MUFFAKHAM JAH COLLEGE OF ENGINEERING AND TECHNOLOGY

(UGC Autonomous Institution)

NAAC A+ Accredited

Proceedings of

RESEARCH SCHOLARS CONCLAVE

03rd January, 2026



Organized by

RESEARCH AND DEVELOPMENT CELL,

MUFFAKHAM JAH COLLEGE OF ENGINEERING AND TECHNOLOGY,

Mount Pleasant, Road No, 3,
Banjara Hills, Hyderabad - 500 034, Telangana



Poster circulated for the registration of the participants



Banner of the MJCET Research Scholar Conclave 2026



Felicitation of the Chief Guest Dr. K. Ganesh Babu, Rtd. Professor, IIT Madras, who presented keynote address on "Importance of interdisciplinary collaboration and ethical research practices"

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ISBN. 978-81-685720-1-0

Editor:

Dr. Ishrat Meera Mirzana

Co-Editor:

Dr. Md. Asrar Ahmed

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RESEARCH AND DEVELOPMENT CELL,

MUFFAKHAM JAH COLLEGE OF ENGINEERING AND

Road No. 3, Banjara Hills, Hyderabad - 500 034, Telangana

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ABOUT MJCET

Muffakham Jah College of Engineering and Technology established in the year 1980 under Sultan-Ul-Uloom Education Society (SUES), is a **Minority Autonomous Educational Institution affiliated to Osmania University, Hyderabad and approved by AICTE, New Delhi along** with four UG programs Civil Engineering, Computer Science and Engineering, Electronics and Communication Engineering and Mechanical Engineering accredited by NBA for a period of 3 years from 2024-25 to 2026-27 up to 30-6-2027 and accredited by the NAAC with Grade A+ in the year 2024 and the Institution of Engineers, India. Located at Banjara Hills and spread over a sprawling 25 acre of land, the college with its serene and picturesque natural landscape is an ideal destination in all aspects to create innovative engineers to face the cut-throat competitions in the global technological scenario. With a glorious past and its current initiatives in terms of state of the art infrastructural facility, motivated faculty, scope of internship, research, association with industry and an enviable number of placements, the college has materialized the dreams of innumerable young minds to contribute in the field of science and technology and emerge victorious.

Muffakham Jah College of Engineering and Technology (MJCET) is a premier institute, offering B.E Courses i.e., AIML, AIDS, Civil, ECE, CSE, IT, Mechanical and 4 M.E Courses (CAD/CAM, Structural Engineering, Embedded systems & VLSI and CSE) of two years duration. Research Centres started in four departments i.e., Mechanical, ECE, CIVIL and CSE for Doctoral Studies.

VISION

To be a part of the universal human quest for development and progress by contributing high calibre, ethical and socially responsible engineers who meet the global challenge of building a modern society in harmony with nature.

MISSION

- To attain excellence in imparting technical education from the undergraduate to through doctoral levels by adopting coherent and judiciously coordinated curricular and co-curricular programs.
- To foster a partnership with industry and Governmental agencies through collaborative research and consultancy.
- To nurture and strengthen auxiliary soft skills for overall development and improved employability in a multicultural workspace.
- To develop scientific temper and spirit of enquiry in order to harness the innovative talents.
- To develop a constructive attitude in the students towards the task of nation-building and empower them to become future leaders.
- To nourish the entrepreneurial instincts of the students and hone their business acumen.
- To involve the student and faculty in solving local community problems through economical and sustainable solutions.

ABOUT R & D CELL

For any education, and technical education, in particular, the basic model of a 'teaching – only' the institution is inadequate to ensure quality education. In all disciplines of technical education, knowledge is dynamic with new technologies being introduced very frequently. In this scenario, it is not possible for the teachers to deliver good quality instructions without being tuned to the current developments in the subjects, for which they must constantly update their knowledge.

A well-recognized way to deal with this paradigm is for the teachers to be active researchers in the areas in which they teach. As researchers, they need to understand the past and recent developments in their subject areas. MJCET recognized the importance of R & D in the vertical growth of the institution and established the R & D cell to focus on the scientific and industrial research in the various disciplines of Engineering. The MJCET R & D cell is a nominated committee consisting of professors from various programs of Engineering and Basic Sciences. The organizational structure consists of a chairman and convener for facilitating the routine functioning of the cell. The R & D budget for the year 2024-2025 is Rs. 60 lakhs.

The R & D also works in collaboration with Institute Innovation council (IIC), Industry Institute Interaction Cell (IIIC) and encourages start-ups in support and guidance for SU Knowledge hub. The R & D cell is also registered with KAPILA and provides support to the institute and faculty in IPR process. The R & D cell with a motive to support its faculty and other institute faculties has registered with STEM

VISION AND MISSION of RDC

VISION

To empower the faculty and students in the area of Research & Development by providing seed funds for implementing their innovative research and product development ideas.

MISSION

i. To motivate faculty and students to undertake Research and Development activities as a means of nourishing innovative thought process

ii. To encourage interdisciplinary R & D projects leading to solutions to real world problems through synthesis of diverse ideas and skills.

iii. To serve as a medium for three way interaction between the Institute, R & D Organizations and Industry.

iv. To assist the faculty, Ph. D. scholars and students to apply for funding under various Government, Professional Chapter or Private Sector schemes.

v. To encourage publication of technical papers in National / International refereed Journals and Conferences based on the research carried by the faculty and students

vi. To register under Intellectual Property Rights like Patents & copyright the outcome of R & D work carried out by the faculty and students of the Institution

vii. To facilitate signing of MOU with industries and R & D Organizations for research and product development

MESSAGE



Mr. Mohammed Waliullah
Chairman, Sultan-ul-Uloom Education Society

It is indeed a matter of satisfaction to note that Muffakham Jah College of Engineering and Technology (MJCET), under the aegis of the Sultan-ul-Uloom Education Society, successfully organized the **Research Conclave – 2026**, and is now bringing out this volume of proceedings that documents the scholarly contributions presented during the event.

The successful conduct of this conclave reflects the institution's growing commitment to strengthening research culture and academic inquiry. The proceedings stand as a valuable record of the ideas, innovations, and intellectual discussions that emerged from this important academic gathering.

In recent years, the Government of India has placed significant emphasis on innovation, research, and indigenous technological development through initiatives aimed at building a knowledge-based economy. The **National Education Policy (NEP) 2020** has further reinforced the importance of research and development by encouraging higher educational institutions to create an ecosystem that promotes critical thinking, interdisciplinary learning, innovation, and problem-solving. Such policy directions have made it increasingly important for institutions to cultivate an environment where research becomes an integral part of academic life.

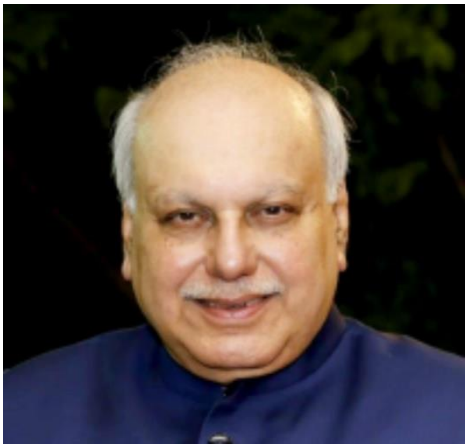
In today's rapidly evolving world, research can no longer remain confined to laboratories and academic journals alone. It must address real-world challenges, support national priorities, and contribute meaningfully to sustainable social and technological advancement. Faculty members and scholars therefore carry the responsibility of generating knowledge that is not only academically rigorous but also socially relevant and future-oriented.

The Sultan-ul-Uloom Education Society has consistently encouraged its institutions to embrace this vision by supporting initiatives that strengthen research capability, improve academic standards, and foster collaboration with industry and emerging research domains. Building a vibrant research ecosystem requires not only infrastructure and resources, but also a culture of curiosity, integrity, and perseverance.

The Research Conclave provided an excellent platform for faculty members, researchers, and academicians to share their work, exchange perspectives, and explore opportunities for future collaboration. The publication of these proceedings ensures that the insights generated during the conclave continue to benefit the wider academic community beyond the event itself.

I congratulate the organizers, contributors, and participants whose efforts made this conclave meaningful and successful. I am confident that such initiatives will continue to advance the institution's mission of academic excellence and research-driven growth.

MESSAGE



Mr. Zafar Javeed
Honorary Secretary, Sultan-ul-Uloom Education Society
Chairman, Governing Council, MJCET

At Muffakham Jah College of Engineering and Technology (MJCET), under the visionary guidance of the Sultan-ul-Uloom Education Society, the pursuit of research and innovation continues to be a defining pillar of academic excellence and institutional growth.

The publication of this souvenir, marking the Research Conclave – January 2026, reflects the growing recognition of research as a cornerstone of quality education and institutional progress.

In today's rapidly evolving world, the role of research extends far beyond academic fulfilment. It serves as a catalyst for innovation, critical thinking, and sustainable development. Institutions of higher learning carry the responsibility not only to disseminate knowledge but also to create it. A strong research culture equips faculty and scholars to address real-world challenges, contribute to technological advancement, and foster societal transformation.

At Muffakham Jah College of Engineering and Technology (MJCET), consistent efforts are being made to build and strengthen such a research ecosystem. The Society remains committed to providing the necessary encouragement, infrastructure, and academic environment that enable

faculty members and research scholars to pursue meaningful and impactful research. It is essential that research activities are guided by integrity, relevance, and a spirit of inquiry, ensuring that outcomes are both academically significant and socially beneficial.

I would like to emphasize that research is a continuous journey that demands perseverance, discipline, and intellectual curiosity. Faculty members, particularly those pursuing doctoral studies, should strive to maintain high standards of scholarship while aligning their work with emerging global trends and national priorities. Collaborative research, interdisciplinary approaches, and industry engagement must be actively encouraged to enhance the quality and applicability of research outcomes.

The Sultan Ul Uloom Education Society will continue to support initiatives that strengthen research capabilities and promote a culture of innovation across its institutions. It is my earnest hope that this endeavour will inspire all members of the academic community to contribute meaningfully to the advancement of knowledge and to uphold the values of excellence that define our institution.

I convey my best wishes to all faculty members and research scholars in their on-going academic pursuits.

MESSAGE



Dr. S. Srinivasa Rao
Principal, MJCET

“Education is the Architecture of the Soul”

Research is fast becoming an important activity in academia and it is felt that now there is more need of converting the research undertaken in academia into realizable products or technologies that find applications in industry and society at large. The objective of this seminar is to give necessary applied orientation which is more relatable and understandable to budding researchers. The focus of the seminar will be to go beyond the concepts in order to identify the actual problems prevailing in industry and society.

This one day seminar is going to facilitate the researchers to learn tools for enunciating the problem, formulating a hypothesis, collecting the facts or data, analysing the facts and reaching certain conclusions in the form of solution(s) towards various problems and challenges. I firmly believe that all the participants are surely going to acquire maximum knowledge, directions and guidance with the help of eminent speakers associated with this seminar. Finally, I wish this One Day Seminar titled “Research Scholars’ Conclave 2026” a grand success.

MJCET Research Scholars Conclave Schedule

Time	Activity
10.00 AM- 10.02 AM	Qirat
10.03 AM- 10.05 AM	Welcome Address by Director, RDC
10.06 AM- 10.10 AM	Opening Remarks by Director, MJCET
10.11 AM- 10.15 AM	Inaugural Address by Principal, MJCET
10.16 AM- 10.25 AM	Keynote address by Dr. K. Ganesh Babu, Rtd. Professor, IIT Madras
10.26 AM- 10.30 AM	Vote of thanks
10.31 AM- 10.45 AM	Tea Break
10.46 AM- 11.00 AM	Research journey presentation by Principal, MJCET
11.01 AM- 11.15 AM	Research journey presentation by Director, MJCET
11.16 AM- 11.30 AM	Research journey presentation by Director, RDC
11.31 AM- 11.45 AM	Research journey presentation by Head, CSED
11.46 AM – 12.45 PM	Research Scholars presentation (5-7 minutes each)
12.46 PM- 1.45 PM	Lunch Break
1.46 PM – 1.55 PM	Research journey presentation by Head, CED
1.56 PM – 2.05 PM	Research journey presentation by Head, CS & AI D
2.06 PM – 2.15 PM	Research journey presentation by Head, ECED
2.16 PM – 2.25 PM	Research journey presentation by Head, EEED
2.26 PM – 2.35 PM	Research journey presentation by Head, MED
2.36 PM – 2.45 PM	Research journey presentation by Head, BS & H
2.45 PM – 3.45 PM	Research Scholars presentation (5-7 minutes each)
3.46 PM – 3.55 PM	Concluding Remarks
3.56 PM – 3.58 PM	National Anthem

Preface

The **Research Scholars Conclave** is envisioned as a vibrant academic platform to celebrate, showcase, and strengthen the culture of research and innovation at Muffakham Jah College of Engineering and Technology (MJCET). It brings together the institution's research scholars, academic leaders, and faculty to share research journeys, achievements, ideas, and emerging areas of scholarly inquiry.

The conclave provides an opportunity for research scholars to present their ongoing work, reflect on their research journeys, and receive valuable academic perspectives and encouragement. The presentations by the Principal, Director, Research and Development Cell, Heads of various departments, and research scholars collectively highlight the breadth and diversity of research activities across the institution.

The carefully structured programme, beginning with the inaugural session and keynote address and progressing through institutional research journey presentations and research scholar presentations, is intended to foster **knowledge exchange, interdisciplinary interaction, collaboration, innovation, and a stronger research ecosystem**. It also provides a platform for recognising the commitment and contributions of research scholars and encouraging them to pursue impactful research that addresses contemporary societal and technological challenges.

The **Proceedings of the Research Scholars Conclave** serve as a scholarly record of this academic endeavour, bringing together the ideas, research contributions, and experiences shared during the conclave. The event thus marks an important step towards nurturing a vibrant culture of inquiry, innovation, collaboration, and excellence in research at MJCET.

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MUFFAKHAM JAH

COLLEGE OF ENGINEERING AND TECHNOLOGY

RESEARCH AND DEVELOPMENT CELL



Name of the Research Scholar: Mrs. Asma Sultana

Department: Civil Engineering Department

Name of the Supervisor: Prof. P.Rajashekar

Name of the University from which pursuing the Ph.D.: Osmania University

Title of the Thesis (Tentative): PREDICTION OF STREAM FLOW USING MACHINE LEARNING TECHNIQUE

Machine learning and Prediction are two terms of cutting edge technology ruling today's world. High performance machine learning algorithms are attracting more applications.

Application area of prediction is about river flooding, which occurs on river basin and the scenario is supervised in nature, both classification and regression methods are exercised with respect to nature of data.

One of the objectives of the study is to generate flood inundation map of downstream of the River using predicted values of stream flow as it is prone to frequent floods

Two Flood inundation maps are generated using two different stream flow values, one is predicted values and other is observed values provided by Central Water Commission of India.

Proposed Timeline for completion of work: May be End of 2027



Name of the Research Scholar: Mrs. S.SHAHAR BANU

Department: CIVIL ENGINEERING

Name of the Supervisor: DR. T. KRISHNAIAH

Name of the University from which pursuing the Ph.D: ANURAG UNIVERSITY

Title of the Thesis (Tentative): "Numerical and Experimental Investigation of Shell and Tube Heat Exchanger with the Optimization of Tube Geometry under Variable Flow Rate by Using Hybrid Nano Fluids"

Research Gaps:

• Very few literatures were reported on the optimization of tube shapes, considering different materials or introducing other complex geometries to maximize heat transfer surface area and efficiency.

• Research is lacking in the investigation of tubes in a turbulent flow regime and research is needed to improve the efficiency of heat exchangers by optimizing the tube geometry using hybrid nano fluids

Proposed Objectives:

• To develop and validate a computational fluid dynamics (CFD) model for simulating heat transfer, fluid flow, Nusselt number, and friction factor in shell and tube heat exchangers with hybrid nanofluids at different flow rates.

• To experimentally fabricate and test a shell and tube heat exchanger prototype, measuring key parameters such as overall heat transfer

coefficient, temperature profiles, and pressure drops using hybrid nanofluids under variable flow rates.

• To analyze the influence of tube geometry variations on thermal performance and flow characteristics when employing hybrid nanofluids compared to base fluids.

• To compare numerical predictions with experimental results, achieving close agreement and propose empirical correlations for Nusselt number and friction factor under optimized conditions with hybrid nanofluids



Name of the Research Scholar: Mr. MOAHMMED AKBER ALI

Department: CSE

Name of the Supervisor: DR.JOTHI

Name of the University from which pursuing the Ph.D: ANURAG UNIVERSITY

Title of the Thesis (Tentative): Assessing the capabilities of MBERT and Flan- T5 in detecting of multilingual suspicious messages

Brief about the Work:

These days, the increasing prevalence of internet threats such as phishing, spam, dangerous intent, fraud, and other related threats have posed many risks to individuals and organizations across the world. Previous research in this scope primarily focused on rule-based or keyword-driven approaches, which were mostly limited to single-language datasets and lacked the adaptability required for multilingual contexts. The need of detecting these messages multilingually arises from the growing number of digital dangers. This paper explores the use of LLM (Large Language Models), for identifying potentially suspicious content across multiple language contexts. MBERT model utilizes a transformer-based bidirectional attention mechanism to extract the meaning of words in multilingual messages and offers reliable detection of risks across diverse languages. Flan-T5 is fine-tuned using a broad set of task-specific instructions, improving its performance on unseen tasks. Moreover, approaches like zero-shot learning allow the system to get used to work on/adapt to different languages, on which it is not trained.

Both our models show promising results with synthetic multilingual datasets. The overall accuracies are 82.3% and 83.33% for MBERT and Flan T5 respectively. The results obtained are helpful in dealing with messages involving cyber threats.

Proposed Timeline for completion of work: 3 years



Name of the Research Scholar: Mr.Mohammed Ahmed
Department: CSE
Name of the Supervisor: Prof. A. Govardhan
Name of the University from which pursuing the Ph.D: JNTU -H

Title of the Thesis (Tentative): Predictive Framework in Health care for Disease Prediction using ML Techniques

Incorporating machine learning methods into healthcare systems has demonstrated significant potential for enhancing diagnosis, prognosis, and customized treatment strategies. This work offers a thorough summary of predictive frameworks in healthcare for disease diagnosis through the use of machine learning techniques. It focuses on essential methodologies, obstacles, and progressions within the subject. Machine learning methods, such as supervised, unsupervised, and deep learning techniques, are now commonly used with different healthcare data types like electronic health records (EHR), medical imaging data, genetic data, and wearable sensor data. These algorithms can efficiently evaluate extensive amounts of intricate data to detect patterns, trends, and connections that could indicate the presence, development, or likelihood of disease.

Feature engineering is a key strategy used in predictive frameworks for illness detection. It involves extracting important features from raw data to reflect significant characteristics of individuals or disease states. Feature selection, dimensionality reduction, and data transformation techniques are frequently employed to improve the discriminative ability of predictive models. The present work implements Supervised learning algorithms like

logistic regression, support vector machines (SVM), random forests, and gradient boosting machines (GBM) are commonly employed for disease classification and risk prediction. These algorithms utilize labeled training data to forecast disease stages accurately by analysing patient features and clinical factors. Convolution neural networks (CNNs) are a potent tool in medical image analysis for automated disease detection and diagnosis. CNNs are capable of examining extensive medical pictures including X-rays, MRI scans, and histo-pathological images to detect anomalies, lesions, and tumor with great precision and effectiveness.

Although predictive frameworks have advanced, there are still some difficulties that need to be resolved. Data quality problems such as missing values, noise, and bias can greatly affect the efficiency of machine learning models. Moreover, the interpretability and explain ability of predictive models are essential for establishing trust and approval from healthcare professionals and patients. Ethical concerns such patient confidentiality, data protection, and fairness in algorithms need to be thoroughly considered while creating and using predictive systems in healthcare. It is crucial to provide transparency, accountability, and regulatory compliance to reduce potential hazards and assure the ethical usage of machine learning technologies.

Data quality issues, model interpretability, ethical considerations, and regulatory compliance remain significant barriers to the widespread adoption of machine learning technologies in clinical practice. Addressing these challenges requires interdisciplinary collaboration, rigorous validation, and transparent communication between data scientists, healthcare providers, policymakers, and patients. The Predictive frameworks in healthcare for disease detection using machine learning techniques hold immense promise for revolutionizing clinical decision-making, improving patient outcomes, and advancing public health initiatives. By continuing to innovate, refine, and integrate predictive models into healthcare systems, we can harness the full potential of machine learning to create a future where preventive and personalized medicine is accessible to all.

Predictive frameworks in healthcare employing machine learning techniques have great potential to revolutionize clinical practice, enhance patient outcomes, and progress population health management. Utilizing extensive healthcare data along with advanced machine learning algorithms can help create predictive frameworks for early disease detection, tailored treatment planning, and proactive healthcare interventions.

Proposed Timeline for completion of work:

Proposed Plan:

1. Literature review and Problem statement identification 6 months
2. Design and implementation of technique-1 and first paper and publication -6months
3. Design and implementation of technique-2 and paper publication---- 6 months
4. Comparison of the proposed technique with previous work and paper publication 6 months
5. Thesis writing 9 months.

Name of the Research Scholar: Ms. Sabiha Mahveen



Department: Computer Science and Artificial Intelligence

Name of the Supervisor: Dr Debajyoti Nayak

Name of the University from which pursuing the Ph.D: Anurag university, Hyderabad

Title of the Thesis (Tentative): Not yet finalized

Proposed Timeline for completion of work:



Name of the Research Scholar: Ms. Saba Sheiba
Department: CS and AI
Name of the Supervisor: Dr. Neelakantappa
Name of the University from which pursuing the Ph.D: BEST Innovation University, AP

Title of the Thesis (Tentative): Segmentation of Retinal Blood Vessels and Optic Disc Using Deep Neural Networks

Brief about the Work:

This PhD research focuses on the development of robust and intelligent deep learning frameworks for automated analysis of retinal fundus images, with the objective of enabling early diagnosis and screening of vision-threatening diseases such as diabetes, diabetic retinopathy, glaucoma, and hypertension. Retinal imaging plays a critical role in clinical ophthalmology; however, automated analysis remains challenging due to low contrast, uneven illumination, complex vessel morphology, and limited availability of annotated medical data. The overall aim of this research is to address these challenges by integrating advanced convolutional neural networks with bio-inspired optimization techniques to improve segmentation accuracy, generalizability, and clinical reliability.

The first phase of the research concentrates on retinal blood vessel segmentation, which is a foundational step for many ophthalmic diagnostic systems. Traditional machine learning and handcrafted feature-based methods struggle to detect thin capillaries and vessel bifurcations due to noise, poor illumination, and complex vessel structures. To overcome these limitations, Patch-wise U-Net architecture optimized using Harris Hawk

Optimization (HHO) is proposed. The patch-based strategy divides fundus images into overlapping regions, enabling the network to focus on fine-grained local vessel features that are often missed in full- image segmentation approaches. The HHO algorithm is employed to automatically tune critical hyperparameters and learning weights, eliminating the need for manual parameter selection and improving convergence stability. The proposed framework is evaluated on standard DRIVE and STARE datasets, demonstrating high segmentation performance across multiple metrics, including accuracy, precision, recall, F1-score, IoU, and Dice coefficient. Both quantitative and qualitative analyses confirm that the model effectively preserves vessel continuity and accurately segments both thin and thick vessels, even in challenging low-contrast regions, highlighting its suitability for real-world clinical applications.

Building upon the vessel segmentation framework, the second phase of the research addresses optic disc (OD) and optic cup (OC) segmentation, which is essential for assessing the cup-to-disc ratio in glaucoma screening and for identifying diabetic retinopathy-related abnormalities. One of the key challenges in OD and OC segmentation is achieving high accuracy with limited annotated data while maintaining robustness across different datasets. To address this, a Transferable Attention U-Net (TAU-Net) integrated with Particle Swarm Optimization (PSO) is proposed. The model incorporates attention mechanisms and dual discriminators to extract invariant features across datasets, enhancing transferability and reducing overfitting. Structured dropout blocks are used in place of conventional convolutional blocks to improve generalization, while PSO optimizes the network parameters for improved segmentation performance. The proposed approach is validated on DRISHTI-GS1, RIM-ONE, and REFUGE datasets, achieving consistently high accuracy, precision, recall, and Dice scores for both optic disc and optic cup segmentation. The results demonstrate significant improvements over existing state-of-the-art methods and confirm the statistical effectiveness of the proposed optimization strategy.

Overall, this research contributes novel, optimization-driven deep learning models for retinal image analysis that improve segmentation accuracy,

robustness, and generalizability across datasets. The proposed methods reduce dependency on extensive manual tuning and large annotated datasets, thereby enhancing their practical applicability in automated ophthalmic screening systems. The outcomes of this work provide a strong foundation for reliable computer-aided diagnosis tools aimed at early detection and monitoring of retinal diseases in real-world clinical environments.

Proposed Timeline for completion of work: 1 year

Name of the Research Scholar: Mrs. B.Sucharitha



Department: ECED

Name of the Supervisor: Dr. K. Anitha Sheela

Name of the University from which pursuing the Ph.D: JNTUH

Title of the Thesis (Tentative): Compression of Hyper Spectral Images using Tensor Decomposition Methods

Brief about the Work:

Hyperspectral imaging (HSI) captures images across hundreds of contiguous spectral bands, providing rich spectral information for each pixel. Unlike traditional RGB images (3 bands), hyperspectral images form a three-dimensional data cube: two spatial dimensions (x, y) and one spectral dimension (λ). This high spectral resolution makes HSI extremely valuable in applications such as remote sensing, medical imaging, agriculture, mineral exploration, and environmental monitoring. However, the large data volume poses significant challenges for storage, transmission, and processing.

Tensor-based compression methods have emerged as powerful tools to efficiently compress hyperspectral images while preserving their structural and spectral integrity. The first method presents a hybrid hyperspectral image compression approach that combines 3-Way SVD Tucker tensor decomposition with the Discrete Wavelet Transform (DWT) to efficiently exploit both spatial and spectral correlations within the hyperspectral data cube. The tensor decomposition reduces global redundancy through

multilinear rank approximation, while the wavelet transform further compacts energy in the spatial-frequency domain, resulting in improved compression performance. Experimental results on four datasets show that this hybrid technique achieves superior visual quality and significantly higher PSNR, SSIM, and PCC values compared to standalone DWT and Tucker decomposition methods, with average PSNR improvements of more than 7 dB and 8 dB respectively, while maintaining a high compression ratio. The method can also be extended to other hyperspectral applications such as unmixing and classification.

The second method focuses on hyperspectral image compression using Higher Order Orthogonal Iteration (HOOI) Tucker decomposition, where the hyperspectral image is represented as a 3D tensor to remove spatial and spectral redundancy. The approach applies Alternating Least Squares (ALS) for initialization and Higher Order Singular Value Decomposition (HOSVD) within the HOOI framework to achieve optimized tensor approximation. Experimental results on four real datasets indicate that the method provides high compression with acceptable reconstruction quality.

However, due to the iterative ALS optimization and tensor decomposition process, the method requires longer computational time compared to simpler approaches. The implementation and experimental evaluation of the proposed methods were carried out using both MATLAB and Python environments. MATLAB was primarily used for tensor modeling, multilinear algebra operations, and implementation of Tucker decomposition, HOSVD, HOOI, and DWT due to its strong matrix computation capabilities and availability of tensor toolboxes. Python was used to enhance flexibility, reproducibility, and performance analysis, utilizing libraries such as NumPy, SciPy, and TensorLy for tensor operations and numerical computation.

The combination of MATLAB's robust mathematical framework and Python's open- source ecosystem provided an efficient and reliable platform for algorithm development, experimentation on multiple datasets, and

evaluation of compression metrics such as PSNR, SSIM, PCC, and compression ratio.

Proposed Timeline for completion of work: One year (max)



Name of the Research Scholar: Mrs. Shubhangi Saxena

Department: ECE

Name of the Supervisor: Dr. K. Manjunathachari

Name of the University from which pursuing Ph.D: GITAM University

Title of the Thesis (Tentative): Memristor-based Design for Neuromorphic Applications

Brief about the Work:

Methodology:

- Review memristor physics: resistance switching mechanisms, Conductance states.
- Analyse neuromorphic computing principles: Event-driven processing, and parallel architectures.
- Material and Circuit-level design: memristor synapse circuits, neuron circuits. SPICE-level simulations using memristor models.

Tools being used: SPICE simulators (Cadence, HSPICE), COMSOL Multiphysics

Expected outcome:

- Insights into device-level requirements and fabrication challenges.
- Memristor-based neuromorphic architecture design.

Proposed Timeline for completion of work:

10-12 months for another paper and thesis submission.



Name of the Research Scholar: Ms.Rafath Unnisa

Department: ELECTRONICS and COMMUNICATION ENGINEERING

Name of the Supervisor: Dr. K. MANJUNATH CHARI

Name of the University from which pursuing the Ph.D: GITAM, HYDERABAD

Title of the Thesis (Tentative): Designing a Low Power IC Based Temperature Sensor

Brief about the Work

Introduction: Smart temperature sensors, when realized in CMOS technology, the sensing element is usually a parasitic bipolar junction transistor (BJT), i.e. a PNP or NPN transistor, whose base-emitter voltage VBE has a well-defined temperature dependency [1-3].

The dominant source of inaccuracy in such sensors is the effect of process spread on the BJT's saturation current Is, which, in turn, results in (PTAT) errors. BJT-based sensors typically require supply voltages above 1V, since VBE will be about 0.8V at -55°C and some headroom is required for the current source that biases the BJT. This restricts the use of such sensors in battery powered systems, and also restricts the temperature range of implementations in nanometer CMOS [4].

Objectives:

i) Improving the energy efficiency of very high-resolution ADCs represents a challenge due to their low thermal noise and high linearity requirements.

ii) To develop a zoom ADC and understand the trade-off between noise and linearity.

iii) To design a VLSI based temperature-to-digital converter (TDC) .

iv) To achieve ultra-low power consumption.

Methodology:

i) Cpp Sim used for design and simulation of ADC and DSP Blocks.

ii) Using Cadence tool circuits are designed and complete simulation is obtained.

Expected Outcomes:

i) Designed a VLSI based temperature-to-digital converter (TDC) using CMOS technology achieving high accuracy specifically an inaccuracy of ±18mk over a wide temperature range of -60°c to +60°c.

ii) Achieved ultra low power consumption.The design is implemented in 0.045um CMOS technology with only 0.3uA of current being drawn with a power dissipation of 18.09E-12W.

Literature Review:

[1] S.H. Shalmany , D. Draxelmayr , K.A .A . Makinwa , A ±5 integrated current-sensing system with 0.3% gain error 16 μA offset from −55 °C to + 85 °C, IEEE J. Solid-State Circuits 51 (4) (Apr. 2016) 800–808

[2] K. Souri , Y. Chae , K.A .A . Makinwa , A CMOS temperature sensor with a voltage–calibrated inaccuracy ±0.15 °C (3 σ) from −55 °C to + 4125 °C, IEEE J. Solid-State Circuits 48 (1) (Jan. 2013) 292–301.

[3] M.A.P. Pertijs, J. Huijsing , Precision Temperature Sensors in CMOS Technology, Springer, Dordrecht, the Netherlands, 2006 .

[4] S.H. Shalmany, et al. ,A ±36 a integrated current-sensing system with ±0.3% gain error 400 μA offset from −55 °C to + 85 °C, in Proc. IEEE Symp. VLSI (Jun. 2016) 96–97.

[5] SiTime Corporation. (Mar. 2016). SiT1568 Data Sheet.[Online]

Available: http://www.sitime.com/products/datasheets/sit1568/SiT1568-datasheet.pdf.

Proposed Timeline for completion of work: A Request Letter Given to Supervisor for Allowing to Submit Thesis.



Name of the Research Scholar: Mr. Kadiyam Sasidhar

Department: Electronics and Communication Engineering

Name of the Supervisor: Prof.K. Manjunathachari

Name of the University from which pursuing the Ph.D: GITAM, Hyderabad

Title of the Thesis (Tentative): Investigation on Facial Gesture Recognition Using Deep Learning Techniques

Brief about the Work

Introduction

Facial Gesture Recognition (FGR) is a significant research area in computer vision and artificial intelligence that focuses on identifying human facial movements and expressions through automated systems. Facial gestures are essential components of non-verbal communication and play a vital role in applications such as human-computer interaction, biometric authentication, surveillance systems, healthcare monitoring, and assistive technologies. With the rapid growth of artificial intelligence, deep learning techniques have shown promising results in facial analysis; however, several practical challenges remain unresolved.

Problem Statement

Existing facial gesture recognition systems face difficulties such as illumination variations, pose changes, occlusion, noisy image data, redundant feature extraction, and high computational complexity. These issues reduce recognition accuracy and system efficiency, especially in real-time and large-scale environments. Therefore, there is a need to develop a robust, optimized, and noise- resilient framework that enhances performance while reducing computational burden.

Objectives

The primary objectives of this research are:

1. To develop an efficient pre-processing model for facial image enhancement and noise reduction.
2. To design an intelligent feature extraction and optimized feature selection mechanism to reduce redundancy.
3. To implement a deep learning-based classification framework for accurate facial gesture recognition.
4. To improve recognition accuracy while minimizing computational complexity.
5. To validate the proposed model using standard benchmark datasets.

Proposed Methodology

The proposed system consists of multiple stages including image acquisition, pre-processing, feature extraction, feature optimization, and classification. Initially, facial images are pre-processed using normalization and advanced denoising techniques to enhance image quality. Deep convolutional neural networks are employed for extracting discriminative spatial features. An optimization-based feature selection algorithm is incorporated to eliminate irrelevant and redundant features. Finally, a deep learning classifier is used to recognize different facial gestures. System performance will be evaluated using metrics such as accuracy, precision, recall, F1-score, and computational efficiency.

Expected Outcomes and Applications

The proposed framework is expected to achieve higher recognition accuracy, reduced feature dimensionality, improved robustness against environmental variations, and real-time implementation capability. The research findings can be applied in smart surveillance systems, emotion-aware computing, biometric authentication, healthcare monitoring, and intelligent human-computer interaction systems.

Proposed Timeline for completion of work: Oct-2027

Name of the Research Scholar: Mr. Md Noorullah Khan



Department: ELECTRONICS AND COMMUNICATION ENGINEERING

Name of the Supervisor: Dr E Srinivas

Name of the University from which pursuing the Ph.D: Anurag University

Title of the Thesis (Tentative): Design of Low power and high speed data converter using emerging and innovative devices.

Brief about the Work:

This work proposes the design of a low-power and high-speed Analog-to-Digital Converter (ADC) using memristor technology implemented with Cadence Virtuoso tools. Conventional CMOS ADCs suffer from high power consumption and large chip area, particularly in high-speed applications, whereas memristors offer advantages such as nanoscale size, fast switching speed, non-volatility, and low power operation. In the proposed approach, a memristor-based Flash ADC architecture will be developed in which the conventional resistor ladder network is replaced by a memristor voltage divider to reduce static power consumption and silicon area while improving conversion speed. The memristor device will be modeled using a Verilog-A model and integrated with CMOS circuits in the Cadence environment. The design will be simulated using Spectre to evaluate key performance parameters including power consumption, conversion speed, delay, resolution, and linearity. The results will be compared with a conventional

CMOS ADC to demonstrate the advantages of the memristor-based design for high-speed and low-power mixed-signal applications.

Proposed Timeline for completion of work: 2027



Name of the Research Scholar: Mrs. Mahmooda Mubeen
Department: Electrical Engineering Department
Name of the Supervisor: Dr.G.Srinivas, EECE
Name of the University from which pursuing the Ph.D: GITAM
Title of the Thesis (Tentative): Battery Thermal Manangement

About the Work: Monitoring the battery temperature and its cooling technologies in EV's are essential parts of modern battery systems utilized in electric vehicle applications. As operational temperature has a substantial impact on the functionality, safety, and lifespan of batteries, thermal management is an essential design consideration. While charging the battery, heat is generated in the battery pack which increases the battery temperature. If this heat generated is not dissipated to atmosphere, it may lead to thermal runaway and fire accidents. Therefore Battery cooling technology along with accurate temperature monitoring is essential for battery systems to lower down the temperature of battery specially while charging. Electric vehicle adoption facilitates advancements in battery safety and performance brought about by temperature monitoring and battery cooling technology. This makes the charging process safer, efficient and fast.

Methodology:

Testing the battery design for different casing material, cell arrangement and cooling arrangements.

Tool: Simulation using ANSYS

Expected Outcome: To attain lower battery temperature for safe, efficient and fast charging.

Publications:

Two Papers Accepted:

1. International Journal (Q2)
2. Conference

Proposed Timeline for completion of work: Work under Review Process, Thesis Writing Started.



Name of the Research Scholar: Mrs. Nausheen Bano

Department: Electrical Engineering Department

Name of the Supervisor: Dr.T.Anil kumar

Name of the University from which pursuing the Ph.D: Anurag university

Title of the Thesis (Tentative): Load Frequency Control of RE Integrated Smart Deregulated Power System Using Reinforcement Learning Based controller.

Brief about the work:

The integration of renewable energy sources and the transition to deregulated electricity markets present significant challenges for frequency control. As a result, there is a strong need to develop robust, adaptive, and intelligent Load Frequency Control (LFC) mechanisms. These solutions are essential to ensure system stability, meet regulatory requirements, and enable the economical operation of modern power systems.

CONTROL METHDOLOGIES

Two reinforcement learning controllers are implemented namely Actor Critic Controller based on Deep Deterministic Policy Gradient (DDPG) algorithm and Deep Q Neural Network (DQN) controller for regulating frequency of two area smart deregulated power system under different transaction scenario.

EXPECTED OUTCOMES

The performance of various controllers tested on simulation model of two area smart deregulated power system with PI, FOPI, Actor critic and DQN controllers. The performance of the controllers presented in terms of peak overshoot and setting time.

The application of DQN for LFC shows a promising direction for intelligent and adaptive control in modern power systems, facilitating more resilient and flexible grid operations. The regulation of change in frequency of two area smart deregulated power system with DQN control method is very efficient as compared to PI, FOPI, and Actor Critic Controller.

PROPOSED TIMELINE FOR COMPLETION OF WORK:

Published first paper in JISEM (Feb2025) and second paper is presented in GIEST conference (October 2025) which is to be published in IEEE.



Name of the Research Scholar: Mr. P.Sai Krishna
Department: EED
Name of the Supervisor: Dr.Santhosh.M
Name of the University from which pursuing the Ph.D: Anurag University

Title of the Thesis (Tentative):
Implementing Robust Multi layered Security for a Modern & Legacy SCADA based Process control System.

Brief about the Work:
In this work, we are going to demonstrate the vulnerabilities of SCADA systems. Typically, Critical Infrastructure is managed and maintained by government organizations. In this work, we demonstrate how the lack of software patches and OS upgrades result in compromise of entire critical infrastructure.
Industrial Supervisory Control and Data Acquisition (SCADA) systems manage and control critical processes in sectors like manufacturing, energy, water treatment, and transportation, widely continue to operate on legacy systems worldwide. This persistence is not due to the superiority of old technology but rather a complex interplay of operational reliability, significant upgrade costs, and unique industrial challenges that make modernization difficult

Proposed Timeline for completion of work: 2026-2027



Name of the Research Scholar: Mr. Mohammed Abdullah

Department: EEE

Name of the Supervisor: Venkata Padmavathi S

Name of the University from which pursuing the Ph.D: GITAM Hyderabad

Title of the Thesis (Tentative): Transformerless PV Inverters to reduce leakage current (yet to be finalised from my Guide)

Brief about the work: This work investigates the operation of a Filter-Clamped Inverter (FCI) for grid-connected three-phase transformerless photovoltaic (TLPV) systems. Compared with PV systems that use line-frequency or high-frequency isolation transformers, transformerless configurations offer higher efficiency and lower cost; however, the absence of galvanic isolation often leads to significant leakage current. Conventional inverter topologies mitigate this issue by introducing additional semiconductor devices or relying on complex control strategies. In contrast, the proposed inverter topology inherently suppresses leakage current without requiring extra components or changes in control methods, resulting in a more compact and simplified solution for transformerless PV applications.

Furthermore, when compared with the conventional three-phase full-bridge (FB) inverter, the FC inverter demonstrates a substantial reduction in leakage current. Simulation results confirm that the FC inverter effectively minimizes leakage current while also improving grid current quality.

Methodology: Matlab Simulink and practical set up to be proposed.

Tools being used: Microsoft Word, Microsoft Excel & Microsoft Visio.

Expected outcome: Improved leakage current suppression for Grid connected PV Systems.

Proposed Timeline for completion of work: One or one and half Year.

Name of the Research Scholar: Mrs. V.Vimala



Department: Mathematics

Name of the Supervisor: Dr V..Vibobha

Name of the University from which pursuing the Ph.D: Bharathidasan University

Title of the Thesis (Tentative): A STUDY ON REPEATED GAME THEORY IN WIRELESS SENSOR NETWORKS

Brief about the Work:

WSNs is networks consisting of randomly or regularly spread sensor nodes. In this connection a novel protocol may be designed using Repeated game theory to extend the life time of network.

Here Cooperative Game Theory, Non-Coperative Game Theory, Zero-Sum Game Theory, Non-zero Sum Game Theory and Repeated Game Theory may be employed to enhance the efficiency of Power management in Wireless Sensor networks.

The proposed Repeted Game Theory methods may be applied effectively for the analysis of power management in Wireless Sensor Networks and these games significantly may reduce the total transmission power , save nodes energy and prolongs the network lifetime effectively.

In future the results obtained through my Proposed Work may be simulated and validated using Network Simultor NS2.

Proposed Timeline for completion of work: 2029

Name of the Research Scholar: Mr. Mohd. Abdul Haleem Rizwan

Department: Maths

Name of the Supervisor: Dr P.Suresh

Name of the University from which pursuing the Ph.D: Dravidian University



Title of the Thesis (Tentative):

A Study of Regression Models for Physical Properties of Oxide Glasses

Research Proposal

Introduction

The study of regression models for predicting the physical properties of glasses is a critical area of research due to the wide-ranging applications of glass materials in various high-tech industries. Glass, defined as an inorganic product of fusion that cools to a rigid condition without crystallization, is a versatile material used in applications ranging from everyday items like windows and bottles to specialized uses in electronics, telecommunications, and renewable energy.

This thesis proposes the development and application of mathematical regression models to predict key physical properties of oxide glasses, specifically focusing on density and refractive index. For the first time, the study leverages a large dataset comprising 10,000 unique glass compositions to construct and validate these models. The work involves the use of advanced machine learning techniques, implemented through Python's Scikit-learn library, to analyze and predict glass properties with high accuracy. The overarching aim is to establish reliable predictive models that can assist in the design and optimization of new glass materials.

Chapter 1: Introduction to Regression Analysis

Regression analysis is a foundational statistical method widely used in various fields such as economics, engineering, and the natural sciences. It allows researchers to model the relationship between a dependent variable and one or more independent variables. In the context of this research, regression analysis is employed to predict physical properties of glasses, such as density and refractive index, based on their chemical composition and atomic packing fraction (APF).

This chapter introduces the concept of regression analysis, including both linear and nonlinear models. It discusses the significance of these models in scientific research and their specific application to materials science. The chapter also provides a brief historical overview of glass, tracing its origins back to ancient Mesopotamia around 2500 BC. While early uses of glass were limited to simple decorative items, the material's versatility has led to its widespread adoption in numerous advanced technological applications.

Oxide glasses, in particular, are of significant interest due to their unique properties and industrial relevance. These glasses are primarily composed of oxides such as SiO_2, Na_2O_3, B_2O_3, and Al_2O_3, which serve as glass formers. The addition of network modifiers like Na_2O, Ag_2O, and Li_2O further influences the glass structure, enabling the tailoring of properties for specific applications. Examples include the use of glasses in photovoltaic cells, optical fibers, flat-screen displays, and protective coatings. The chapter concludes by setting the stage for the development of regression models aimed at predicting these critical physical properties.

Chapter 2: Mathematical Framework of Regression Models and Dataset Analysis

The second chapter delves into the mathematical underpinnings of the regression models used in this study. It begins with a review of relevant literature, highlighting key studies that have applied regression and machine learning models to predict the properties of various materials, including bioactive glasses, metallic glasses, and complex oxide systems. These studies provide a foundation for the current research, which aims to

extend these methodologies to oxide glasses with a focus on density and refractive index predictions.

The dataset used in this research is one of the largest and most comprehensive compilations of glass compositions available, consisting of 10,000 unique samples. Each sample is characterized by its chemical composition, density, elastic constants, thermal properties, and structural analysis. This dataset was meticulously compiled from reputable sources, including peer-reviewed journals and experimental data.

The chapter discusses the preprocessing steps taken to prepare the dataset for regression analysis, including clustering techniques such as spectral clustering and K-Means clustering. These methods were employed to group the data based on the mol% of the glass formers, allowing for a more refined analysis of the relationships between composition and physical properties. The regression models were then developed using Python's Scikit-learn library, which provides a robust platform for implementing various machine learning algorithms.

Chapter 3: Mathematical Modeling for Density Prediction

Chapter 3 focuses on the application of different regression models to predict the density of oxide glasses. The chapter begins by establishing an empirical relationship between the density and the atomic packing fraction (APF) of glasses. This relationship serves as the basis for developing linear regression models, which are then refined using gradient descent optimization. Linear Regression Modelling: Linear regression is the simplest form of regression analysis, where the relationship between the independent variables (e.g., chemical composition, APF) and the dependent variable (density) is modelled as a linear function. In this study, the linear regression model was initially applied using experimental data as input variables, with the predicted density as the output. The model accuracy was evaluated using statistical metrics such as the root mean squared error (RMSE) and the coefficient of determination (R^2).

The research demonstrated that linear regression, when combined with gradient descent, significantly improved the model predictive power. Gradient descent is an optimization algorithm that iteratively adjusts the

model parameters (weights) to minimize the cost function, typically defined as the mean squared error (MSE) between the predicted and actual values. The study found that the linear regression model, enhanced by gradient descent, provided accurate predictions for the densities of B_2O_3, SiO_2, and Al_2O_3 glasses, with R^2 values indicating a strong fit.

Artificial Neural Networks (ANNs): In addition to linear regression, the chapter explores the application of artificial neural networks (ANNs) to the density prediction problem. ANNs are a class of machine learning models inspired by the structure and function of biological neural networks. They are particularly well-suited for modeling complex, nonlinear relationships between variables. The ANN models developed in this study were tested with various configurations, including single-layer and multi-layer architectures. The choice of activation functions—sigmoid, ReLU, identity, and tanh—was carefully considered, as these functions play a crucial role in determining the model39; ability to capture the underlying patterns in the data. The results showed that multi-layer neural networks, particularly those using the tanh activation function, provided the best predictions for Al_2O_3 glasses, achieving an R^2 value of 0.845.

Chapter 4: Mathematical Approaches to Refractive Index Prediction and Raman Spectroscopy

This chapter extends the application of regression models to predict the refractive index of glasses. The refractive index is a critical optical property that determines how light propagates through a material. It is closely related to the material's density and can be predicted using regression models that incorporate the density parameter as an independent variable.

Refractive Index Prediction: The refractive index prediction models developed in this study include linear regression, polynomial regression, random forest regression, and ANNs. The random forest regression model, in particular, demonstrated the highest predictive capability, with an R^2 value of 0.950 for refractive index prediction. This result underscores the effectiveness of ensemble learning techniques, such as random forests, in handling complex datasets with multiple interacting variables.

The ANN models also performed well, with the tanh activation function once again providing the best results. The study found that the ANN model achieved an R^2 value of 0.944 for refractive index prediction, closely matching the performance of the random forest model.

These results highlight the potential of machine learning techniques in predicting optical properties of materials, paving the way for their application in the design of advanced glass materials.

Raman Spectroscopy Analysis: In addition to refractive index prediction, this chapter explores the use of Raman spectroscopy to analyze the structural properties of glasses. Raman spectroscopy is a powerful tool for probing the vibrational modes of a material atomic lattice, providing insights into its structural characteristics.

The study employed machine learning techniques, including support vector machines (SVM) and random forest classifiers, to predict Raman spectra based on the chemical composition of the glasses. The models were trained and tested using a subset of the dataset, with the results showing high precision, recall, and F1-scores. The analysis revealed structural changes in the glasses, such as the conversion of BO_3 to BO_4 units and shifts in peak intensities, indicating modifications in the glass network due to varying La_2O_3 content.

The SVM model, in particular, demonstrated its effectiveness in capturing and predicting the complex spectral features of glasses. The study concluded that SVM, combined with appropriate feature selection and data preprocessing, can accurately predict Raman spectra, providing valuable insights into the material structure and composition.

Chapter 5: Conclusions

The final chapter summarizes the key findings of the thesis and discusses the implications of the research for the broader field of materials science. The study successfully demonstrated the application of regression models in predicting the physical properties of oxide glasses, providing a robust framework for future research in this area.

Among the models tested, random forest regression emerged as the most effective in predicting both density and refractive index, particularly for

glasses with high mol% of glass formers. The ANN models also provided accurate predictions, especially when using multi- layer configurations with the tanh activation function. These findings highlight the potential of machine learning techniques in materials science, offering new avenues for the design and optimization of advanced glass materials.

The thesis concludes with suggestions for future research, including the exploration of additional glass properties, such as thermal conductivity and mechanical strength, using the established regression models. The research also opens the door to the application of more advanced machine learning techniques, such as deep learning and reinforcement learning, in the study of complex materials systems.



Name of the Research Scholar: Mr. V. Suvarna Kumar
Department: Mechanical Engineering
Name of the Supervisor: Dr. S. Irfan Sadaq

Name of the University from which pursuing the Ph.D: Bharath Institute of Higher Education and Research (Bharath University) Deemed to be University, Chennai, India

Title of the Thesis (Tentative):
Development and Evaluation of Sustainable High-Performance Polymer Composites for Extreme Environmental and Mechanical Conditions

Research Proposal

1. **Introduction**

The increasing demand for materials capable of withstanding extreme mechanical loads and harsh environmental conditions has accelerated the development of advanced polymer and polymer-based composite systems. Industries such as aerospace, automotive, energy, defense, and infrastructure require materials that combine high strength, durability, and resistance to temperature, moisture, and chemical exposure. However, most high-performance polymers are petroleum-based and associated with high carbon emissions and limited recyclability. This research proposes the development of sustainable polymer composites that deliver advanced mechanical performance while minimizing environmental impact.

2. Literature Review

The increasing demand for materials capable of operating under extreme mechanical loads and harsh environmental conditions has driven extensive research into advanced polymer and polymer-based composite systems. Polymers and composites are widely used in aerospace, automotive, energy, defense, and infrastructure applications due to their high strength-to-weight ratio, corrosion resistance, and design flexibility. However, conventional high-performance polymers such as ABS, Nylon, and epoxy-based composites are predominantly petroleum-derived, energy-intensive to produce, and pose challenges in recyclability and end-of-life management (Ngo et al., 2018).

Bio-based polymers such as Polylactic Acid (PLA) and Polyhydroxyalkanoates (PHA) have emerged as promising alternatives due to their renewable origin and reduced carbon footprint. Life Cycle Assessment (LCA) studies indicate that PLA exhibits a carbon footprint of approximately 1.8–2.5 kg CO_2-eq/kg, which is nearly 50–60% lower than conventional polymers like ABS (Oliveira et al., 2022). Despite these sustainability advantages, PLA suffers from inherent brittleness, low impact resistance, and limited thermal stability, restricting its use in extreme service environments (Wang et al., 2021). PHA, on the other hand, offers improved toughness and chemical resistance but presents processing challenges due to its narrow thermal window and lower mechanical strength, typically in the range of 25–40 MPa tensile strength (Shen et al., 2016).

To overcome these limitations, researchers have explored polymer composite approaches, wherein bio-based polymers are reinforced with fibers or nanoparticles to enhance mechanical and environmental durability. Such strategies aim to retain sustainability benefits while meeting the performance demands of extreme applications. Natural fibers such as flax, jute, hemp, and kenaf have been extensively studied as sustainable reinforcements due to their low density, renewability, and favorable specific mechanical properties. These fibers exhibit tensile strengths ranging from

300 to 900 MPa and elastic moduli between 10 and 70 GPa (Pickering et al., 2016). Studies by Tao et al. (2017) demonstrated that incorporating 20–30 wt% flax fiber into PLA increased tensile strength by up to 40% and flexural modulus by 60%, although moisture sensitivity remains a concern under humid or thermal cycling conditions.

At the nanoscale, nanoclays and carbon-based nanofillers have been shown to significantly improve stiffness, thermal stability, and barrier properties even at low loadings (1–5 wt%). Ranganathan et al. (2021) reported improvements of 20–30% in elastic modulus and enhanced fatigue resistance in nanoclay-reinforced polymer composites. For applications demanding extreme mechanical reliability, carbon and glass fibers are widely used due to their superior strength and fatigue resistance. Carbon fibers, with tensile strengths exceeding 3–5 GPa, provide exceptional load-bearing capacity but are associated with high embodied energy, prompting interest in hybrid composite systems that partially replace synthetic fibers with sustainable alternatives (Ngo et al., 2018).

Additive Manufacturing (AM), particularly Fused Deposition Modelling (FDM), Selective Laser Sintering (SLS), and Stereolithography (SLA), has enabled the fabrication of complex polymer composite structures with reduced material waste and enhanced design freedom. However, AM-fabricated parts often suffer from anisotropy and weak interlayer bonding, which significantly affect mechanical performance under extreme loading conditions. Goh et al. (2018) reported that mechanical strength of FDM-printed polymer composites can vary by up to 70% depending on process parameters such as raster orientation, layer height, and infill density.

SLS-based Nylon composites offer superior isotropy and fatigue resistance, making them suitable for high-stress applications, while SLA provides excellent surface finish and dimensional accuracy but is limited by material availability and long-term durability. Optimization of processing parameters has been shown to reduce anisotropy by up to 50% and significantly enhance fatigue life (Torrado & Roberson, 2016).

Performance under extreme environmental conditions—such as elevated temperatures, humidity, and cyclic mechanical loading—is a critical requirement for structural applications. Environmental aging studies have shown that moisture absorption can reduce tensile strength of natural fiber composites by 10–25%, emphasizing the need for surface treatments and matrix modification (Le Duigou et al., 2016). Thermal cycling can also induce microcracking and interfacial debonding, which are key failure mechanisms observed through SEM analysis.

Life Cycle Assessment (LCA) has become a vital tool for quantifying the environmental benefits of sustainable polymer composites. Studies indicate that AM-fabricated bio-based composites can reduce overall energy consumption by 30–50% compared to conventional manufacturing routes, depending on material choice and process parameters (Tseng et al., 2020). Furthermore, recent research has integrated statistical analysis and machine learning models to predict mechanical performance and environmental impact with over 90% accuracy, enabling efficient material and process optimization (Kumar et al., 2020).

2.1 Research Gaps

Despite significant progress, existing literature reveals several gaps:

- Limited studies integrate extreme mechanical performance and sustainability simultaneously
- Lack of standardized methodologies for LCA in AM-based composite systems
- Insufficient long-term durability data under combined mechanical and environmental stress

3. Objectives

The primary objective of this research is to design, fabricate, and evaluate novel polymer and polymer-based composite systems that perform reliably under extreme mechanical and environmental stress. Specific objectives include:

- To develop sustainable polymer composite formulations using bio-based and recyclable polymers with suitable reinforcements
- To evaluate mechanical performance under tensile, flexural, impact, and fatigue loading
- To investigate environmental durability under thermal cycling, moisture, and chemical exposure
- To analyze processing–structure–property relationships, particularly for additive manufacturing
- To assess environmental performance using life cycle assessment (LCA) metrics

4. Methodology

Bio-based polymers such as PLA and PHA, along with high-performance conventional polymers like Nylon, PETG, and ABS, will be selected as matrix materials. Reinforcements including natural fibers, nanoclays, carbon fibers, and glass fibers will be incorporated to improve strength, stiffness, and fatigue resistance. Composite fabrication will be carried out using additive manufacturing techniques such as Fused Deposition Modelling (FDM), Selective Laser Sintering (SLS), and Stereolithography (SLA), with optimization of process parameters including layer height, infill density, print temperature, and raster orientation.

Mechanical testing will follow ASTM standards to determine tensile strength, flexural modulus, impact resistance, and fatigue life. Environmental testing will include thermal aging, humidity exposure, and cyclic loading to simulate extreme service conditions. Fracture behavior and interfacial bonding will be examined using scanning electron microscopy (SEM). Sustainability performance will be evaluated through life cycle assessment focusing on energy consumption, carbon emissions, and material circularity. Statistical analysis and machine learning tools will be employed to model process–structure–property relationships.

5. Proposed Timeline for completion of work:

Phase	Duration	Activities
Phase I: Literature Review & Problem Definition	Months 1–6	Comprehensive literature review, identification of research gaps, finalization of objectives and methodology
Phase II: Material Selection & Preliminary Characterisation	Months 7–12	Selection of polymers (PLA, PHA, Nylon, PETG), reinforcements (natural fibers, nanoclays, carbon/glass fibers), baseline material characterization
Phase III: Composite Development & AM Process Optimization	Months 13–20	Composite formulation, fabrication using FDM/SLS/SLA, optimization of process parameters using DOE
Phase IV: Mechanical & Environmental Testing	Months 21–28	ASTM-based tensile, flexural, impact, fatigue testing; environmental aging (thermal, humidity); SEM analysis
Phase V: Sustainability Assessment & Modelling	Months 29–34	Life Cycle Assessment (LCA), energy and carbon footprint analysis; statistical and ML-based modeling
Phase VI: Validation, Writing & Publications	Months 35–48	Validation of results, thesis writing, journal publications, thesis submission and defense



Name of the Research Scholar: Mr. Syed Ilyas Mohiuddin

Department: Physics

Name of the Supervisor: Dr.Mohd.Khalid Mubashir Uz Zafar

Name of the University from which pursuing the Ph.D: Rayalaseema University

Title of the Thesis (Tentative): Fabrication of Metal Oxide Sensors and Sensitivity Studies in Relation to Human Body Fluid Odours.

Briefing about the Work

1. Introduction

Human olfactory systems are widely used worldwide to evaluate various products. Food odours, including those of grain, wine, cheese, whisky, and fish, are analysed to assess their intrinsic quality and freshness. We also evaluate fragrances and deodorants to ascertain their olfactory desirable qualities. The disorder destabilises the physiological functioning of the human body. When disease stimulates novel and distinct metabolic processes in the body, these actions can result in the synthesis of tiny volatile compounds. The bloodstream has the ability to convey these unstable compounds to the respiratory system, therefore liberating them through exhalation, urine, and sweat. Therefore, clinicians can use the sense of smell to non-intrusively detect prevalent diseases in the human body. As part of my research, I produced metal oxide sensors using TiO 2 -MnO 2 , Pd-doped TiO 2 -MnO 2 , ZnO-MnO 2 , Pd-doped ZnO-MnO 2 , CuO-doped SnO 2 , SnO 2 , TiO 2 , and ZnO materials and investigated their sensitivity to odours in human body fluids.

2. **Need and Importance of Research Problem**

Olfactory perception is highly esteemed by physicians. Doctors can employ a chemical sensor, such as a metal oxide sensor, as a diagnostic instrument to analyse odours in human body fluids, thereby non-invasively detecting any issues and avoiding the necessity for laborious laboratory findings.

3. Methodology

3.1 Sensor fabrication process

1. First the sensing material is taken in powder form.
2. Secondly, the material is ground in the presence of distilled water or ethyl alcohol.
3. The ground material is mixed with polyvinyl alcohol to make a paste. The slurry is then coated on an alumina tube substrate provided two with two copper or silver electrodes.
4. The sensor is then subjected to sintering to make the film rigid. After sintering the sensor is ready for subjecting it to odours

3.2 Measurement of sensitivity

Secondly, the study of the sensitivity of the sensor to odors from human body fluids is done by connecting the sensor in series with the standard resistance and a dc voltage is applied across them. A digital voltmeter is connected across the sensor and a digital ammeter is connected in series with the sensor. Now the sensor can be exposed to odors of human fluids to measure the sensitivity.



Inaugural session Dignitaries on the Dias



Address by Dr. S. Srinivas Rao,

Principal, MJCET



Address by Dr. Mahipal Singh R,

Director, MJCET



Group photograph of the participants with Director, Principal, Registrar, Dean- Academics and HoD's of MJCET

Key Research Insights

The Top Research Innovations of 2025–2026 reflect a growing convergence of artificial intelligence, biotechnology, advanced materials, clean energy and climate science. Major advances include AI-driven scientific discovery and autonomous laboratories, AI-designed drugs and proteins, precision medicine and advanced gene technologies, quantum and photonic computing, next-generation batteries and clean-energy systems, carbon-negative materials and carbon-removal technologies, atmospheric water harvesting, advanced robotics and medical micro-robots, and AI-enabled climate and environmental monitoring. Together, these innovations are transforming how research is conducted while addressing critical global challenges such as healthcare, energy security, climate change, resource scarcity, sustainable development and human well-being.