Van Goethem, C.; Agrawal, K. V. Gas Separation Membranes with Atom-Thick Nanopores: The Potential of Nanoporous Single-Layer Graphene. Acc. Mater. Res. 2022, 3 (10), 1073–1087. 3. Babu, D. J.; He, G.; Hao, J.; Vahdat, M. T.; Schouwink, P. A.; Mensi, M.; Agrawal, K. V. Restricting Lattice Flexibility in Polycrystalline Metal–Organic Framework Membranes for Carbon Capture. Advanced Materials 2019, 31 (28), 1900855. 4. Babu, D. J.; Bruns, M.; Schneider, R.; Gerthsen, D.; Schneider, J. J. Understanding the Influence of N-Doping on the CO2 Adsorption Characteristics in Carbon Nanomaterials. J. Phys. Chem. C 2017, 121 (1), 616–626. 5. Babu, D. J.; Bruns, M.; Schneider, J. J. Unprecedented CO2 Uptake in Vertically Aligned Carbon Nanotubes. Carbon 2017, 125, 327–335. **Dr. Pritha** 1. Krishna Chaitanya, N., Nair, P. S., Rajpurohit, A., & Chatterjee, P. (2024). Impact of cell voltage on synthesis of caproic acid from carbon dioxide and ethanol in direct current powered microbial electrosynthesis cell. Bioresource Technology, 412. https://doi.org/10.1016/j.biortech.2024.131383 2. Chaitanya, N. K., Thulluru, L. P., & Chatterjee, P. (2023). Optimization of Long-Chain Fatty Acid Synthesis from CO2 Using Response Surface Methodology. Journal of Hazardous, Toxic, and Radioactive Waste, 27(4). https://doi.org/10.1061/JHTRBP.HZENG 1229

	3. Chaitanya, N. K., Rajpurohit, A., Nair, P. S., & Chatterjee, P. (2023). Electrochemical synthesis of propionic acid from reduction of ethanol and carbon dioxide at various applied potentials. Biochemical Engineering Journal, 194. https://doi.org/10.1016/j.bej.2023.108896 4. Dessì, P., Rovira-Alsina, L., Sánchez, C., Dinesh, G.K., Tong, W., Chatterjee, P., Tedesco, M., Farràs, P., Hamelers, H.M. V, Puig, S., 2021 Microbial electrosynthesis: Towards sustainable biorefineries for production of green chemicals from CO2 emissions. Biotechnol. Adv., 46. 5. Kumar, P., Chatterjee, P., & Ghangrekar, M. M. (2024). Polyacrylic co-maleic acid as an anti-scaling binder for air–cathode microbial fuel cell: An oxygen reduction reaction perspective. Results in Chemistry, 7. https://doi.org/10.1016/j.rechem.2023.101251
Essential qualifications	B.Tech./M.Tech. in Materials Science, Chemical Engineering, Environmental Engineering, MSc in Chemistry or any other relevant areas
Desirable qualifications	Electrochemistry knowledge, Experience with building experimental setups, hands-on experience with GC and characterization techniques like SEM, BET, TG, XRD etc.
Broad proposal objectives	https://drive.google.com/open?id=1QgybhL12jngnzz0hJ09n61DQ2VzdzbNz

PROPOSAL No. - IDPHD2025015	
Title of the Proposal	**Development of nanostructured high-entropy alloys for hydrogen storage/utilization applications**
Supervisor-1	Dr. Sudarsanam Putla, *Chemistry*
Supervisor-2	Prof. Pinaki Bhattacharjee, *Materials Science and Metallurgical Engineering*
Email IDs	sudarsanam.putla@chy.iith.ac.in pinakib@msme.iith.ac.in
Abstract	This project focuses on developing novel, efficient nanoalloys for hydrogen storage and catalytic hydrogen applications, essential for a future hydrogen-based economy. Both solid-state and wet-chemical methods will be used to synthesize novel HEAs, followed by their characterization to ensure the desired properties for enhanced hydrogen storage and catalytic hydrogenation applications.
Keywords	High-entropy nanoalloys, Wet and solid-state synthesis, Micro/nanostructure and characterization, Hydrogen storage, Catalytic hydrogenation
Background and Motivation	Hydrogen storage and utilization are currently the bottlenecks towards shifting to a hydrogen-based economy, owing to the inherent difficulty in handling hydrogen gas. A potential solution is to employ solid-state hydrogen storage systems, especially emerging multicomponent high entropy alloys (HEAs). The hydrogen storage and utilization properties of HEAs can be further enhanced by tailoring their compositions and properties, which can be achieved by employing innovative synthesis strategies.
Relevant publications	1. P. Subha, K. Krishan, P. Sudarsanam*, In situ hydroprocessing of lignocellulosic biomass-derived molecules into fuels and chemicals using heterogeneous catalysts, Sustainable Energy Fuels, 2024, 8, 3775-3800. highlighted on the inside front cover page. IF: 5 2. B. Swapna, M. Bobby Barnabas, P. M. Gogoi, P. Bharali, G. Madras, P. Sudarsanam*. Morphology-tuned MnOx/TiO2 nanocatalysts for recycling PET plastic waste with biomass-derived ethylene glycol, Nanoscale, 2025, https://doi.org/10.1039/D4NR05373G. IF: 5.8 3. M.A. Kumar, B. Swapna, P.N. Kalbande, L. Yalagandula, S.A Singh, P. Sudarsanam*, Selective Synthesis of Renewable Diesel Fuel Precursors via C–C Condensation of Biomass-Derived Furans Using a Niobium Oxide Nanocatalyst, ACS Sustainable Chemistry & Engineering, 2024, 12 (43), 15923-15934. highlighted on the front cover page. IF: 7.1 4. B. Swapna, S.B. Putla, A. Ramesh, Ch. Subrahamanyam, G. Madras, P. Sudarsanam*, Catalytic recycling of PET waste bottles into a value-added amide monomer using a heterogeneous niobium pentoxide nanocatalyst, Sustainable Energy Fuels, 2024, 8, 5170-5180. highlighted on the front cover page. IF: 5 5. B. Swapna, N. Singh, S. Patowary, P. Bharali, G. Madras, P. Sudarsanam*, Efficient glycolysis of used PET bottles into a high-quality valuable monomer using a shape-engineered MnOx nanocatalyst, Catalysis Science & Technology, 2024, 14, 5574-5587. highlighted on the back cover page. IF: 4.4 6. Significant Enhancement of Strength–Ductility Synergy of a Cost-Effective Eutectic High-Entropy Alloy via Strain-Partition Engineering, B Tripathy, PK Ojha, S Paul, P.P. Bhattacharjee*, Advanced Engineering Materials, 27 (2025) 2402061. 7. Highly Deformable Laves Phase in a High Entropy Alloy, PK Ojha, S Yoshida, U Sunkari, B Tripathy, N Tsuji, P.P. Bhattacharjee*, Scripta Materialia 240 (2024) 115828 (finalist of the very prestigious Acta Student Award, most popular article published in Scripta Materialia)

	8. Microstructure and mechanical properties of a severely cold-rolled and annealed dual-phase compositionally complex alloy (CCA) with an exceptionally deformable Laves phase, P.K. Ojha, U. Sunkari, P.P. Bhattacharjee*, Intermetallics 174 (2024) 108461. 9. High Strain Rate Superplastic Flow and Fracture Characteristics of a Fine-Grained Eutectic High Entropy Alloy, SR Reddy, X Li, S Guo, P.P. Bhattacharjee, AH Chokshi, Metall Mater Trans A, 55 (2024) 173-182. 10. Annealing-mediated microduplex structure and texture evolution in severely cold-rolled nanolamellar pearlite: a perspective on the effect of starting inter-lamellar spacing, R Hamshini, B Tripathy, S Paul, S Narayanswamy, R Saha, P.P. Bhattacharjee*, Metall Mater Trans A 54 (2023) 1199-1212.
Essential qualifications	1. MSc in Chemistry or BTech/MTech in Materials Science/Metallurgical Engineering/Ceramics with min 60% marks 2. Gate or Net qualification 3. Knowledge in nanochemistry/heterogeneous catalysis/physical metallurgy 4. Sorption/spectroscopy/microscopy characterization
Desirable qualifications	1. One year of research experience in the relevant field 2. Expertise in solid/nanomaterials synthesis/physical metallurgy/catalysis 3. Analysis of solid materials' properties/microstructural characterization techniques 4. H2 adsorption-desorption analysis 5. Catalytic hydrogenation applications
Broad proposal objectives	https://drive.google.com/open?id=11a-jKSQBRdNpiuL5J194z-uouIe6NeRK

PROPOSAL No. - IDPHD2025016	
Title of the Proposal	**Investigation on coal-biomass blends as reductant and fuel in rotary kiln DRI making towards CO2 mitigation**
Supervisor-1	Dr. Gnanaprakash K, *Mechanical & Aerospace Engineering*
Supervisor-2	Dr. Ashok K, *Materials Science and Metallurgical Engineering*
Email IDs	gnan@mae.iith.ac.in ashokk@msme.iith.ac.in
Abstract	The major outcome of this project would be to the target beneficiaries, such as secondary steel industries with coal-fired rotary kiln processes for DRI making that are aspired to minimize emissions/pollutants and maximize positive environmental impact through the utilization of the coal-biomass/biochar fuel blends, thus creating a circular economy and decarbonization in the steel sector. 1. Investigation on the co-firing of coal-biomass/biochar blends in the burner of the lab-scale rotary kiln furnace to understand the performance and emission characteristics towards CO2 mitigation in the DRI process. 2. Study on the coal-biochar blends as a reductant of iron ore in the co-fired lab-scale rotary kiln furnace to understand the overall DRI process efficiency. 3. Sustainability assessment of the modified rotary kiln DRI making with biochar/biomass as co-reductant and fuel.
Keywords	DRI making, Sponge iron, Coal/biochar cofiring, Green reductants
Background and Motivation	In the DRI sector, only a few attempts have been reported to utilize coal-biomass/biochar fuel blends in the rotary kiln burner to demonstrate reduced emissions. Furthermore, no articles are available in the literature on utilizing coal-biochar blends in the rotary kiln feed system as reductants for iron ore. Therefore, investigating the influence of coal-biomass/biochar cofired burners and reductants in rotary kiln DRI-making process towards optimum combustion behavior & efficiency, reduction behavior & yield, and % metallization is essential.
Relevant publications	1. Analysis of Vortex Stability During the BOF Tapping Process: P Kakara Sripushpa, Usha Yenni, Syed Furqan Bukhari Murugaiyan, Ashok Kamaraj#: Materials and Metallurgical Transactions B (2024) Vol. 55B, p. 3894-3911. 2. The Role of Slag Carryover on the Non-metallic Inclusion Evolution and Magnetic Behavior in Electrical Steel: Ashok Kamaraj#, P Murugaiyan, G K Mandal, G G Roy: Materials and Metallurgical Transactions B (2022) Vol. 53B, p. 1989-2003. 3. Characterization and Assessment of Mold Flux for Continuous Casting of Liquid Steel Using an Inverse Mold Simulator: Ashok Kamaraj#, S. Tripathy, G. Chalavadi, P. P. Sahoo, S. Misra: Steel Research International (2021) Vol. 93, 3, p. 2100121. 4. K. Gnanaprakash, Y. Lee, J.J. Yoh, Investigation of aging induced processes on thermo-kinetic and combustion characteristics of tungsten pyrotechnic delay composition, Combustion and Flame, Vol. 228, 2021, 114-127 5. K. Gnanaprakash, D. Lim, J.J. Yoh, Combustion characteristics of lithium perchlorate-based electrically controlled solid propellants at elevated pressures, Thermochimica Acta, Vol. 720, 2023, 179421
Essential qualifications	MTech in Mechanical/Metallurgy/Chemical; BTech in Mechanical/Metallurgy/Chemical from CFTIs with CGPA >8.0 or BTech in Mechanical/Metallurgy/Chemical with valid GATE score from other institutions
Desirable qualifications	Publications in the relevant field; Hands-on experience in high-temperature experiments
Broad proposal objectives	https://drive.google.com/open?id=1MlVgUpuaiHd5WWLtQxhxFEZdqfoH6l4S

PROPOSAL No. - IDPHD2025017	
Title of the Proposal	**Machine learning-enabled multi-fidelity computational fluid dynamics simulations of wind farm flows**
Supervisor-1	Dr. Niranjan S. Ghaisas, *Mechanical & Aerospace Engineering*
Supervisor-2	Dr. Sumohana S. Channappayya, *Electrical Engineering*
Email IDs	nghaisas@mae.iith.ac.in sumohana@ee.iith.ac.in
Abstract	This project combines machine-learning (ML) techniques along with computational fluid dynamics (CFD) simulations to enable optimal wind farm designs that would be of immense use to the wind industry. The student will gain experience in conducting turbulence simulations, developing machine-learning algorithms, handling large datasets, and CPU/GPU parallel computing.
Keywords	Computational Fluid Dynamics, Machine Learning, Wind Energy, Turbulence, High-Performance Computing
Background and Motivation	Wind farm design optimization is crucial to ensure efficient utilization of the wind resource. High-fidelity CFD methods are accurate but too expensive for design studies while cheaper reduced models are not sufficiently accurate. The use of machine-learning techniques to develop cheap and accurate tools for wind farm predictions will be explored.
Relevant publications	1. N. N. Kethavath, N. S. Ghaisas, "Effect of an abrupt rough-to-smooth surface roughness transition on wind farm wakes: An LES and analytical modelling study", Journal of Renewable and Sustainable Energy, 16, 033302, 2024. doi: 10.1063/5.0202733 2. K. Mondal, N. N. Kethavath, N. S. Ghaisas, "Large-eddy simulation study of atmospheric boundary-layer flow over an abrupt rough-to-smooth surface roughness transition", Boundary-Layer Meteorology, 188, 229 - 257, 2023. doi: 10.1007/s10546-023-00811-3 3. N. N. Kethavath, K. Mondal, N. S. Ghaisas, "Large-eddy simulation and analytical modelling study of the wake of a wind turbine behind an abrupt rough-to-smooth surface roughness transition", Physics of Fluids, 34, 125117, 2022. doi: 10.1063/5.0129022 4. S. R. Bhavanam, S. S. Channappayya, P. K. Srijith, S. Desai, “Enhanced Astronomical Source Classification with Integration of Attention Mechanisms and Vision Transformers, ” Astrophysics and Space Science. DOI:10.1007/s10509-024-04357-9. 5. S. R. Bhavanam, S. S. Channappayya, P. K. Srijith, S. Desai, “Cosmic Ray Rejection with Attention Augmented Deep Learning,” Astronomy and Computing. DOI:10.1016/j.ascom.2022.100625.
Essential qualifications	BE/BTech/ME/MTech in Mechanical Engineering, Electrical Engineering, Aerospace Engineering or MS in Physics or allied areas.
Desirable qualifications	Experience in one or more of Computational Fluid Dynamics, Turbulence Simulations, Machine Learning, Distributed-memory Parallel Computing
Broad proposal objectives	https://drive.google.com/open?id=1hE3yW94f35XAjczavr1ernLvEi7ct4Xs

PROPOSAL No. - IDPHD2025018	
Title of the Proposal	**Development of process intensified zero-discharge process for extraction of rare earth elements from secondary sources (coal ash, overburden, red mud etc).**
Supervisor-1	Dr. Ashok K, *Materials Science and Metallurgical Engineering*
Supervisor-2	Dr. G Vamsi Vikram, *Chemical Engineering*
Email IDs	ashokk@msme.iith.ac.in vamsigande@che.iith.ac.in
Abstract	Given the increasing demand for critical minerals, it is essential to recover them in an ecologically friendly manner from sources like metal-rich soil, coal topsoil, overburden, red mud, and coal fly ash for commercial metal recovery. Various combination of physical separation, pyrometallurgy and hydrometallurgy are being explored to extract REEs from various sources.
Keywords	Rare earth, pyrometallurgy, hydrometallurgy, recycling, circular economy
Background and Motivation	The concentration of rare earth elements (REEs) and critical minerals is notably higher in coal fly ash compared to coal itself. The overburden, often considered waste material, can have higher concentrations of critical minerals than the primary coal seam itself, presenting another potential secondary resource for recovery. With the right techniques, overburden could be processed to extract valuable metals, reducing the need for new mining operations. Additionally, red mud, a byproduct of bauxite refining, is rich in various minerals, including iron oxide, titanium, and trace amounts of REEs. Though traditionally viewed as an environmental challenge due to its caustic nature, red mud holds promise as a secondary source of critical minerals.
Relevant publications	1. A novel approach for the efficient recovery of lead from End-of-Life Silicon Photovoltaic modules: D.S. Prasad, P.P. Srinivasa Kumar, B. Sanjana, D. Sai Kiran, Ashok Kamaraj, R. Ratheesh: Solar Energy Materials and Solar Cells (2024) Vol. 266 112672. 2. comparative study on environmental impact analysis of synthetic and ESR flux used for refining of steel: Ashok Kamaraj, Rohit B Meshram#: Procedia CIRP (2021) Vol. 98, p. 448-451 3. V.V. Gande, S. Vats, N. Bhatt, S. Pushpavanam, Sequential recovery of metals from waste printed circuit boards using a zero-discharge hydrometallurgical process , Clean. Eng. Technol. 4 (2021) 100143. doi:10.1016/j.clet.2021.100143. 4. V.V. Gande, S. Pushpavanam, Continuous synthesis of copper nanoparticles using a polyol process in a milli-channel reactor , J. Flow Chem. (2021). doi:10.1007/s41981-021-00169-y.
Essential qualifications	M.Tech in Chemial Engineering or Metallurgy or Material Science, B.Tech in Chemial Engineering or Metallurgy or Material Science from CFTI with CGPA more than 8 or B.Tech in Chemial Engineering or Metallurgy or Material Science with gate score
Desirable qualifications	Hands on experience in hydrometallurgy, pyrometallurgy.
Broad proposal objectives	https://drive.google.com/open?id=1hWvlifq0XfGvuvxiyigavOXb-D7IJRdm
******Please Note that this proposal is for a Project-funded position from the research funds of the supervisors. For more information, please contact the supervisors directly.***	

PROPOSAL No. - IDPHD2025019	
Title of the Proposal	**Development of Chemical Combustion Kinetics of Coal Water Slurry and Its Effect on Combustion**
Supervisor-1	Dr. Raja Banerjee, *Mechanical & Aerospace Engineering*
Supervisor-2	Dr. Saptarshi Majumdar, *Chemical Engineering*
Email IDs	rajabanerjee@mae.iith.ac.in saptarshi@che.iith.ac.in
Abstract	Coal water slurry derived from high ash reject coal was be used as an alternative fuel for industrial furnaces. However, due to high water content in such coal slurry, combustion stability is a challenge. In this project, a pilot scale combustor will be designed to study combustion of such slurry and develop chemical kinetics for modelling purposes.
Keywords	Combustion, multiphase flow, chemical kinetics, emission, waste to wealth technology
Background and Motivation	Indian coal has high ash content and such coal cannot be used in its native form. Ash removal process in coal washeries generates large amount of coal in slurry form which is not used and usually rejected as waste. However, coal slurry can be effectively used as an alternative fuel for industrial furnace applications. This project aims at developing burner and combustor design that can effectively burn coal slurry with significant water content.
Relevant publications	1. Krishna Kant and R. Banerjee, Study of the secondary droplet breakup mechanism and regime map of Newtonian and power law fluids at high liquid–gas density ratio, Physics of Fluids 34 (2024) 043108 2. S.K. Sriramoju, D. Kumar, S. Majumdar, P.S. Dash, D. Shee, R. Banerjee, Sustainability of coal mines: Separation of clean coal from the fine-coal rejects by ultra-fine grinding and density-gradient-centrifugation, Powder Technology 383 (2021) 356 – 370 3. Anil Bhurao Wakale, S. Banerjee, R. Banerjee, Estimation of NOx and soot emission from a constant volume n-butanol/n-dodecane blended spray using unsteady flamelet model based on n-dodecane/n-butanol/NOx/PAH chemistry, Journal of the Energy Institute 93 (2020) 1868 – 882
Essential qualifications	MTech in Mechanical/Chemical/Petroleum Engineering with emphasis on thermal and reaction engineering on combustion, reaction kinetics, heterogenous reaction, multiphase CFD modelling
Desirable qualifications	MTech in Mechanical/Chemical/Petroleum Engineering with emphasis on thermal and reaction engineering on combustion, reaction kinetics, heterogenous reaction, multiphase CFD modelling
Broad proposal objectives	https://drive.google.com/open?id=1FEobucVuINUPE4QFxHm14Wi9F5q1CyO0

PROPOSAL No. - IDPHD2025020	
Title of the Proposal	**Stories, Camera, Traction: Can the Subaltern film?**
Supervisor-1	Dr. Shuhita Bhattacharjee, *Liberal Arts*
Supervisor-2	Dr. Sonali Srivastav, *Design*
Email IDs	shuhita@la.iith.ac.in sonali.srivastav@des.iith.ac.in
Abstract	We are looking for candidates rigorously trained in a combination of disciplines including both humanities/social sciences and film studies (theory and practice). We want to supervise projects by candidates trained in these subjects who want to research marginalized communities (especially across axes of gender/sexuality) and produce cinematic output aimed at social intervention and behavioral change.
Keywords	film studies, alternative narratives, gender and sexuality, audio-visual media, literature and culture
Background and Motivation	Both supervisors have a keen interest in visual media (films) and their psychological and sociological implications, with a focus on alternative narratives platformed on audio-visual media. Sonali has a background in design, and specializes in film, while Shuhita's expertise is in literary and cultural narratives and projects of social inclusion and policy advocacy. These sets of expertise will help in approaching the project from both theoretical and practical aspects.
Relevant publications	1. Bhattacharjee, Shuhita. “Shockwaves of Rape and Shattering of Power in the Contemporary Indian Web-Series: The Case of Delhi Crime, Made in Heaven, and Judgement Day.” In The Politics of Emotional Shockwaves. Edited by Ana Falcato and Sara Graça da Silva. Lisbon: Palgrave Macmillan, 2021. DOI: https://doi.org/10.1007/978-3-030-56021-8_6 2. Bhattacharjee, Shuhita. “Dark Humour and the Female Performance of Subversion in South- Asian Diaspora Cinema: Chadha’s Rich Deceiver, It’s A Wonderful Afterlife, and What Do You Call An Indian Woman Who’s Funny?” South Asian Studies. 2022. DOI: 10.1080/02666030.2022.2035085 3. Bhattacharjee, Shuhita. “‘Rosy Ki Khwaheeshein’: Scripted Romance and Acquaintance Rape in Alankrita Shrivastava's Oeuvre of Female Desire," In Women Filmmakers in Contemporary Hindi Cinema: Looking through their Gaze. Edited by Aysha Iqbal Viswamohan. Palgrave Macmillan, 2023. DOI: https://doi.org/10.1007/978-3-031-10232-5_13 4. Bhattacharjee, Shuhita. "'A Punch Back, . . . a Contagious Guffaw': Feminist Humor in The Marvelous Mrs. Maisel and the Professionalization of the Rebellious Laugh." Studies in American Humor. 9.1 (2023). DOI: https://doi.org/10.5325/studamerhumor.9.1.0031 5. Bhattacharjee, Shuhita. "Producing the Vampire: Victorian Afterlives of the 'Un-Dead' and Contemporary Sexual Crime in the Cinema of Anushka Sharma." In Women in Contemporary Indian Films and Media. Edited by Aysha Iqbal Viswamohan. Routledge. 2024. DOI: https://doi.org/10.4324/9781003583851 1. Srivastav, S., & Desiraju, S. (2025). Fashion Education and Self Sexualization: A Case Study of NIFT Panchkula Students. Sexuality & Culture, 29(1), 232-247.

	2. Srivastav, S., & Rai, S. (2024). Culture Production and Consumption in Post-COVID Era: A Meta-Analysis of OTT Industry in India. Journal of Creative Communications, 09732586241242580. 3. Srivastav, S., & Rai, S. (2022). Alternate entertainment or shifting discourse: A narrative analysis of popular web series in India. International Journal of Media and Information Literacy, 7(1), 242-254.
Essential qualifications	Bachelors in any humanities discipline and Masters in films, media, communication etc. with a high percentage at both levels.
Desirable qualifications	Rigorous training in literary and cultural analysis, critical theories of culture, film studies (theory and practice), practical training in filmmaking
Broad proposal objectives	https://drive.google.com/open?id=1GOyO8TcYesWafivWrNBILajgdhEdaPX7

PROPOSAL No. - IDPHD2025021	
Title of the Proposal	**To design an operational system for Urban Air Mobility (UAM)**
Supervisor-1	Prof. Deepak JohnMathew, *Design*
Supervisor-2	Dr. Mahesh M S, *Mechanical & Aerospace Engineering*
Email IDs	djm@des.iith.ac.in mahesh@mae.iith.ac.in
Abstract	The issue of traffic congestion has sparked interest in aerial taxis, particularly within the framework of Urban Air Mobility (UAM). UAM seeks to offer a cost-effective alternative, utilizing on-demand or scheduled operations. Indian cities are seeing rapid urbanization and the present transportation system cannot meet the growing commuting needs, which is an opportunity to look for an alternative mode like UAM. In this project, we aim to design the infrastructure required for the operation of UAM.
Keywords	Design, Urban AIr Mobility, Traffic management design, Transportation systems,
Background and Motivation	Autonomous UAM aircraft mentioned above is an application of UAVs that is currently under development. Globally, there is a race for improved UAM design. However, the expansion of UAM faces the challenge due to the current inadequacy of the air traffic management system to regulate urban airspace effectively. Thus, with rapid progress towards UAM technology, it becomes imperative to establish guidelines and infrastructure that guarantee the secure and effective operation of these aerial vehicles.
Relevant publications	1. Mathew D.J, Kar S.K., Prasad V.S. (2025) Study and evaluation of user perception of light and shadow on the shape and form of physical products, in the context of industrial product design 2. Mathew D.J, Kar S.K. Chaturmutha K (2025) Exploring Urban Air Mobility A Proposal for Dual Landing Capabilities on Different Surfaces 3. Mathew D.J, Mishra M.M (2025) A Comprehensive Study on User Experience and Cabin Interior Design in Fully Autonomous Passenger Drones 4. Mathew D.J, Mishra M.M (2025) Study of User Experience for a Futuristic Fully Autonomous Passenger Drone Cabin Interior Mathew D.J, Chaturmutha K (2025) Human-Centred Design Approach: A Comprehensive Review on Enhancing the UAM Aircraft Experience for Indian Passengers
Essential qualifications	BTech in Civil / Mechanical engineering from a recognized university and qualified in GATE in the last two years Or BTech in Civil/ Mechanical Engineering from NITs/IITs. GATE qualification is not mandatory for NIT/IIT graduates. Or BDes in any Design Discipline from NID/NIFT/ or MFA/M Des in Design from any recognized University or ME/MTech in Mechanical Engineering from any recognized University
Desirable qualifications	experience in product design/ UAM design /Aerospace engineering/ system design
Broad proposal objectives	https://drive.google.com/open?id=1e81Hxtpw2toZ3R1E0MikWlc3NfQ1Au_f

PROPOSAL No. - IDPHD2025022	
Title of the Proposal	**Gasification of low-grade coal and biomass in a fluidized bed gasifier to produce synthesis gas**
Supervisor-1	Dr Sayak Banerjee, *Mechanical & Aerospace Engineering*
Supervisor-2	Dr Debaprasad Shee, *Chemical Engineering*
Email IDs	sayakb@mae.iith.ac.in dshee@che.iith.ac.in
Abstract	Gasification is generally considered as the most effective for low rank coal and biomass exploitation for the production of gas-based building block feedstock, syngas. The proposed project is therefore focused on the investigation of coal and biomass gasification in a laboratory scale fluidized bed gasifier. The influence of the temperature and time, particle size and composition of feed gas will investigate in detail. The fundamental reaction kinetics and reactivity under controlled laboratory conditions will be developed to understand the gasification chemistry. Multi-zone CFD models for catalytic coal gasification in a bed will be developed, which will take into account of hydrodynamics, mass and heat transfers and catalytic reaction kinetics.
Keywords	Coal-biomass gasification, Syngas, process optimization, Catalysts development, H2 production, CFD
Background and Motivation	Gasification is a process for utilizing the energy contained in coal or biomass without the traditional process of combustion. Specifically, high-ash coal is expected to remain as a key energy source in several countries for at least the next 30–40 years. Nonetheless, the syngas generated from gasification process is used as feedstock to produce numerous end-use products such as power generation, liquid fuels and chemical feedstock. The application of modern gasification technology integrated with downstream process is generally considered as the most appropriate for low rank coal and biomass exploitation for energy and chemicals production. Therefore, the comprehensive study of high ash coal (or low rank coal) and biomass gasification (pure or blended form) is an essential feature towards understanding the reaction mechanisms, kinetics, and hydrodynamics for sizing gasifiers and its operation as well. Additionally, developing a CFD based numerical model for the fluidized bed gasifier integrating the coal and biomass reactivity is necessary to design and scale up the gasification process.
Relevant publications	1. Wakale, A.B., Banerjee, S. and Banerjee, R., 2020. Estimation of NOx and soot emission from a constant volume n-butanol/n-dodecane blended spray using unsteady flamelet model based on n-dodecane/n-butanol/NOx/PAH chemistry. Journal of the Energy Institute, 93(5), pp.1868-1882. 2. Biswal, A., Kale, R., Teja, G.R., Banerjee, S., Kolhe, P. and Balusamy, S., 2020. An experimental and kinetic modeling study of gasoline/lemon peel oil blends for PFI engine. Fuel, 267, p.117189. 3. Pranay Rajendra Chandewar, Debaprasad Shee, Role of copper and cerium species in Cu/CeZSM catalysts for direct methane to methanol reaction: Insights of structure-activity relationship, Journal of Catalysis 442 (2025) 115916. 4. Tatinaidu Kella, Debaprasad Shee, Enhanced selectivity of benzene-toluene-ethyl benzene and xylene (BTEX) in direct conversion of n-butanol to aromatics over Zn modified HZSM5 catalysts, Microporous and Mesoporous Materials 323 (2021) 111216. 5. Santosh Kumar Sriramoju, D Kumar, Saptarshi Majumdar, Pratik Swarup Dash, Debaprasad Shee, Raja Banerjee, Sustainability of Coal Mines: Separation of Clean Coal from the Fine-Coal Rejects by Ultra-Fine Grinding and Density-Gradient-Centrifugation, Powder Technology 383 (2021) 356-370
Essential qualifications	MTech in Mechanical Eng, Chemical Eng and MSc in Chemistry
Desirable qualifications	MTech in Mechanical Eng, Chemical Eng and MSc in Chemistry
Broad proposal objectives	https://drive.google.com/open?id=1IISjD2dULUI82nDnhGgs-Px_PJrtJNLH

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PROPOSAL No. - IDPHD2025023	
Title of the Proposal	**Development of Efficient Electrodes for High Temperature Alkaline Electrolysis**
Supervisor-1	Dr. Subrahmanyam, *Chemistry*
Supervisor-2	Dr. Vinod Janardhanan, *Chemical Engineering*
Email IDs	csubbu@chy.iith.ac.in vj@che.iith.ac.in
Abstract	1. Evaluate the operation of AWE at high temperatures as high temperatures are expected to decrease the activation over potential 2. Use to electrolyte that are much more concentrated (> 6 M KOH) as concentrated electrolytes are more relevant to industrial operation. 3. Study the structural/morphological changes to the catalyst during operation under harsh conditions
Keywords	Alkaine electrolysis, zerogap electrolyzer, electrodes for Alkaline electrolysis
Background and Motivation	Alkaline water electrolysis (AWE) is one of the mature technologies for the production of green H2. However, the technology is inferior in terms of efficiency compared to other electrolyzer technologies, particularly polymer electrolyte membrane electrolyzers and solid oxide electrolyzers. Suitable Catalysts, different operational and cell assembly aspects must be considered to improve the performance of the AWE
Relevant publications	1. None in the last three years. But we have a joint publication in 2015- Study of Short-Term Catalyst Deactivation Due to Carbon Deposition during Biogas Dry Reforming on Supported Ni Catalyst, Vivek Pawar, De
Essential qualifications	M.Sc Chemistry with a valid GATE or M.Tech CHE/Nanotechnology
Desirable qualifications	M.Sc Chemistry with a valid GATE or M.Tech CHE/Nanotechnology
Broad proposal objectives	https://drive.google.com/open?id=1LwNEGJQtI761L5PrlnyhF3svXcrfKKKs

PROPOSAL No. - IDPHD2025024	
Title of the Proposal	**Development of an AI, Blockchain and Hybrid Cloud Enabled Sustainable Digital Twin Cloud Service for the Built Environment**
Supervisor-1	Prof. Shiva Ji, *Design*
Supervisor-2	Dr. Sathya Peri, *Computer Science and Engineering*
Email IDs	shivaji@des.iith.ac.in sathya_p@cse.iith.ac.in
Abstract	This project develops an AI, blockchain, and hybrid cloud-enabled Digital Twin service for the built environment, integrating BIM workflows, real-time IoT data, and distributed knowledge graphs. Leveraging AI-driven analytics and blockchain for secure data exchange, it enhances sustainability, predictive maintenance, and decision-making, fostering resilient, efficient, and adaptive infrastructure ecosystems.
Keywords	1. AI-driven Digital Twin 2. Blockchain for Built Environment 3. BIM Integration 4. Sustainable Infrastructure 5. Hybrid Cloud Computing
Background and Motivation	The built environment faces challenges in sustainability, efficiency, and resilience due to fragmented data management and inefficient decision-making. AI-driven digital twins, integrated with blockchain for secure and decentralized data exchange, address these issues. This project advances real-time, data-driven insights for design, operations, and maintenance, promoting sustainable and intelligent infrastructure.
Relevant publications	1. Shilpi Chakraborty, Shiva Ji and Tomohiro Fukuda., Exploring Architectural Heritage Values through Bibliometric Visualization: A Comprehensive Review. International Conference on research into Design 2025 organised by Indian Institute of Science Bangalore. January 2025. 2. Shilpi Chakraborty, Tomohiro Fukuda and Shiva Ji., Navigating Challenges and Opportunities in Digital Heritage Preservation: Towards Consolidated 3D Archives. International Conference on research into Design 2025 organised by Indian Institute of Science Bangalore. January 2025. 3. Shiva Ji and Shylesh Kumar., Optimized Workflow for Photogrammetry based High Poly Mesh Simplification for 3D Printing. International Conference on research into Design 2025 organised by Indian Institute of Science Bangalore. January 2025. 4. “DAG-based Efficient Parallel Scheduler for Blockchains: Hyperledger Sawtooth as a Case Study”, Manaswini P, Saheli C, Anjana PS, and S Peri. In 29th International European Conference on Parallel and Distributed Computing (Europar) 2023, Limassol, Cyprus. 5. “DiPETrans: A framework for distributed parallel execution of transactions of blocks in blockchains”, Shrey Baheti, Parwat Singh Anjana, Sathya Peri, Yogesh Simmhan. Concurrency and Computation: Practice and Experience (IF - 1.536) 2022. https://doi.org/10.1002/cpe.6804
Essential qualifications	1. AI/ML for Built Environment 2. Blockchain and Smart Contracts 3. BIM and Digital Twin Modeling 4. IoT-based Data Analytics 5. Cloud Computing and Edge AI
Desirable qualifications	1. Experience in AEC (Architecture, Engineering, Construction) Sector 2. Knowledge of Sustainability and Energy Analytics 3. Proficiency in Python, TensorFlow/PyTorch 4. Understanding of GIS and Urban Informatics 5. Hands-on with Industry BIM Software (Revit, Navisworks)
Broad proposal objectives	https://drive.google.com/open?id=1bvLTaQLLNL0iYxPm_TA-V6VT56Hx2eP8

PROPOSAL No. - IDPHD2025025	
Title of the Proposal	**Micro and Nanoplastic Pollution in the Musi River: Distribution, Degradation, and Bioremediation Potential**
Supervisor-1	Dr. Debraj B, *Civil Engineering*
Supervisor-2	Dr. Tarun K Panda, *Chemistry*
Email IDs	debrajb@ce.iith.ac.in tpanda@chy.iith.ac.in
Abstract	This research addresses the serious issue of microplastic pollution by investigating contamination in Hyderabad's Musi River. The study will analyze spatial and temporal distribution patterns, examine transport mechanisms and degradation pathways, and identify microbial species capable of breaking down plastics. This could lead to developing bacterial consortia for innovative bioremediation strategies to restore urban waterways.
Keywords	Microplastic, nanoplastic, contamination, water quality
Background and Motivation	The study is motivated by the growing crisis of microplastic pollution in urban rivers, which threatens both environmental and human health. Multiple pollution sources and slow degradation rates create persistent contamination, while research is shifting from merely documenting presence to understanding impacts and developing solutions. The Musi River provides an opportunity to study these dynamics and explore promising bioremediation approaches.
Relevant publications	1. 10.1016/j.jclepro.2019.118693, 10.1061/(ASCE)HZ.2153-5515.0000484, 10.1007/s40999-019-00448-9
Essential qualifications	Essential & minimum qualifications: The candidate interested in applying for this project must satisfy both Criterion A and Criterion B. Criterion A: First Class/Div. in M.Tech./M.E. in any of the following engineering disciplines: Civil Engineering (with specialization in Environmental Engineering), Environmental Engineering, Chemical Engineering; OR, First Class in M.Sc. in Chemistry. Criterion B: First Class/Div. in B.Tech./B.E. in any of the following engineering disciplines: Civil Engineering, Environmental Engineering, Chemical Engineering; OR, First Class in B.Sc. in Chemistry.
Desirable qualifications	Essential & minimum qualifications: The candidate interested in applying for this project must satisfy both Criterion A and Criterion B. Criterion A: First Class/Div. in M.Tech./M.E. in any of the following engineering disciplines: Civil Engineering (with specialization in Environmental Engineering), Environmental Engineering, Chemical Engineering; OR, First Class in M.Sc. in Chemistry. Criterion B: First Class/Div. in B.Tech./B.E. in any of the following engineering disciplines: Civil Engineering, Environmental Engineering, Chemical Engineering; OR, First Class in B.Sc. in Chemistry.
Broad proposal objectives	https://drive.google.com/open?id=1sVwX2uWCW8CnALKaaDPArJnNzcGds1Lo

PROPOSAL No. - IDPHD2025026	
Title of the Proposal	**Optimal transportation service network design considering shipper behaviour characteristics**
Supervisor-1	Dr. Lohithaksha Maniraj Maiyar, *Entrepreneurship and Management*
Supervisor-2	Dr. Digvijay S Pawar, *Civil Engineering*
Email IDs	l.maiyar@em.iith.ac.in dspawar@ce.iith.ac.in
Abstract	This research will focus on development of freight service network design model while integrating shipper's behavioral preferences for minimization of total delay time and maximizing freight route frequencies for optimized service levels. Further, it is aimed at development of robust freight service demand model while incorporating shipper's behavioral attributes
Keywords	Freight service network design (FSND), shipper's behavioral preference, Optimization
Background and Motivation	The service network design (SND) problem is aimed at optimization of frequency of freight routes and service levels. Traditional SND primarily focuses on multi-commodity flows and product characteristics. However, there is need to captures shipper's heterogeneous preferences by influenced by shipper's demographic profile, commodity characteristics and product logistics characteristics.
Relevant publications	1. Yarlagadda, J., & Pawar, D. S. (2025). Identification of Out-of-the-Normal Driving Behaviors Using Instantaneous Driving Decisions—A Case-Study on Indian Drivers. IEEE Transactions on Intelligent Transportation Systems. 2. Roy, I., & Maiyar, L.M. (2023). An Ecologically Sustainable Omnichannel Fresh Food Distribution Model Considering Freshness-Keeping Effort and Carbon Emissions. In International conference on soft computing for problem-solving 3. Maiyar, L. M., Ramanathan, R., Roy, I.,Ramanathan, U. (2023). A decision support model for cost-effective choice of temperature-controlled transport of fresh food. Sustainability 4. Pavan, K., Roha, V. S., Igasaki, T., Karthick, P. A., Pawar, D. S., & Ganapathy, N. (2024, July). Classifying Driver Distraction with Textile Electrocardiograms. In 2024 46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) (pp. 1-4). IEEE. 5. Pavan, K., Singh, A., Igasaki, T., Pawar, D. S., & Ganapathy, N. (2024). Assessment of Driver's Stress State using smart T-shirt Textile Electrodes and Multimodal Cross-Attention Networks. IEEE Sensors Letters.
Essential qualifications	60% or equivalent CGPA in MTech in Industrial Engineering/ Transportation engineering/ affliated areas
Desirable qualifications	MTech in Industrial Engineering/ Transportation engineering/ affliated areas
Broad proposal objectives	https://drive.google.com/open?id=1mNZcLnD5vMxiFG8rjvvT7id0a5SYWm0U

PROPOSAL No. - IDPHD2025027	
Title of the Proposal	**Development and feasibility study of Garnet-based electrolyte materials for all-solid-state Li-battery (ASSLBs)**
Supervisor-1	Dr. Surendra Kumar Martha, *Chemistry*
Supervisor-2	Dr. Ranjith Ramadurai, *Materials Science and Metallurgical Engineering*
Email IDs	martha@chy.iith.ac.in ranjith@msme.iith.ac.in
Abstract	*ASSLBs* will be developed using NMC/LFP-based standard LIB cathode and Li anode using garnet-polymer-based composite electrolytes in coin-type and pouch-type cells (TRL3-5). Thin film technology will be used to develop battery materials. The ionic conductivity, mechanical properties, and interfacial issues of electrolytes will be addressed. Further, kinetics, diffusivity, and structural and thermal stability will be analyzed.
Keywords	Solid-state Li-ion batteries, Inorganic-polymer electrolytes, Thin films, Electrochemistry
Background and Motivation	Solid-state Li-batteries could revolutionize the secondary battery system by surpassing the current Li-ion battery technology in energy density (~500 Wh kg^{-1}), safety (eliminating the flammable organic electrolyte), packaging, and operable temperature range. However, the challenges associated with low ionic conductivity at room temperature, limited electrochemical windows, and weak thermodynamic stability are a matter of concern for polymer and inorganic-based electrolytes.
Relevant publications	https://scholar.google.com/citations?user=8g9SNxwAAAAJ&hl=en (Surendra Martha) https://scholar.google.com/citations?user=NtP7jtYAAAAJ&hl=en (Ranjith R) 1. Room-Temperature Synthesis of Carbon-Encapsulated $Na_3V_2O_2(PO_4)_2F$ Nanoparticles: A Cost-Effective, High-Power Cathode for Sodium-Ion Batteries, Mohammad Zaid, Kiran Kumar Garlapati, Vilas G. Pol, and **Surendra K. Martha,** ***ACS Applied energy materials***, 2025, **(I.F. 5.5)** https://doi.org/10.1021/acsaem.4c02903. 2. Conducting $LixPO_y$ Interface Generated From Insulating Residual Lithium Compounds on $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ Surface Improves Cycle Life and Assists in Fast Cycling. Dutta, Jyotirekha, Shuvajit Ghosh, Kiran Kumar Garlapati, and **Surendra K. Martha**. ***Small***: 2405432, (2024). **(I.F. 13.0)** https://doi.org/10.1002/smll.202405432 3. Transforming Residual Lithium Compounds on the $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ Surface into a Li–Mn–P–O-Based Composite Coating for Multifaceted Improvements. Jyotirekha Dutta, Shuvajit Ghosh, and **Surendra K. Martha**. **ACS Applied Materials & Interfaces** 16, no. 15 (2024): 19720-19729. **(I.F. 8.3).** https://doi.org/10.1021/acsami.3c19371 4. Enhanced microstructure and electrical performance of a cost-effective Ni/Cu/n-GaN Schottky diode with a V_2O_5 interlayer for optoelectronic applications, K Aswini, K Munirathnam, V Manjunath, NNK Reddy, S Alhammadi, **Ranjith Ramadurai** et al., **Journal of Materials Science: Materials in Electronics** 36 (7) (2025), 430. 5. Magnetic Field-Induced Polarization Rotation in Strain-Engineered $0.94(Na_{0.5}Bi_{0.5}TiO_3)$-$_{0.06}BaTiO_3/CoFe_2O_4$ Magnetoelectric Nanocomposites for Energy, AP Bhat, MC Joshi, V SM, S Panneerselvam, A Manivannan, **Ranjith Ramadurai**, **ACS Applied Electronic Materials** 6 (4), (2024)2188-2196.
Essential qualifications	MSc Chemistry, MSc/MTech Nanotechnology, MTech in Materials Science with Valid GATE Score/ CSIR/UGC fellowships
Desirable qualifications	MSc Chemistry, MSc/MTech Nanotechnology, MTech in Materials Science with Valid GATE Score/ CSIR/UGC fellowships
Broad proposal objectives	https://drive.google.com/file/d/1aWH2wsQyPj8kwtAtIN8ijIEiY4uX2fsv/view?usp=drive_link

PROPOSAL No. - IDPHD2025028

Title of the Proposal	**Physics-Informed Machine Learning for Accelerating Process-Structure-Property Predictions in Advanced Materials**
Supervisor-1	Prof. Saswata Bhattacharya, *Materials Science and Metallurgical Engineering*
Supervisor-2	Prof. Kishalay Mitra, *Chemical Engineering*
Email IDs	saswata@msme.iith.ac.in kishalay@che.iith.ac.in
Abstract	Physics-informed machine learning (PIML), particularly Physics-Informed Neural Operators (PINO), offers a transformative approach for predicting process-structure-property (PSP) relationships in advanced materials. We aim to develop a PIML framework that embeds governing physics into deep learning models, accelerating simulations, enhancing generalizability, and providing efficient alternatives to computationally expensive solvers for microstructure evolution, mechanical response, and functional properties assessment.
Keywords	Physics-Informed Machine Learning (PIML), Physics-Informed Neural Operators (PINO), Process-Structure-Property (PSP) Relationships, Microstructure Evolution, Integrated Computational Materials Engineering (ICME)
Background and Motivation	Advancing materials design requires efficient modeling of process-structure-property (PSP) relationships, traditionally relying on computationally expensive simulations. Physics-informed machine learning (PIML) integrates domain knowledge with data-driven methods, enhancing accuracy and efficiency. While Physics-Informed Neural Networks (PINNs) offer zero-shot superresolution, they lack scalability. To address this, we explore Physics-Informed Neural Operators (PINO) for efficient, scalable PSP predictions.
Relevant publications	1. Learning coupled Allen-Cahn and Cahn-Hilliard phase-field equations using Physics-informed neural operator (PINO) G Gangmei, S Rana, B Rolfe, K Mitra, S Bhattacharyya* - 2025 (github.io) 2.Interplay between thermal and compositional gradients decides the microstructure during thermomigration: A phase-field study 2. S Guin, S Bandyopadhyay, S Bhattacharyya*, R Mukherjee* - Acta Materialia, 2025 3. A physics-informed neural network-based numerical inverse method for optimization of diffusion coefficients in NiCoFeCr multi principal element alloy 3. H Kumar, A Dash, A Paul, S Bhattacharyya* - Scripta Materialia, 2022 4. Synergizing Machine Learning with Physics-Based Modelling: A Unified Approach for Characterizing Wake Effects 4. NSK Pujari, SS Miriyala, K Mitra - Optimization, Uncertainty and Machine Learning in Wind Energy Conversion Systems, 2025, 5. Integration of Neural Networks and First-Principles Model for Optimizing l-Lactide Branched Polymerization GP Paul, V Nagajyothi, K Mitra - Journal of Chemical Theory and Computation, 2024
Essential qualifications	Bachelor's or Master's degree in Chemical Engineering, Materials Science and Engineering, Physics, Mechanical Engineering, Mathematics, Artificial Intelligence, Computer Science and Engineering, or any related discipline.
Desirable qualifications	Strong mathematical proficiency and passion for problem-solving are highly desirable.
Broad proposal objectives	https://drive.google.com/open?id=1BA7_Blp7n4PP7tMjLM7FzVojNiBxvoFr

PROPOSAL No. - IDPHD2025029

Title of the Proposal	**Synthesis and fabrication of self-healing, organic semiconductor devices.**
Supervisor-1	Prof. Chilla Malla Reddy, *Chemistry*
Supervisor-2	Dr. Shubhadeep Bhattacharjee, *Electrical Engineering*
Email IDs	cmreddy@chy.iith.ac.in shubhadeep@ee.iith.ac.in
Abstract	This project focuses on the synthesis and fabrication of self-healing organic semiconductors for advanced devices. It aims to enhance device longevity and reliability in dynamic environments. The approach utilizes electrostatic potential-driven repair in polar crystalline semiconductors. We will synthesize the semiconductor organic crystals, fabricate and characterize devices from these materials for possible applications in bioelectronics.
Keywords	Self-healing, Organic crystals, Device fabrication, Materials and Electrical characterization
Background and Motivation	Self-healing organic semiconductors hold immense potential for bioelectronic applications, where device longevity, reliability, and biocompatibility are crucial. Bioelectronic devices, such as biosensors, neural interfaces, and implantable electronics, often operate in dynamic and mechanically demanding environments. Mechanical damage can lead to device failure, compromising performance and patient safety. The newly introduced electrostatic surface potential-driven self-healing mechanism enables ultrafast, near 100% autonomous repair in polar crystalline materials, ensuring long-term functionality without external intervention. Additionally, the ease of chemical functionalization in organic semiconductors allows for tunable electronic and interfacial properties, enabling tailored performance for specific bioelectronic applications.
Relevant publications	1. Bhunia, S., Chandel, S., Karan, S. K., Dey, S., Tiwary, A., Das, S., Kumar, N., Chowdhury, R., Mondal, S., Ghosh, S., Mondal, A., Khatua, B. B., Ghosh, N & **Reddy, C. M.** (2021), Science, 373, Issue 6552, pp. 321-327. 2. Mondal, S., Tanari, P., Roy, S., Bhunia, S., Chowdhury, R., Pal, A.K., Datta, A., Pal, B. and **Reddy, C.M.**, 2023. Autonomous self-healing organic crystals for nonlinear optics. *Nature Communications*, *14*(1), p.6589. 3. Samanta, Ranita, Susobhan Das, Saikat Mondal, Tamador Alkhidir, Sharmarke Mohamed, Satyaprasad P. Senanayak, and **C. Malla Reddy**. "Elastic organic semiconducting single crystals for durable all-flexible field-effect transistors: insights into the bending mechanism." *Chemical Science* 14, no. 6 (2023): 1363-1371. 4. Weston, A, … **Bhattacharjee. S**, Shuigang Xu, Héctor Corte-León et al. "Interfacial ferroelectricity in marginally twisted 2D semiconductors." *Nature nanotechnology* 17, no. 4 (2022): 390-395. 5. Peddaboina, L., Agrawal, K., Kumar, P., Hegde, G., Badami, O. and **Bhattacharjee, S.,** A Variability-Aware Behavioral Model of Monolayer MoS2 RRAM for Tunable Stochastic Sources. *Advanced Theory and Simulations*, p.2401235.
Essential qualifications	MSc./BTech/BE/MTech in Chemistry/Physics/Electrical/Materials Engineering and Sciences.
Desirable qualifications	Interest/Expertise in Chemical Synthesis, Device Fabrication, Materials/Electrical Characterization
Broad proposal objectives	https://drive.google.com/file/d/1v6Vnu4FYJ5kIpDVb4QrdynyKKs0wO1o_/view?usp=drive_link

PROPOSAL No. - IDPHD2025030

Title of the Proposal	**Floquet engineering for molecular systems**
Supervisor-1	Dr. Atanu Rajak, *Physics*
Supervisor-2	Dr. Debasish Koner, *Chemistry*
Email IDs	atanu@phy.iith.ac.in debasishkoner@chy.iith.ac.in
Abstract	In this project, we consider a realistic molecular system that is strongly coupled to a cavity field and exposed to an external time-dependent electric field. Using an open quantum system approach, we want to investigate how the molecular vibrational modes get modified in the presence of periodic driving and how it can be controlled with respect to the amplitude and the frequency of the drive. This project will elucidate the quantum dynamics of molecular systems under electromagnetic fields. In addition, we will explore the possibility of tuning important physical/chemical phenomena e.g., electron transfer in molecule- metal interfaces, excitation energy transfer in condensed phase molecular systems using Floquet engineering and, as a consequence, manipulate target properties for our convenience.
Keywords	Floquet Engineering, Molecule, Open Quantum Systems, Cavity field
Background and Motivation	Periodic drives are used to create exotic phases of matter like Floquet topological phases and Floquet time crystals which do not have any static analogue. One common research direction, known as Floquet engineering, aims to design such novel states of matter using periodic driving in high frequency regime. Although the Floquet engineering in closed quantum systems is extensively studied with realizations in optical lattice experiments, the driven open quantum systems are comparatively less explored. In this context, the chemical systems are good candidates to investigate dissipative effects in the Floquet scenario. Also, excitation energy transfer is another elementary and important chemical processes in molecular systems which can be tuned using Floquet engineering. We aim to investigate the effect of periodic driving in the rate of chemical phenomena e.g., electron transfer in electrochemical processes.
Relevant publications	1. A. Rajak, S. Suzuki, A. Dutta, and B K Chakrabarti, Quantum annealing: an overview, Philos. Trans. R. Soc. A 381 20210417 (2023). 2. Y. Sadia, E. G. Dalla Torre, A Rajak, From prethermalization to chaos in periodically driven coupled rotors, Phys. Rev. B 105, 184302 (2022). 3. B K Chakrabarti, A. Rajak, and A. Sinha, Stochastic learning in Kolkata paise restaurant problem: Classical and quantum strategies, Frontiers in Artificial Intelligence 5, 874061 (2022). 4. A. Nandy, T. Hariharan, D. Kalita, D. Koner, and S. Banerjee, Stabilizing Highly Reactive Aryl Carbanions in Water Micro-droplets: Electrophilic Ipso-substitution at the Air-Water Interface JACS Au 4, 11, 4488-4495 (2024). 5. A. Nandy, S. Mondal, D. Koner, and S. Banerjee, Heavy Water Microdroplet Surface Enriches the Lighter Isotopologue Impurities J. Am. Chem. Soc. 146, 19050-19058 (2024).
Essential qualifications	M.Sc. or equivalent degree in Physics or Chemistry
Desirable qualifications	Basic computer programming, Quantum Mechanics, Basis Mathematics, Analytical Skills, Good communication skill
Broad proposal objectives	https://drive.google.com/open?id=1l7uRNqWYKZJ_mChDAG_dv738gCmFSGMr

PROPOSAL No. - IDPHD2025031

Title of the Proposal	**Computational Modelling of Molecular Magnets on Surfaces**
Supervisor-1	Dr. Saurabh Kumar Singh, *Chemistry*
Supervisor-2	Prof. Manish K. Niranjan, *Physics*
Email IDs	sksingh@chy.iith.ac.in manish@phy.iith.ac.in
Abstract	The objective of the project is to apply DFT and multireference approach to study the magnetic properties of single-molecule magnets (SMMs) and develop an in-depth understanding of SMMs to provide a roadmap for the deposition of the SMMs on surface architecture to scale the molecular phenomenon at the bulk level.
Keywords	Magnetic Bistability, Magnetic molecules on surfaces, DFT and Multireference calculations, Computational protocols for molecules on surfaces, Periodic mixed Gaussians-Plane Waves, Single Molecule Magnets
Background and Motivation	With the rapid development of information technology, minimizing the magnetic data storage device to the nanometer scale is imperative. Single-molecule magnet open up molecular hysteresis and represent the smallest conceivable information storage devices. The end-user application of SMMs requires sufficient resilience upon grafting/absorption on surfaces to access individual molecules as magnetic bits for the read-and-write processes.
Relevant publications	1. K. Kumari, S. Moorthy and S. K. Singh, Dalton Trans., 2025, 54, 4715 - 4727. 2. A. Ghosh, S. Jana, M.K. Niranjan, F. Tran, D. Wimberger, P. Blaha, L.A. Constantin, and P. Samal, P., J. Phys. Chem. C, 2022, 126,14650-14660. 3. I. Tarannum, S. Moorthy and S. K. Singh, Dalton Trans., 2023, 52, 15576–15589. 4. S. Moorthy, I. Tarannum, K. Kumari and S. K. Singh, Dalton Trans., 2024, 53, 12073–12079. 5. D. Rani, S. Jana, M.K. Niranjan, and P. Samal, J. Phys. Chem. C, 2025, 129, 3784–3797.
Essential qualifications	M.Sc. in Chemistry or Physics
Desirable qualifications	M.Sc. in Chemistry or Physics with Experience in Density Functional Theory Calculations for Molecular or Periodic Systems
Broad proposal objectives	https://drive.google.com/open?id=1iCLHXBo5o1hMn_Ql8yhTpDYEbSRvdFGo

PROPOSAL No. - IDPHD2025032

Title of the Proposal	**Developing Atomistically Informed TCAD Modelling of Semiconductor Flash Memory Transistors**
Supervisor-1	Dr. Oves Badami, *Electrical Engineering*
Supervisor-2	Dr. Anuj Goyal, *Materials Science and Metallurgical Engineering*
Email IDs	oves.badami@ee.iith.ac.in anujgoyal@msme.iith.ac.in
Abstract	The project aims to develop a computational multiscale and multiphysics framework to model semiconductor Flash memory. The model will employ first-principles calculation to model defect properties in the charge trapping layer, which then will be used in a Kinetic Monte Carlo based solver to predict device properties, which will ultimately be connected to the continuum-based solver for optimal device-level design.
Keywords	Defect, abintio, kinetic Monte Carlo, Flash memory
Background and Motivation	The role of semiconductor memories in the VLSI has increased tremendously over the last decade with the increase in data generation and data-intensive computing (AI/ML applications).To discover, design, and scale the next generation of Flash semiconductor memories, we require a multiscale simulation model that can perform a detailed analysis of the sensitivity of the device performance on materials' properties and design parameters, as well as help us estimate the ultimate engineering limits of flash memory devices.
Relevant publications	1. Ghulam Ali Gauhar, Abhishek Chenchety, Hashish Yenugula, Vihar Georgiev, Asen Asenov, Oves Badami, Study of gate current in advanced MOS architectures, Solid-State Electronics, Volume 194, 2022, 108345, ISSN 0038-1101, https://doi.org/10.1016/j.sse.2022.108345. 2. A. Goyal, A. Zakutayev, V. Stevanovic and S. Lany, "Computational Fermi level engineering anddoping-type conversion of Mg:Ga2O3 via three-step synthesis processing", Journal of Applied Physics, 129, 245704 2021. DOI: 10.1063/5.0051788. 3. Jie Ding, Dejiang Mu, Oves Badami, Cristina Medina-Bailon, Xiaomin Chang, Daniel Nagy, Paul Lapham, Vihar Georgiev and Asen Asenov, KMC-based POM flash cell optimization and time-dependent performance investigation, Semiconductor Science and Technology, Volume 36, Number 7, 2021. doi 10.1088/1361-6641/ac008b 4. O. Badami et al., "A Kinetic Monte Carlo Study of Retention Time in a POM Molecule-Based Flash Memory," in IEEE Transactions on Nanotechnology, vol. 19, pp. 704-710, 2020, doi: 10.1109/TNANO.2020.3016182. 5. A. Goyal, P. Gorai, H. Peng, S. Lany, and V. Stevanovic, "A computational framework for au- tomation of point defect calculations", Computational Materials Science 130, 1-9 2017. DOI: 10.1016/j.commatsci.2016.12.040.
Essential qualifications	Masters or Bachelors in Electrical, Electronics, Materials, Physics, Chemistry
Desirable qualifications	Masters or Bachelors in Electrical, Electronics, Materials, Physics, Chemistry
Broad proposal objectives	https://drive.google.com/open?id=1ZRcy6CYBtTNF2ozKV9jFh_NW487H2cAj

PROPOSAL No. - IDPHD2025033

Title of the Proposal	**Fusion of machine learning and Bayesian inference for reliability-based design optimization of crashworthiness**
Supervisor-1	Dr. Biswarup Bhattacharyya, *Civil Engineering*
Supervisor-2	Dr. Prabhat Kumar, *Mechanical & Aerospace Engineering*
Email IDs	biswarup@ce.iith.ac.in pkumar@mae.iith.ac.in
Abstract	The main objective is to propose an efficient computational framework utilizing advanced machine learning and Bayesian inference for reliability-based design optimization of crashworthiness. The optimization will include different safety aspects of a vehicle for crash scenarios. The research work is a blend of computational science and engineering mechanics.
Keywords	Machine learning, Bayesian inference, Reliability-based design optimization, Uncertainty quantification, Crashworthiness
Background and Motivation	The crashworthiness design of automobiles/vehicles has shown efficacy, which can avoid fatalities by up to 43%. The uncertainty associated with a crash should be considered to enhance safety criteria. Very little research has been performed to address the optimization under uncertainty. Bayesian inference and ML will be a game changer.
Relevant publications	1. N Singh, P Kumar, A Saxena Normalized field product approach: A parameter-free density evaluation method for close-to-binary solutions in topology optimization with embedded length scale, International Journal for Numerical Methods in Engineering, 2025 2. J Pinskier, X Wang, L Liow, Y Xie, P Kumar, M Langelaar, D Howard: Diversity-Based Topology Optimization of Soft Robotic Grippers, Advanced Intelligent Systems, 2300505, 2024. 3. P. Kumar TOPress3D: 3D topology optimization with design-dependent pressure loads in MATLAB, Optimization and Engineering, 2024. 4. N Singh, P Kumar, A Saxena: Three-Dimensional Material Mask Overlay Topology Optimization Approach With Truncated Octahedron Elements, Journal of Mechanical Design 146 (1), 2023. 5. P. Kumar: SoRoTop: a hitchhiker's guide to topology optimization MATLAB code for design-dependent pneumatic-driven soft robots, Optimization and Engineering, 2023. 6. Bhattacharyya, B. (2023), “On the use of sparse Bayesian learning-based polynomial chaos expansion for global reliability sensitivity analysis”, Journal of Computational and Applied Mathematics. 7. Bhattacharyya, B., Jacquelin, E. and Brizard, D. (2022), “Stochastic analysis of a crash box under impact loading by an adaptive POD-PCE model", Structural and Multidisciplinary Optimization, 65: 229, pp. 1-26. 8. Bhattacharyya, B. (2022), “Uncertainty quantification of dynamical systems by a POD-Kriging surrogate model”, Journal of Computational Science, Vol. 60, 101602, pp. 1-12. 9. Bhattacharyya, B. (2021), “Uncertainty quantification and reliability analysis by an adaptive sparse Bayesian inference based PCE model”, Engineering with Computers, Vol. 38, pp. 1437-1458.

	10.Bhattacharyya, B. (2021), “Structural reliability analysis by a Bayesian sparse polynomial chaos expansion”, Structural Safety, Vol. 90, 102074, pp. 1-13.
Essential qualifications	B.E./B.Tech/BS/BSc in Civil/Mechanical/Aerospace Engineering/Applied Mechanics/Applied Mathematics/ allied areas and/or M.E./M.Tech/MS/MSc in Structural/Mechanical/Aerospace Engineering/Applied Mechanics/Applied Mathematics/ allied areas
Desirable qualifications	Matlab/Python programming
Broad proposal objectives	https://drive.google.com/open?id=127riD6li7EeiPeFxaYfAkath3diUtAia

PROPOSAL No. - IDPHD2025034

Title of the Proposal	**Multi-phase CFD and Coupled CFD-DEM models for flow of complex suspensions with an application for 3D Concrete Printing**
Supervisor-1	Dr. Narasimha Mangadoddy, *Chemical Engineering*
Supervisor-2	Dr. Kolluru V.L. Subramaniam, *Civil Engineering*
Email IDs	narasimha@che.iith.ac.in KVLS@ce.iith.ac.in
Abstract	Predicting the flow of complex suspensions made of irregularly shaped inclusions is essential to develop applications that require rheology control for the extrusion-based layer deposition process used in 3D Concrete Printing (3DCP). The advances in the proposed work include the development of a CFD-DEM computational framework and multi-phase CFD granular flow framework to enable two coupling in a suspension made with non-Newtonian fluid and spherical as well as irregular-shaped inclusions.
Keywords	Multi-phase CFD, DEM, and coupled CFD-DEM, 3D Concrete Printing
Background and Motivation	Prof. Narasimha and Prof. Subramaniam came together with a common interest to foster the development of coupled CFD-DEM code as well as multi-phase CFD granular flow strategy to understand the flow in complex suspensions such as concrete for developing the 3D Concrete printing application. Numerical simulations that allow two-way coupling will provide insights into the relative movements of suspension components under different flow regimes and lead to better material design.
Relevant publications	**Narasimha Mangadoddy** 1. Aman Mittal, Narasimha Mangadoddy, Raja Banerjee, 2025, GPU based Discrete Element Modeling for Convex Polyhedral shape particles: Development and Validation, Powder Technology, Volume 449, 15 January 2025, 120407 (Impact factor 4.9) 2. Aman Mittal, Narasimha Mangadoddy, Raja Banerjee, 2024, Advances in granular flow modeling: GPU-based multi-sphere DEM approach and tumbling mill dynamics, Powder Technology, 2024, 444, 120024 (Impact factor 4.9) 3. Aman Mittal, Mayank Kumar, Narasimha Mangadoddy, A coupled CFD-DEM model for tumbling mill dynamics - effect of lifter profile, Powder Technology, 2024, 433, 119178, doi.org/10.1016/j.powtec.2023.119178 (Impact factor 4.9) 4. Vakamalla Teja Reddy, Mangadoddy Narasimha, A comprehensive dense slurry CFD model for performance evaluation of industrial hydrocyclones, Industrial & Engineering Chemistry Research, August 2021, 60, 12403–12418, (Impact factor 3.8) 5. Aman Mittal, Narasimha Mangadoddy, Raja Banerjee, Development of Three-Dimensional GPU DEM Code – Benchmarking, Validation and Application in Mineral Processing, Journal of Computational Particle Mechanics, 2023, 10(6), pp. 1533–1556 (Impact factor 2.8) **K.V.L. Subramaniam** 1. Kamakshi, T., and Subramaniam, K.V.L., (2024) Formulating printable concrete mixtures based on paste rheology and aggregate content: Application to alkali-activated binders, in Cement and Concrete Research. 184 (2024) 107611, (DOI: 0.1016/j.cemconres.2024.107611) 2. Kamakshi, T., and Subramaniam, K.V.L., (2024) Rheology Control and 3D Concrete Printing with Fly ash-based Aqueous Nano-silica Enhanced Alkali-activated Binders, Materials and Structures. 57:106. DOI: 10.1617/s11527-024-02385-z. 3. Kondepudi, K., and Subramaniam, K.V.L. (2022) “Alkali-activated fly ash-blast furnace slag blend rheology: Evaluation of yield and Maxwell responses,” Cleaner Engineering and Technology. 100398

	4. Kondepudi, K., and Subramaniam, K.V.L., (2021) “Formulation of Alkali-Activated Fly Ash-Slag Binders for 3D Concrete Printing,” Cement and Concrete Composites. Volume 119, May 2021, 103983 (DOI: 10.1016/j.cemconcomp.2021.103983) 5. Kondepudi, K., and Kolluru V.L. Subramaniam, (2019) “Rheological characterization of low-calcium fly ash suspensions in alkaline silicate colloidal solutions for geopolymer concrete production,” Journal of Cleaner Production, 234, 690-701 (DOI: 10.1016/j.jclepro.2019.06.124).
Essential qualifications	B.Tech/M.Tech in Chemical Engineering or Civil Engineering specialized in Computational Fluid Dynamics, Rheology, DEM & Numerical methods
Desirable qualifications	Multi-phase CFD, Numerical Simulation, rheology of suspensions, DEM
Broad proposal objectives	https://drive.google.com/open?id=1WCXXeTgTe_jq6VM3LeJBzLCN1dfbTjB2

PROPOSAL No. - IDPHD2025035

Title of the Proposal	**Development of Nanostructured Perovskite Halides for multifunctional applications**
Supervisor-1	Dr. Suresh Perumal, *Materials Science and Metallurgical Engineering*
Supervisor-2	Prof. Sivakumar Vaidyanathan, *Chemistry*
Email IDs	suresh@msme.iith.ac.in vsiva@chy.iith.ac.in
Abstract	The current scenario of thermoelectric (TE) research for waste heat recovery relies on costly and toxic materials. Recently, the eco-friendly metal perovskite halides (A2BX6:Cs2SnI6) with low thermal conductivity and large Seebeck coefficient have seen a great attention in TE community. This proposal aims to design and engineer such class of materials for near-room-temperature thermoelectric applications.
Keywords	Halide Perovskites, Thermoelectrics, LEDS
Background and Motivation	The clean energy technologies have been put forward by scientists due to increased energy demand. Most automobiles and industries release thermal energy as untapped waste heat, which can be converted into usable electricity by thermoelectric (TE) materials. The heat-to-electricity conversion efficiency depends on the figure of merit, zT. Due to the interdependency nature of electronic and thermal properties, the conversion efficiency is always low, and materials that show relatively large conversion efficiency are relatively toxic and costly. So, a search for low-cost and eco-friendly materials with high zT remains a challenging task. So, we attempt to design various classes of metal perovskite halides (A2BX6) with improved electrical properties for thermoelectric application near room temperature.
Relevant publications	**Dr. Suresh Perumal** (Five publications in last three years) 1. Moorthy, Manojkumar; Govindaraj, Prakash; Parasuraman, Rajasekar; Bhui, Animesh; Gadhavajhala, Sri Sai Samhitha; Srinivasan, Bhuvanesh; Venugopal, Kathirvel; Perumal, Suresh*, Sulfur vacancies driven band splitting and phonon anharmonicity enhance the thermoelectric performance in n-type CuFeS2, ACS Appl. Energy Mater., 7, 5, 2008–2020, 2024. 2. Akshara Dadhich, Madhuvathani Saminathan, Kaushalya Kumari, Suresh Perumal*, MS Ramachandra Rao*, K Sethupathi*, Physics and Technology of Thermoelectric Materials and Devices, J. Phys. D: Appl. Phys., 56, 333001, 2023. 3. Manojkumar Moorthy, Bhuvanesh Srinivasan, David Berthebaud, Rajasekar Parasuraman, Suresh Perumal*, Enhanced Thermoelectric Performance and Mechanical Property in Layered Chalcostibite CuSb1–xPbxSe2, ACS Appl. Energy Mater. 6, 2, 723-730, 2023. 4. Manojkumar Moorthy, Animesh Bhi, Manjusha Battabyal, Suresh Perumal*, Nanostructured CuFeSe2 Eskebornite: An efficient thermoelectric material with ultra-low thermal conductivity, Mater. Sci. Eng., B., 248,115914, 2022. 5. Madhuvathani Saminathan, Saravanan Muthaiah, Lokeswaran Ravi, Animesh Bhui, Reeshma Rameshan, Ravikirana, and Suresh Perumal*, Improved Thermoelectric properties of Fe-doped Si-rich Higher Manganese Silicides, Mater. Sci. Eng., B., 284, 115912, 2022. **Dr. Sivakumar Vaidyanathan** (Five publications in last three years) 1. Priyansha Sharma , Jaya Prakash Madda and Sivakumar Vaidyanathan, Narrow band dazzling red emitting (LiCaLa(MoO4)3:Eu3+) phosphor with scheelite structure for Hybrid White LEDs and LiCaLa(MoO4)3:Sm3+, Eu3+ Based Deep-Red LEDs for Plant Growth Applications, Dalton Trans., 52, 15043-15056, 2023.

	2. Jaipal Devesing Girase, Mangey Ram Nagar, Shahnawaz, A. Choudhry, Jwo-Huei Jou and Sivakumar Vaidyanathan*, Highly Efficient Multifunctional luminogens for Near UV/Deep Blue (CIEy ~0.02) and Hybrid White OLEDs (CIE~0.33, 0.37) with Superior Color Stability – ACS Appl. Electron. Mater. 4, 9, 4368–4382, 2022. 3. Jaipal Devesing Girase, S Singh, BP Debata, SR Nayak, Mangey Ram Nagar, Jwo-Huei Jou, S. Patel and Sivakumar Vaidyanathan* "Solution-processed imidazole-triphenylamine based fluorophores exceeding theoretical limit (>5%) for deep-blue organic light-emitting diodes: Combined theoretical and experimental study" J. Phys. Chem. C 127, 33, 16623–16635, 2023. 4. Sibani Mund, and Sivakumar Vaidyanathan*, "New Isomeric ancillary ligand and their EuIII complexes: A single component white light emissive phosphor and their applications in Red/White smart LEDs, Electronic Noses and Temperature sensing". J. Mater. Chem. C, 10 (18), 7201-7215, 2022 5. R. Marikumar, R Devi, S. Mund, K. Singh and Sivakumar Vaidyanathan*, Energy transfer cooperation between ligands and EuIII ion in molecular europium complexes for vapoluminescence sensor (reversible on/off emission switching) and hybrid white LEDs, J. Mater. Chem. C, 9 (42), 15034-15046, 2021.
Essential qualifications	M.Tech (Nanoscience, Energy Technologies, and Materials Science) and M.Sc (Physics/Chemistry/Materials Science) with valid GATE/CSIR-NET
Desirable qualifications	M.Tech or M.Sc (Physics/Chemistry/Materials Science) with valid GATE/CSIR-NET
Broad proposal objectives	https://drive.google.com/open?id=1sjq9YDx_4mVrN8Oril4hijG0eYaaGbhK

PROPOSAL No. - IDPHD2025036

Title of the Proposal	**Advancing electrospinning technologies to produce polymeric nanofibers for high-performance applications**
Supervisor-1	Dr. Satyavrata Samavedi, *Chemical Engineering*
Supervisor-2	Dr. Harish N. Dixit, *Mechanical & Aerospace Engineering*
Email IDs	samavedi@che.iith.ac.in hdixit@mae.iith.ac.in
Abstract	Electrospinning is a powerful technique for producing nanofibers, driving innovations in several industrial applications (e.g., filtration, drug delivery). This project will advance electrospinning technologies by enabling the production of high-quality polymeric nanofibers with controlled properties. The project will involve experiments using a state-of-the-art electrospinning system in combination with rheological measurements, advanced imaging techniques (including AI/ML algorithms for image processing) and real-time control strategies. The project will emphasize both fundamental and applied aspects, with special focus on high-performance industrially relevant applications.
Keywords	Electrospinning, Polymeric Nanofibers, Polymer Rheology, Real time imaging, Machine Learning
Background and Motivation	Electrospinning is a widely used technique for producing polymeric nanofibers which find use in several applications such as filtration, catalysis, drug delivery and tissue engineering. Achieving consistent and precise control over the properties of electrospun fibers remains a challenge. This project is motivated by an industrial and fundamental need to enhance the electrospinning process. By integrating rheological insights, advanced imaging techniques and real-time control strategies to produce nanofibers with tailored properties, we aim to drive innovations in nanofiber technologies for high-performance applications.
Relevant publications	1. S Arunachalam, Harish N Dixit*, S Samavedi*, “Establishment of unique cone-shapes and universal shape-parameters toward predicting fiber diameter in polymer electrospinning”, Industrial & Engineering Chemistry Research, 63(30), pp. 13238-13251, 2024 2. N Joy, D Venugopal, AM Gopinath, S Samavedi*, “Connecting in situ cone/jet length in electrospinning to fiber diameter and drug release for the rational design of electrospun drug carriers”, Chemical Engineering Science, 295, 120168, 2024 3. N Joy, R Anuraj, A Viravalli, Harish N Dixit, S Samavedi*, “Coupling between voltage and tip-to-collector distance in polymer electrospinning: insights from analysis of regimes, transitions and cone/jet features”, Chemical Engineering Science, 230, 116200, 2021 4. N Joy, D Venugopal, S Samavedi*, "Robust strategies to reduce burst and achieve tunable control over extended drug release from uniaxially electrospun composites", European Polymer Journal, 168, 111102, 2022 5. C. Gupta, L. D. Chandrala, Harish N Dixit*, An experimental study of flow near an advancing contact line: a rigorous test of theoretical models, Journal of Fluid Mechanics, 1000, A45, 2024
Essential qualifications	B.Tech or M.Tech in Chemical Engineering or Mechanical Engineering or Materials Science & Engineering or Polymer Science and Engineering or Allied areas; Or, MSc in Physics
Desirable qualifications	B.Tech or M.Tech in Chemical Engineering or Mechanical Engineering or Materials Science & Engineering or Polymer Science and Engineering or Allied areas; Or, MSc in Physics
Broad proposal objectives	https://drive.google.com/open?id=1jA_iBBftGQfmYVNA_E07podc1ujswCu-

PROPOSAL No. - IDPHD2025037

Title of the Proposal	**IMPACT PERFORMANCE OF COLD-FORMED STEEL SHEATHED WALL PANELS SUBJECTED TO WIND-BORNE DEBRIS**
Supervisor-1	Prof. Mahendrakumar Madhavan, *Civil Engineering*
Supervisor-2	Dr. Chandra Prakash, *Mechanical & Aerospace Engineering*
Email IDs	mkm@ce.iith.ac.in cprakashj@mae.iith.ac.in
Abstract	The proposed research study will be focused on structural assessment of CFS sheathed wall panels subjected to impact loading. A comprehensive system of experimentally validated computational models for analysis is proposed that will lead to development of design provisions for CFS wall panels under impact loading and prevent penetration threats.
Keywords	Cold-Formed Steel, CFS Sheathed wall panels, Impact loading, Sustainable construction, LGSF building systems
Background and Motivation	Seasonal cyclones hit the coastal region of India almost every year. In such a case, studying the behaviour of structural members subjected to extreme events (cyclones) is imperative to prevent loss of lives and properties. Limited research has been carried out on the impact behaviour of CFS sheathed wall panels.
Relevant publications	1. Karmugilan Panchamoorthy and Mahendrakumar Mathialagu Madhavan. (2024) "Experimental study on screw connection between plywood sheathing to CFS stud subjected to In-plane shear loading", Journal of Structural Engineering (ASCE). 2. Sivaganesh Selvaraj and Mahendrakumar Madhavan. (2023). "Direct Stiffness-Strength Method: An Alternative Design Approach to AISI for Sheathed Cold-Formed Steel Z Section Structural Members subjected to bending". Journal of Structural Engineering (ASCE). 3. Sivaganesh Selvaraj and Mahendrakumar Madhavan. (2022). "Application of Direct Stiffness-Strength Method for Design of Gypsum and Plywood sheathed CFS wall panels Subjected to Bending". Thin-Walled Structures. 4. Prakash C. (2024) Overview of impact performance of polymer composites using FEA. In: Editors: Sathish Kumar Palaniappan, Rajeshkumar Lakshminarasimhan, Sanjay M R, Suchart Siengchin (eds) Finite Element Analysis of Polymers and its Composites. 5. Prakash, C. and Ghosh, S., 2023, Self-consistent homogenization-based parametrically upscaled continuum damage mechanics model for composites subjected to high strain-rate loading, Journal of Composite Materials, Vol. 57 (4), pages 545-563.
Essential qualifications	Relevant Master's or Bachelor's degree, Relevant Research experience, Technical skills, Writing & communication
Desirable qualifications	Interdisciplinary Knowledge, Conference Presentations, Applied Research Exposure
Broad proposal objectives	https://drive.google.com/open?id=1nSpKcg10vxFEOIhiySNkMiSMev-MxnkM

PROPOSAL No. - IDPHD2025038	
Title of the Proposal	**Design and development of insect-size microrobot with multi-locomotion capabilities**
Supervisor-1	Dr. Safvan Palathingal, *Mechanical & Aerospace Engineering*
Supervisor-2	Dr. Rupesh Ganpatrao Wandhare, *Electrical Engineering*
Email IDs	safvan@mae.iith.ac.in rupesh@ee.iith.ac.in
Abstract	This work explores the design of a compliant insect-scale robot with multimodal locomotion for diverse terrains. Inspired by cockroaches, it can walk, jump, and perform short-burst flights, making it suitable for hazardous environments. The study encompasses mechanical design, fabrication, actuator development, and control for efficient navigation.
Keywords	Robotics, Compliant Mechanism, Actuator Design, Gait Control
Background and Motivation	Insects use coordinated leg movements for complex locomotion such as walking and jumping. Inspired by this, researchers develop legged robots that navigate uneven terrain better than wheeled ones, aiding in disaster response. Their design is interdisciplinary, integrating mechanical design, fabrication, actuator design, and control systems for efficient movement in hazardous environments.
Relevant publications	1. Srivastava, M., Gunna, T., Kandiyaped Serkad, M., Sebastian, M., and Palathingal, S., “Design of an Engaging–Disengaging Compliant Mechanism by Using Bistable Arches,” International and National Conference on Machines and Mechanism, 2023, December (2024), pp. 193-203. Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-97-5423-6_14 2. Sebastian, M., Balakrishnan, S., and Palathingal, S., “Design and Modelling of Compliant Mechanisms With Invertible Poisson’s Ratio Effect for Growing Biological Cells”, International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Vol. 87363, American Society of Mechanical Engineers, (2023). https://doi.org/10.1115/DETC2023-110544. 3. Goswami, R., Unnikrishnan, and Palathingal, S., “Analysis of Bistable Arches Connected at the Centre with Pinned Boundary Conditions,” *Structural Integrity Conference and Exhibition* (2022, December), pp. 287-298. Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-97-6367-2_24 4. A. Chabukswar and R. Wandhare, "Modified Back-Stepping Sliding Mode Controller With Robust Observer-Less Disturbance Rejection for DC Microgrid Applications," in IEEE Transactions on Power Electronics, vol. 40, no. 1, pp. 451-466, Jan. 2025, doi: 10.1109/TPEL.2024.3462448. 5. A. Chabukswar and R. Wandhare, "Adaptive Feed-Forward Sliding Curve-based Hybrid Fixed-Time Extended-Order Terminal Sliding Mode Control for DC Microgrids," in IEEE Journal of Emerging and Selected Topics in Industrial Electronics, doi: 10.1109/JESTIE.2024.3517713. 6. R. Raj Kar and R. Wandhare, "Passivity Principle-Based Active Damper Design to Enhance Stability of a Voltage Source Converter for Weak Grid Scenario," in IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 12, no. 5, pp. 5076-5089, Oct. 2024, doi: 10.1109/JESTPE.2024.3406566.
Essential qualifications	Either “BTech in Mechanical or allied engineering” or “BTech in Electrical or allied engineering”
Desirable qualifications	MTech in Mechanics and Design (Mechanical Engineering); MTech in Control Engineering (Signal Processing and Control, Mechatronics)
Broad proposal objectives	https://drive.google.com/open?id=1S36XYAv9beu35ft_ph5La4GYOiZG2fHG