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Recent Advancements in Applied Science and Engineering, RAASE - 2026

3 - Day National Conference

16-18 March 2026

E-Book of Abstracts

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Preface

The *3-Day National Conference on Recent Advances in Applied Science and Engineering (RAASE 2026)*, organized by Jawaharlal College of Engineering and Technology, Palakkad, serves as a multidisciplinary platform to bring together researchers, academicians, industry professionals, and students to share and discuss emerging trends in science, engineering, and allied domains. The primary objective of the conference is to foster innovation, encourage knowledge exchange, and promote collaborative research addressing contemporary technological and societal challenges.

The theme of the conference reflects the growing need for sustainable development, advanced scientific exploration, and the integration of technology with human values. With focused tracks on *Engineering and Technology for Sustainable Development*, *Advances in Applied Sciences and Mathematics*, and *Humanities, Social Sciences, and Communication Studies*, the conference highlights the importance of interdisciplinary approaches in solving real-world problems. Topics such as renewable energy systems, artificial intelligence, smart infrastructure, nanotechnology, mathematical modelling, and the socio-cultural implications of technology underline the relevance and timeliness of the conference.

This e-book of abstracts presents a carefully selected collection of 112 research contributions spanning diverse domains. The submissions reflect significant advancements in areas including aerospace engineering, composite materials, propulsion systems, IoT and digital twin technologies, machine learning applications, environmental engineering, and sustainable infrastructure. In addition, contributions from applied sciences and mathematics explore developments in nanomaterials, chemical synthesis, statistical modelling, graph theory, and computational techniques. The volume also captures valuable insights from humanities and social sciences, addressing themes such as artificial intelligence in education, cultural studies, communication, sustainability practices, and the evolving relationship between technology and society.

The wide range of topics and the interdisciplinary nature of the contributions demonstrate the active participation of researchers from various regions and institutions. The abstracts included in this volume not only showcase current research efforts but also indicate future directions in science, engineering, and societal development.

We believe that this compilation will serve as a valuable reference for researchers and practitioners, and will contribute to ongoing discussions and innovations in the respective fields.

Editor & Conference Convener

About the Organizing Institution

Established in 2008 under the Nehru Group of Institutions, **Jawaharlal College of Engineering and Technology** (JCET), Lakkidi, is a well-recognized autonomous institution affiliated with A. P. J. Abdul Kalam Technological University. The institution is known for its strong commitment to academic quality, innovation, and continuous improvement in higher education.

JCET has been accredited with an NAAC A+ grade and holds NBA accreditation for its B.Tech programmes in Computer Science and Engineering, Aeronautical Engineering, Civil Engineering, and Electronics and Communication Engineering. The institution is also certified under ISO 9001:2015, reflecting its adherence to quality management standards in education and administration.

As a notable milestone, JCET is the first engineering college in Kerala to introduce a B.Tech programme in Aeronautical Engineering, marking its leadership in advancing specialized engineering education in the region. The institution emphasizes industry-oriented learning, research-driven practices, and the overall development of students, preparing them to meet evolving technological and societal needs.

With a focus on innovation, skill development, and academic excellence, JCET continues to contribute to the growth of competent engineering professionals and future leaders.

About the Conference

The *3-Day National Conference on Recent Advances in Applied Science and Engineering (RAASE 2026)*, organized by Jawaharlal College of Engineering and Technology, Palakkad, is conceived as a dynamic platform for the exchange of knowledge, ideas, and innovations across diverse academic and research domains. The conference aims to bring together researchers, academicians, industry experts, and students to present their work, engage in meaningful discussions, and explore collaborative opportunities that address emerging scientific and technological challenges.

The primary objectives of the conference include promoting interdisciplinary research, encouraging the dissemination of recent advancements, and fostering innovation that contributes to sustainable development. It also seeks to bridge the gap between theoretical research and practical applications by providing a forum for presenting novel methodologies, technologies, and solutions relevant to contemporary issues.

The conference is structured around three major themes: *Engineering and Technology for Sustainable Development*, *Advances in Applied Sciences and Mathematics*, and *Humanities, Social Sciences, and Communication Studies*. These themes encompass a wide range of focus areas such as renewable energy, artificial intelligence, IoT, smart infrastructure, materials science, nanotechnology, mathematical modelling, computational techniques, and the societal and cultural implications of technological advancements. This thematic diversity reflects the growing importance of integrated and multidisciplinary approaches in research and innovation.

The significance of RAASE 2026 lies in its ability to create a convergence of ideas from multiple disciplines, enabling participants to gain broader perspectives and insights. The conference contributes to the advancement of knowledge by showcasing current research trends, encouraging academic excellence, and supporting the development of solutions that are both technologically sound and socially relevant. It also plays a vital role in nurturing young researchers and strengthening the research ecosystem by facilitating dialogue between academia and industry.

Message from the Chairman

It gives me immense pleasure to extend my warm greetings to all the participants, researchers, academicians, and industry professionals associated with the 3-Day National Conference on "Recent Advances in Applied Science and Engineering (RAASE 2026)", organized by Department of Basic Science and Humanities, Jawaharlal College of Engineering and Technology during 16–18 March 2026**.**

The conference, centered on the themes Engineering and Technology for Sustainable Development; Advances in Applied Sciences and Mathematics; and Humanities, Social Sciences, and Communication Studies, highlights the interdisciplinary nature of modern research and the importance of collaborative academic engagement. Such initiatives provide valuable opportunities for scholars and professionals to exchange ideas, present innovative research, and strengthen the culture of academic excellence.

I am pleased to note that an appreciable number of participants were there across India, along with representatives from industry. The wide participation reflects the growing interest in applied science and engineering research and strengthens academic collaboration across regions.

I extend my sincere appreciation to the organizing convener, and committee members, faculty members, and students of Jawaharlal College of Engineering and Technology for their dedicated efforts in successfully organizing this conference. I also convey my best wishes to the distinguished speakers, invited guests, and all participants who contributed their valuable research insights to this academic gathering.

I am confident that RAASE 2026 has provided a meaningful platform for intellectual exchange and has encouraged new ideas, collaborations, and advancements in applied science and engineering. I congratulate the organizers for bringing out this e-Book of Abstracts, which will serve as a useful academic reference for researchers and scholars. I wish the organizers and participants continued success in their future research endeavors.

Adv. Dr. Krishnadas

Honorary Trade Commissioner of Mauritius - India

Chancellor, P K Das Deemed to be University, Tamilnadu

Chairman and Managing Trustee, Nehru Group of Institutions

Message from the CEO & Secretary

It gives me great pleasure to convey my greetings to the organizers, participants, and distinguished guests of the 3-Day National Conference on “Recent Advances in Applied Science and Engineering (RAASE 2026)”, organized by Department of Basic Science and Humanities, Jawaharlal College of Engineering and Technology during 16–18 March 2026.

In the present era of rapid technological advancement and interdisciplinary research, conferences such as RAASE 2026 provide an important platform for researchers, academicians, and industry professionals to share their ideas, present innovative findings, and engage in meaningful academic discussions. The focus of this conference on Engineering and Technology for Sustainable Development; Advances in Applied Sciences and Mathematics; and Humanities, Social Sciences, and Communication Studies reflects the need for collaborative research across diverse fields.

I am pleased to learn that 120 papers were presented from various states across India, along with contributions from industry. Such wide participation highlights the growing interest in research and knowledge sharing across institutions and regions.

I appreciate the sincere efforts of the Convener and the organizing committee members for successfully conducting this conference and for bringing out this e-Book of Abstracts, which will serve as a valuable reference for scholars and researchers.

I am confident that the deliberations and research contributions presented during this conference will inspire further innovations and collaborations in the fields of applied science and engineering. I extend my best wishes to the organizers and participants for continued success in their academic and research endeavors.

Dr. Krishnakumar

Pro - Chancellor, P K Das Deemed to be University, Tmailnadu

CEO & Secretary, Nehru Group of Institutions

Message from the Principal

JCET inherits the habit of research and development at all levels starting from students, PG scholars, and PhD scholars. We appreciate the efforts taken by the Department of Basic Science and Humanities for putting up a National Conference RAASE 2026. The organizing committee really put a lot of efforts to collect papers from across the national level. The choice of the speakers and guests is a reflection of the meticulous planning. While, core technologies are important in research, the focus on science, technologies, engineering, and mathematics (STEM) helps to sustain the research in a multi-disciplinary way. The influence of people in the conference would really make a network for the department of BSH to strengthen the research areas.

Congratulations and best wishes.

Dr. N Gunasekaran

Principal

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Message from the IQAC Director

It is a privilege to present this message in the e-Book of Abstracts for the 3-Day National Conference on “Recent Advances in Applied Science and Engineering (RAASE 2026),” organized by the Department of Basic Science and Humanities, Jawaharlal College of Engineering and Technology, from March 16–18, 2026. This abstract book showcases a valuable collection of research contributions aligned with the key themes of the conference: Engineering and Technology for Sustainable Development, Advances in Applied Sciences and Mathematics, and Humanities, Social Sciences, and Communication Studies. These themes reflect the importance of interdisciplinary approaches in addressing current scientific, technological, and societal challenges. I am pleased to note that 120 research papers have been shortlisted from scholars representing various states of India, including Kerala, Tamil Nadu, Karnataka, Rajasthan, and Assam, along with participation from industry. This diverse contribution highlights the growing importance of collaborative research and knowledge sharing across disciplines.

The Internal Quality Assurance Cell (IQAC) of our institution continuously strives to enhance academic and research quality through initiatives such as conferences, workshops, and research collaborations. The organization of RAASE 2026 reflects our commitment to fostering innovation, strengthening academic standards, and promoting meaningful engagement between academia and industry. I congratulate the organizing committee for their dedicated efforts in successfully compiling this abstract book and conducting the conference. I am confident that this collection of abstracts will inspire further research, encourage new ideas, and contribute to academic excellence. I look forward to the valuable insights and outcomes emerging from this conference.

Dr. C Gajendran

Director, IQAC & Vice Principal

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Message from the Convener

The Department of Basic Science and Humanities at Jawaharlal College of Engineering and Technology, Palakkad, Kerala, takes pride in successfully organizing the National Level Conference, RAASE 2026.

The organizing team - Mrs. Dayana K, Mrs. Dhanya P. B, Mrs. Ramya P, Mrs. Vishnudatha K, Mr. Sathyajith, Mrs. Farzana K. T, Mrs. Sreevidya P, Mrs. Sandhya N. S, Mrs. Rajini K, Dr. Smitha T. G, Mrs. Karthika K, and Mrs. Suchitra Rejith - demonstrated exceptional commitment and coordination in planning and executing the conference, held from 16–18 March 2026. Their sustained efforts over several months, including communication with contributors and seamless management of the three-day event, ensured its success.

The team's dedication extended beyond the conference through the timely distribution of certificates, meticulous editing of this book of abstracts, and the maintenance of high academic and organizational standards.

On behalf of the management, the Principal, and IQAC, I extend my heartfelt congratulations and sincere appreciation to the entire team for their exemplary teamwork and commitment in organizing this significant event, which brings together Humanities, Science, and Engineering in the pursuit of sustainable development.

Dr. Prasad P

Professor and Head

Department of Basic Science and Humanities

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

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JCET/RAASE2026/ETSDT101

Smart Neuro-Posture Neckband for Integrated Posture Monitoring and Neuro-Relaxation Feedback

Aaranya Narayanan, Aima T V, Gopika K V, Gopika P V

Department of Biomedical Engineering, KMCT College Engineering for Women, Kalanthode, Kozhikode, Kerala

aaranyaan@gmail.com

Abstract

Poor neck posture and prolonged forward head positioning have become increasingly common due to extended use of smartphones, laptops, and desk-based work. This condition not only causes musculoskeletal discomfort and cervical strain but may also influence physiological parameters such as heart rate variability and stress levels. Addressing both mechanical posture correction and physiological well-being simultaneously remains a significant challenge in wearable healthcare technology. The proposed Smart Neuro-Posture Neckband aims to provide an integrated solution for real-time posture monitoring, physiological assessment, and neuro-relaxation feedback using multi-sensor fusion techniques. The system combines an MPU-9250 inertial measurement unit to detect neck orientation and movement, a flex sensor to measure cervical bending angles, and a MAX30102 sensor to monitor heart rate and SpO_2 levels. Data from these sensors are processed using a microcontroller-based fusion algorithm to accurately detect poor posture patterns and stress-related physiological variations. Experimental testing was conducted by collecting posture angle data and heart rate readings under various head positions and activity levels. The device successfully identified forward head tilt beyond predefined thresholds and correlated it with slight physiological changes during prolonged strain. When improper posture was detected, a built-in vibration massager provided gentle feedback to encourage correction and relaxation. The findings demonstrate that integrating biomechanical and physiological monitoring within a single wearable platform enhances accuracy and user awareness compared to single-sensor systems. The proposed neckband offers a compact, non-invasive, and user-friendly approach for continuous posture correction and stress management. This innovation has potential applications in occupational health, student well-being, rehabilitation, and preventive healthcare monitoring.

Keywords: Smart Neuro-Posture Neckband, Posture Monitoring, Multi-Sensor Fusion, Wearable Healthcare Technology, Cervical Spine Alignment, MPU-9250, MAX30102, Flex Sensor, Heart Rate and SpO_2 Monitoring, Neuro-Relaxation Feedback System

JCET/RAASE2026/ETSDT102

Solar Powered Dynamic Wireless Charging Corridors for EV Shuttles

Dr. Suman Kundapura, Pavithra K, Sudharshan V S

A J Institute of Engineering and Technology, Mangaluru, Karnataka

sumankundapura@ajiet.edu.in

Abstract

The "Solar-Powered Dynamic Wireless Charging Corridors for EV Shuttles" project presents a functional prototype developed to overcome key challenges in electric vehicle (EV) transportation, including limited driving range, frequent charging stops, and dependence on conventional energy sources. An extensive literature review was done and found that the system addresses major issues in renewable energy integration and wireless power transfer, such as coil misalignment, electromagnetic interference, and transmission losses. The prototype utilizes 10W, 12V photovoltaic solar panels to generate clean, renewable energy, which is supplied to resonant inductive transmitter coils embedded beneath the pavement. These coils wirelessly transfer power to receiver coils mounted on the moving shuttle, enabling continuous charging without halting operations. ESP32 microcontrollers function as the system's control hub, managing coil activation, energy regulation, communication, and sensor-based monitoring of voltage levels. An integrated mobile application developed using Flutter enables real-time monitoring of voltage fluctuations and provides essential vehicle control features. The pavement design includes cutting trenches within the base layer to embedded coils and wiring securely, followed by resurfacing with asphalt to maintain durability and uninterrupted charging performance under traffic loads. This prototype demonstrates the feasibility of combining renewable solar power with dynamic wireless charging technology as a transformative solution for future EV infrastructure.

Keywords: Solar-Powered, Electric vehicles, Pavements, Dynamic Wireless Charging, Smart Corridors

JCET/RAASE2026/ETSDT103

Predictive maintenance & Control of DC Motor & Transformer using IOT & Digital Twin Integration

Chaitrashree S R, Rakshitha Hiremath, Sanjibani Mishra, Sparsha N, Ranjitha M

GSSS Institute of Engineering & Technology for Women, Mysore, Karnataka

chaitrashree@gsss.edu.in

Abstract

Industrial electrical machines, such as transformers and DC motors, are prone to failure due to the inability to continuously monitor their condition and detect faults on time. Maintenance of industrial machines is currently performed according to a fixed schedule with prompt periodic inspections, which can lead to increased downtime and greater operational risks. This paper presents a real-time monitoring and control solution for DC motors and transformers using an IoT-based predictive maintenance system integrated with digital twin technology. With the combination of sensors (INA219 for voltage and current, NTC thermistor for temperature, and optical encoder for RPM) connected to a NodeMCU ESP8266 microcontroller, operational parameters will be collected and transmitted to a Python digital twin platform developed using OpenCV to visualize the data in real-time. A Logistic Regression machine learning model will classify whether or not the equipment is operating within normal ranges based on voltage, current, and speed deviations from their normal ranges. The system will provide remote control capability through relay-based switching. The results of the experiments show that this method accurately predicts machine problems, improves equipment reliability, and is good for use in industrial maintenance.

Keywords: IoT, Digital Twin, Predictive Maintenance, DC Motor Monitoring, Transformer Monitoring, Machine Learning, Logistic Regression, Remote Control

JCET/RAASE2026/ETSDT104

Agentic AI Predictive Maintenance

Rohit R, Sachin M

Department of Computer Science and Engineering, Sri Shakthi Institute of Engineering and Technology, Coimbatore, Tamil Nadu

rohitrangaraju847@gmail.com

Abstract

The Predictive Maintenance - AI Operations Center is an intelligent platform developed to monitor industrial machines, predict possible failures, and help organizations take maintenance actions before problems occur. In modern industries, unexpected machine breakdowns can cause significant production losses and increased maintenance costs. This system aims to reduce such risks by using advanced technologies such as machine learning, real-time data monitoring, multi-agent artificial intelligence, and a conversational AI assistant. By combining these technologies, the platform helps improve machine reliability, reduce downtime, and support better decision-making in industrial environments. The system simulates 20 industrial machines, and each machine contains 10 sensors that continuously track important operating parameters. These parameters include temperature, vibration, pressure, RPM, voltage, current, humidity, oil level, load, and acoustic noise. The sensor data is generated and updated every three seconds, allowing the system to monitor the condition of machines in real time. A Random Forest machine learning model processes this sensor data to estimate the probability of machine failure. Based on the predicted probability, the system categorizes the machine condition into Low, Medium, or High risk levels, helping engineers quickly understand the health status of the equipment. Another important feature of the platform is its multi-agent AI system. Different intelligent agents perform specific tasks such as analyzing predictions, detecting abnormal behavior, and recommending appropriate actions. Depending on the situation, the system may suggest actions such as continuing monitoring, reducing machine workload, scheduling maintenance, or performing an immediate shutdown to prevent serious damage. All predictions and decisions are recorded in the database to ensure transparency and future analysis. The platform also includes ZOYA, an AI assistant powered by a local Large Language Model. Engineers and managers can interact with ZOYA through natural language to understand prediction results, identify possible causes of failures, and even override faulty sensors when necessary. To improve the quality of responses, the system uses a lightweight vector memory mechanism that stores past events and retrieves relevant information during analysis. In addition, the system implements Role-Based Access Control (RBAC) to simulate an industrial management structure, including engineers, plant managers, vice presidents, and CEOs. A real-time dashboard provides a clear view of machine status, risk alerts, and system insights through an interactive industrial interface. Overall, this platform demonstrates how AI-based predictive maintenance can help industries move toward smarter, more efficient, and data-driven operations.

Keywords: Agentic AI, LLM, Machine Learning

JCET/RAASE2026/ETSDT105

Seismic Analysis and Evaluation of Diagrid Structures with Base Isolation

Megha Thomas, Alice Johny, M Gayathri Devi, Vincy Koshy

Department of Civil Engineering, Saintgits College of Engineering, Kottayam, Kerala

meghat.sm2426@saintgits.org

Abstract

Diagrid structures are well known for their ability to withstand lateral forces by maintaining architectural flexibility. But despite these advantages, diagrid structures exhibit high base shear, which results in an increase in foundation cost. The study focuses on analyzing the performance of diagrid structures with the adoption of lead rubber bearing base isolators. A detailed parametric modelling of diagrid structures of varying angles was conducted in E Tabs to analyze the story drifts, time period, base shear, etc., along with a fixed structure. The analysis results indicate that incorporating base isolators in diagrid structures can reduce base shear along with reducing seismic demands. A considerable reduction in base shear was observed in all isolated models compared to the fixed-base configuration. Results demonstrate that the combination of diagrid structural systems with LRB base isolation provides enhanced seismic performance, characterized by significant reduction in base shear, increased structural flexibility, and improved energy dissipation during earthquake loading. The introduction of Lead Rubber Bearing (LRB) isolators significantly reduces the base shear of diagrid structural systems. Normally, diagrid structures save the cost of construction, as they avoid the need for periphery columns, but adopting base isolation in diagrid structures by suitable LRB can reduce the base shear up to 70%, which in turn saves the cost of heavy foundation. i.e., combining diagrid with base isolation can make the building more economical, especially in higher seismic zones.

Keywords: Lead Rubber Bearing, Diagrid, Base Shear, Story Displacement, Seismic Zone, Story Drift

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Collision Avoidance Strategies for Unmanned Aerial Vehicles Using Hybrid Path Planning Techniques

Dr. Ajith V S[1], Vidhya K[2]

[1]Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

[2]Sona College of Technology, Salem, Tamil Nadu

vs.ajith.aero@gmail.com

Abstract

Some of the most popular uses of Unmanned Aerial Vehicles (UAVs) include monitoring disasters, surveillance, infrastructure inspection, and logistics delivery. Since the amount of UAVs using shared airspace is constantly increasing, the possibility of collisions and hitting obstacles is a serious safety issue. The efficient collision avoidance systems are thus important in the safe and reliable autonomous UAV operations. The paper introduces a collision avoidance system of the UAV navigation which involves the combination of the techniques of obstacle detection and path intelligence in order to allow safe maneuvering in dynamic and complicated environments. The suggested solution unites a real-time method of detecting obstacles and the optimal approach to trajectory planning. The onboard sensors, which are environmental data like LiDAR, ultrasonic sensors, or vision-based systems, are being used to identify the surrounding obstacles and approximate the relative positions of these obstacles. UAV, on the basis of this information, analyzes the risk of collisions continuously and adjusts the pathway to sustain the required amount of safe distance. A hybrid path planning system is applied to come up with collision-free trajectories and minimize path length, energy use and flight time. The proposed model is mathematically formulated by taking into consideration its safety constraints and multi-objective optimization criteria to guarantee effective navigation. The performance of the proposed method of collision avoidance was tested in simulation studies within a three dimensional environment with stationary and moving obstacles. The findings show that the hybrid method will enhance the efficiency of navigation and will also drastically decrease the risk of collision as opposed to the standard reactive avoidance approaches. The resulting trajectories show a better transition between paths and are safer. The autonomous UAV based on the proposed framework can be used to assist search and rescue operations, aerial surveillance, and urban air mobility systems. The potential avenue in future studies will be to incorporate machine learning algorithms and multi-UAV coordination algorithms to improve collision avoidance in high aerial traffic scenarios.

Keywords: UAV, Collision Avoidance, Path Planning, Autonomous Navigation, Obstacle Detection

JCET/RAASE2026/ETSDT107

Multi-Scale Spectral–Spatial Convolutional Neural Network for Hyperspectral Image Classification

Vysak Valsan[1], Chithra K G[2]

[1]Dept of Electronics and Communication Engineering, Nehru College of Engineering and Research Centre, Thrissur, Kerala

[2]Dept. of Civil Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

vysakvalsan7@gmail.com

Abstract

In Remote sensing hyperspectral image (HSI) classification is an important due to its ability to identify land cover materials using rich spectral signatures captured across hundreds of adjacent bands. Conventional spectral-based classifiers, such as Support Vector Machines (SVM), make use of pixel-wise spectral information and often ignore spatial context, resulting in reduced performance in heterogeneous and mixed regions. Although convolutional neural networks (CNNs) have demonstrated significant improvements by incorporating spectral–spatial information there are many existing approaches which utilize a single fixed patch size which limit their ability to effectively capture contextual information at varying spatial scales. In this paper, a multi-scale spectral–spatial CNN framework is proposed to enhance hyperspectral image classification performance. The hyperspectral data is partitioned into multiple spatial patch sizes for capturing simultaneously fine local structures and broader contextual dependencies. Parallel convolutional streams are employed to extract hierarchical spectral–spatial features from each scale. The learned features are subsequently fused and fed into fully connected layers for final classification. This multi-scale approach enables improved discrimination between spectrally similar classes while preserving spatial continuity. The proposed method is evaluated using the Indian Pines hyperspectral dataset. Experimental results are compared with a traditional SVM classifier and a single-scale CNN model. Performance is assessed using Overall Accuracy (OA), Average Accuracy (AA), and Kappa coefficient. The results demonstrate that the proposed multi-scale approach achieves improved classification accuracy and enhanced class-wise consistency. The study highlights the effectiveness of multi-scale spectral–spatial feature learning for hyperspectral image analysis and provides a computationally efficient framework suitable for practical remote sensing applications.

Keywords: Hyperspectral Image, Spectral–Spatial Classification, Multi-Scale CNN, Patch-Based Learning, Indian Pines

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Design Analysis and Comparison of Wing Rib of ERCO Ercoupe with Various Cut-out Configurations

Haritha R S, Ardra P, Fathima Fidha K, Geethika K G, Dr. Ajith V S

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

fidabasheerdr@gmail.com

Abstract

The ERCO Ercoupe is a two-seat, light aircraft known to have a novel wing design and interconnected controls. The design of the interior parts of the wing especially the wing ribs dictates to a large degree the structural efficiency of the wing. Wing ribs ensure that the aerofoil profile is kept constant, and that aerodynamic load are transferred to the spars and that the wing structure offers stiffness to the overall structure with minimal structural mass. This paper is aimed at the structural design analysis of an ERCO Ercoupe wing rib by evaluating the impact of various cut out geometries on its performance. Computer aided design (CAD) is used to determine the original rib geometry and various cutout configurations are presented in order to test their structural efficiently. The cutout shapes that are taken into account in this paper are circular, elliptical, and patterned lightening holes. The Finite Element Analysis (FEA) is conducted to explore important structural parameters, including the stress distribution, deformation properties, and buckling. Besides, the impact of every cutout design on the total mass of the rib is examined. A comparative analysis is conducted to establish the effects of change in cutout geometry on structural performance and reduction of weight. The findings give information to the correlation between rib lightening plans and structural integrity. The paper has shown that cut out shapes that are optimized can substantially lower weight without causing any significant alteration in stress levels and structural stability. The findings will help in creating better aircraft wing structure lightweight design-based strategies without affecting the safety or aerodynamic functionality.

Keywords: Wing Rib Design, Finite Elementary Analysis (FEA), Lightening Holes, Stress Analysis, Aircraft Structures, Weight Optimization, Aerofoil Structure

JCET/RAASE2026/ETSDT109

Nature-Based Stormwater Engineering Solutions for Sustainable Reservoir & Catchment Management

Agalya G

Nehru College of Architecture, Palakkad, Kerala

agalyamarchlandscape@gmail.com

Abstract

The increase in impermeable surfaces such as roads and buildings in peri-urban watershed areas has significantly altered natural hydrological processes, resulting in increased stormwater runoff, reduced groundwater infiltration, sediment transport, water pollution and increasing other stormwater management challenges. Chembarambakkam Lake in Kancheepuram District, Tamilnadu, one of the major drinking water reservoirs supplying Chennai city, receives inflow from a large catchment area that has experienced considerable land-use changes over the past three decades. These changes have intensified stormwater runoff during monsoon events, leading to overflow in downstream areas and causing flooding in Chennai city. This also leads to wastage of fresh drinking water in a larger quantity as the flooded water is released in sea. This study aims to explore the possibilities of improving hydrological stability using naturebased stormwater solutions. The research is based on the analysis of catchment characteristics, land use changes, and hydrologic flow characteristics. The major factors influencing stormwater runoff are identified using this research. Based on the outcomes of this research, bioswales, constructed wetlands, and riparian buffers are recommended as nature-based stormwater solutions. Bioswales, constructed wetlands, and riparian buffers placed strategically across the upstream catchment of the reservoir provide control of hydrological flow through designated pathways. These solutions provide a contribution to runoff reduction, infiltration increase, pollutant filtration, and sediment transport control before water finally drains into the reservoir. It has been established through this study that there is potential to use ecological solutions to support stormwater engineering to improve stormwater management, thereby improving water quality and environment in a very sustainable manner.

Keywords: Stormwater management, Nature-based solutions, Hydrological stability, Bio-swales, Constructed wetlands, Riparian buffers

JCET/RAASE2026/ETSDT110

Attention-Enhanced EfficientNetB0 for Multiclass Brain Tumor Classification Using MRI Images

Nayanaa Ajith, Anusha P K

Department of Statistics and Data Science, Christ University, Bengaluru, Karnataka

anushapk533@gmail.com

Abstract

Proper and effective detection of brain tumors is essential to develop a viable treatment schedule that will yield better treatment results. The Magnetic Resonance Imaging (MRI) is a type of imaging that is often used to diagnose brain tumours. Radiologists can be very time-consuming on the manual interpretation of images and this can result in inconsistency. This paper suggests a deep learning-based approach that can be used to classify multi-class brain tumors based on images that have been taken using an MRI scan. Three models were used to categorize the images of brain tumors, namely, a Convolutional Neural Network (CNN), EfficientNetB0, which was equipped with transfer learning, and EfficientNetB0 that was equipped with attention and Convolutional Block Attention Module (CBAM). All the models are tested on the Bangladesh Brain Cancer MRI Dataset with 6056 images of glioma, meningioma, and pituitary tumors classes. The use of data augmentation and transfer learning was done to enhance model accuracy and generalization. Based on the experimental findings, it is clear that the EfficientNetB0 that uses CBAM performs better with an accuracy of 97.47 percent on the test images and F1 score than the other models. The attention mechanisms incorporated have facilitated the model to target important areas of brain tumors to enhance accuracy and reliability of image classification. This study results prove the promise of deep learning models with attention mechanisms as aiding tools in the diagnosis of brain tumors and clinical decision-making.

Keywords: Brain Tumor Classification, Deep Learning, EfficientNetB0, Attention Mechanism (CBAM), MRI Image Analysis

JCET/RAASE2026/ETSDT111

Electric Pump Driven Cycle: Modernizing Upper Stage Engine

Aslamiya Abdulkharim, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

aslamiyaabdulkharim@gmail.com

Abstract

The ongoing innovation in space propulsion is mainly focused on efficiency, reliability, and cost-effectiveness. This topic explores the electric pump driven cycle as a transformative approach to upper stage rocket engine design. Unlike traditional gas generator or staged combustion cycles, the electric pump cycle uses high efficiency electric motors to drive propellant pumps, eliminating the need for complex turbomachinery powered by engine propellants. This shift not only simplifies engine architecture but also allows for more precise control, reduced mass, and increased reliability critical attributes for upper stage applications. The topic discusses the working principle, benefits, and current implementations of electric pump cycles, with case studies including Rocket Lab's Rutherford engine. It also evaluates the trade-offs in terms of battery energy density, thermal management, and scalability for future missions. By modernizing upper stage propulsion with electric pump technology, the space industry can achieve higher performance and flexibility in orbital insertion and deep space missions.

Keywords: Electric pump fed, Gas generator, Flexibility, Turbo machinery, Propulsion

JCET/RAASE2026/ETSDT112

Regression Rate of Hybrid Rocket Engine

Naveenkrishnan C, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

naveenkrishnan.c2004@gmail.com

Abstract

Hybrid rocket engines combine the best of both solid and liquid propulsion systems, offering safety, throttle control, and simpler designs compared to conventional engines. At the heart of their performance lies the regression rate the speed at which the solid fuel burns away. This single factor plays a major role in determining how much thrust the engine produces and how efficiently it operates. This study looks at what affects regression rate, from the type of fuel and oxidizer to the pressure inside the chamber and the shape of the fuel grain. Paraffin-based fuels, for example, burn faster and provide higher thrust but struggle with structural strength. To overcome such issues, techniques like vortex injection, swirl injectors, and innovative grain designs are explored to improve the way fuel and oxidizer mix during combustion. The work also highlights experimental methods to measure regression rates, such as burn-back profiling and mass loss testing. With the rise of additive manufacturing, even more advanced fuel grain designs are now possible, opening doors to tailored solutions for better performance. Ultimately, improving regression rate is key to making hybrid rockets more efficient, reliable, and ready for real-world applications in space exploration and commercial launches.

Keywords: Hybrid rocket, Vortex injection, Swirl, Regression rate, Paraffin based fuel

JCET/RAASE2026/ETSDT113

Review on Mechanical Characteristics of Composite Material

Sneha Sumesh, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

snhsmsh@gmail.com

Abstract

Composite materials have become an essential part of modern engineering because they combine the best qualities of different materials into one. They are lighter, stronger, and more resistant to harsh conditions, which is why industries like aerospace, automotive, marine, and construction rely on them. This paper focuses on understanding how composites behave under different conditions by looking at three key properties – tensile strength (resistance to pulling), flexural strength (resistance to bending), and impact strength (ability to absorb sudden shocks). The study also highlights how factors like the choice of materials, fiber orientation, and manufacturing techniques affect performance. Standard tests used to measure these strengths are discussed, along with insights from past research that shows how fillers and structural designs can improve results. By reviewing these aspects, this report emphasizes how a deeper understanding of mechanical and thermal behavior can help engineers design safer, stronger, and more efficient composite structures.

Keywords: Composite material, Tensile strength, Flexural strength, Fiber orientation, Thermal properties

JCET/RAASE2026/ETSDT114

Aramid Fiber in Hybrid Composites: Toughness, Impact Resistance, and Limitations in Aviation Sector

Gokul P Nair, Prajeesh Raj V

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

gn.nair2004@gmail.com

Abstract

Aramid fibres have come to play a critical role in current aerospace engineering due to their toughness, light weight, and resistance to impacts. When it is combined with other fibres like carbon or glass, they create hybrid composites that produce a balanced blend of toughness, stiffness, and durability. These composites are increasingly found in aircraft panels, fan blades, and it is protecting against damage, where safety and weight saving are equally important. Research indicates that the incorporation of aramid layers significantly enhances energy absorption as well as damage resistance, preventing sudden catastrophic failures in service. Yet, their application is not without issues, such as poor bonding with resin, water sensitivity, and poor performance in compression. High material expense and complex production processes further restrict extensive use. Research is aimed at addressing these challenges through enhanced fibre-matrix adhesion and the addition of Nano-reinforcements to enhance overall performance. On the basis of these developments, aramid-based hybrid composites are likely to contribute an increasing share to aviation in the future through safer, lighter, more efficient designs.

Keywords: Aramid Fibres, Hybrid Composites, Aerospace Structures, Impact Resistance, Composite Materials in Aviation

JCET/RAASE2026/ETSDT115

Synergistic Effect of Epoxy Glass Fibre Reinforced Composite Infused with Reduced Graphene Oxide (rGO)

Indhuja M, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

indhuyuvan21@gmail.com

Abstract

The combination of Reduced Graphene Oxide (rGO) and epoxy glass fiber-reinforced composites leads to significant improvements in mechanical, thermal, electrical, and stealth properties. Mechanically, rGO increases flexural strength by up to 62%, tensile modulus by around 27%, and impact resistance. This is mainly due to better crack-bridging, load transfer, and bonding at the microstructural level. Thermally, rGO boosts stability and raises the glass transition temperature because of its barrier effect and high thermal conductivity, which helps with effective heat dissipation. It also adds electrical conductivity to the typically insulating epoxy matrix, allowing for functions like strain sensing and electromagnetic interference (EMI) shielding. Additionally, rGO improves the composite's stealth performance by enhancing microwave absorption and lowering radar cross-section (RCS). This happens due to its electrical conductivity and high dielectric constant, which aid in turning electromagnetic energy into heat. SEM analysis shows even rGO dispersion and strong interfacial adhesion. Both are essential for maximizing performance. Overall, rGO serves as a multifunctional nano-reinforcement, resulting in lightweight, high-performance composites that are perfect for aerospace, defense, and other engineering applications.

Keywords: Reduced Graphene Oxide (rGO), Synergistic effect, Composites Materials, Radar cross-section (RCS), Stealth

JCET/RAASE2026/ETSDT116

Understanding the Sources and Impact of Errors in Inertial Navigation Systems

Abdullah Makkar, Dr. Gokul Nath R

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

abdullahmakkar1@gmail.com

Abstract

Inertial Navigation Systems (INS) are essential technologies for determining position, velocity, and orientation without external references. They are indispensable in aerospace, marine, defense, robotics, and autonomous vehicle applications where GPS or other external signals may be unavailable. The INS relies on Inertial Measurement Units (IMUs), composed of accelerometers and gyroscopes, to compute navigation parameters through continuous integration of measured acceleration and angular velocity. However, the accuracy of INS degrades over time due to sensor imperfections and accumulated errors. These errors include bias, scale factor deviations, random noise, and thermal drift, which collectively cause navigation drift and long-term instability. The challenge becomes critical in GPS-denied environments, where there are no external corrections to counteract drift. This study analyzes the sources and impact of such errors, examines how they propagate through navigation computations, and highlights their influence on real-world applications. Furthermore, it reviews state-of-the-art error modeling and mitigation techniques, including Kalman filtering, sensor fusion (GPS/INS integration), and emerging AI-based compensation methods. The findings underline the importance of precise calibration, advanced modeling, and intelligent correction mechanisms to enhance the reliability and accuracy of modern INS, especially in autonomous and mission-critical systems.

Keywords: INS, IMU, GPS, Accelerometer, Kalman filter

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Navigation in GPS-Denied Environments

Mashood NT, Dr. Gokul Nath R

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

mashoodnt164@gmail.com

Abstract

Global Positioning System (GPS) technology has revolutionized modern navigation across military, aerospace, maritime, and autonomous applications. However, GPS is not always available, reliable, or secure. Situations such as signal jamming, spoofing, interference, environmental blockage, and satellite malfunction can render GPS-based systems inoperative. These "GPS-denied environments" pose significant challenges for vehicles, robots, and personnel that depend on continuous, precise location information for safety and mission success. To overcome these limitations, researchers and engineers have developed a range of GPS-independent navigation techniques that rely on alternative sensors, environmental cues, and intelligent algorithms. This study explores various navigation strategies designed for GPS-denied scenarios, including Inertial Navigation Systems (INS), visual odometry, LiDAR-based navigation, radar systems, celestial navigation, magnetic anomaly mapping, collaborative navigation among multiple agents, and RF/beacon-based positioning. It also discusses the integration of these systems into hybrid navigation architectures that fuse data from multiple sources to enhance accuracy, robustness, and resilience. Applications across defense, aerospace, autonomous vehicles, and underwater or subterranean domains highlight the critical importance of reliable navigation beyond GPS. Furthermore, the report examines current challenges such as sensor drift, computational complexity, environmental dependency, and integration costs. It concludes by exploring future trends emphasizing artificial intelligence, machine learning, quantum sensors, and multi-sensor fusion. These emerging technologies promise to transform the future of navigation by enabling precise and autonomous operations in even the most hostile, GPS-denied environments. The ultimate goal is to ensure continuity, safety, and reliability of navigation across all domains—air, land, sea, and space—without dependence on GPS.

Keywords: INS, GPS, Lidar, RF/beacon-based positioning, Sensor drift

JCET/RAASE2026/ETSDT118

Theoretical and Experimental Methods to Measure Aerodynamic Performance

Rinshif K T, Dr A Anu Kuttan

Aeronautical Department, Jawaharlal College of Engineering and Technology, Palakkad, Kerala, India

vbrrinshif@gmail.com

Abstract

The study of aerodynamic performance is fundamental in engineering disciplines, particularly in aerospace and automotive design, where efficiency, stability, and safety depend on how effectively an object interacts with airflow. This seminar presents a comprehensive analysis of both theoretical and experimental methods used to measure and optimize aerodynamic performance. Theoretical approaches, including analytical techniques and Computational Fluid Dynamics (CFD), utilize mathematical models and numerical simulations to predict flow characteristics, such as lift, drag, and pressure distribution. These methods are cost-effective, allow rapid design iterations, and provide detailed insight into flow behavior under varied conditions. Conversely, experimental techniques - such as wind tunnel testing, real-world trials, and flow visualization methods like smoke, oil flow, and tuft testing - offer accurate, real-time validation of aerodynamic predictions. Although these experiments are more time-consuming and expensive, they remain essential for verifying theoretical results and understanding complex flow phenomena. The integration of theoretical simulations with experimental validation ensures precise evaluation of aerodynamic characteristics and aids in developing efficient, high-performance designs. The seminar concludes that combining both methods provides the most reliable framework for aerodynamic analysis, ensuring innovation, optimization, and safety in future engineering advancements.

Keywords: Lift, Drag, Computational Fluid Dynamics (CFD), Aircraft Performance, Wind tunnel

JCET/RAASE2026/ETSDT119

Experimental and Computational Analysis of Flow Stabilization in Supersonic Combustion

Adhithyan P V, Dr. Gokul Nath R

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

adhithyanpunathuvayal05@gmail.com

Abstract

Supersonic combustion, a cornerstone of scramjet propulsion systems, presents significant challenges in achieving stable and efficient combustion due to the extremely short residence time of the flow and the inherent instability of shock-flame interactions. This study presents a comprehensive analysis of flow stabilization techniques in supersonic combustion using both experimental investigations and computational simulations. In the experimental component, a model scramjet combustor was tested under varying Mach numbers and fuel injection strategies, with high-speed diagnostics employed to capture shock structures and flame dynamics. Concurrently, computational fluid dynamics (CFD) simulations were conducted using a reactive flow solver with detailed chemical kinetics to replicate and extend experimental observations. Key parameters such as fuel injection location, cavity geometry, and shock positioning were systematically varied to assess their effects on flame anchoring and combustion efficiency. Results demonstrate that flow stabilization is strongly influenced by shock-induced recirculation zones and the interaction between fuel jets and boundary layer separation. The combined approach not only validates computational models with experimental data but also provides deep insight into optimizing combustor configurations for improved flameholding. This dual-mode analysis supports the development of more reliable and efficient

Keywords: Supersonic, Scram jet, Combustor, Hypersonic propulsion, Flameholding

JCET/RAASE2026/ETSDT120

Lateral Dynamics in Motorsports: A Study of Cornering Forces

Dr. A Anu Kuttan, Lekshmi Prasad S

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

lekshmiprasad2005@gmail.com

Abstract

Motorsport vehicles are engineered to operate at the limits of physics, where cornering performance often determines race outcomes. This report focuses on the study of lateral dynamics in motorsport vehicles, emphasizing the complex interaction of forces experienced during cornering. In high-speed racing, cornering performance is crucial to overall vehicle stability, control, and lap time efficiency. The key forces influencing lateral dynamics include tire grip, downforce, centrifugal and lateral forces, and load transfer. Each of these factors contributes to how effectively a race car maintains traction and balance while navigating turns. The report also examines how parameters such as vehicle speed, suspension geometry, tire temperature, and aerodynamic setup affect these forces. A real world case study, analyzing Sebastian Vettel's2018 German Grand Prix crash, demonstrates the practical implications of lateral force imbalance under changing track conditions. Through theoretical analysis and reference to experimental studies, this seminar underscores that mastery of lateral dynamics is essential for designing high-performance, safe, and predictable race cars. By optimizing the balance between grip, aerodynamics, and load distribution, engineers and drivers can significantly enhance cornering performance where races are often won or lost.

Keywords: Cornering Forces, Drag, Down force, Aerodynamics, Tire grip

JCET/RAASE2026/ETSDT121

Role of Semi-Aerofoil Structures in High-Speed Combustion Stabilization

Adith Murali P, Gokulnath R

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

koyangaramurali@gmail.com

Abstract

The stabilization of high-speed combustion remains one of the key challenges in the design and operation of supersonic and hypersonic propulsion systems, such as scramjets and ramjets. Traditional flame-holding techniques often fall short under extreme flow conditions due to rapid flow velocities and short residence times. This seminar explores the role of semi-aerofoil structures in enhancing combustion stability in high-speed regimes. Semi-aerofoil geometries, due to their aerodynamic shaping, can generate controlled recirculation zones, reduce flow separation, and create low-velocity regions that promote flame anchoring. The report discusses the fundamental fluid dynamics behind these effects, including shock-boundary layer interactions and vortex generation. Emphasis is placed on both experimental and computational studies that demonstrate improved flame holding characteristics using semi-aerofoil flame holders. The integration of such structures presents a promising direction for achieving reliable and efficient combustion in advanced propulsion systems, with potential benefits including increased combustion efficiency, reduced ignition delay, and better thermal management. This seminar aims to provide a comprehensive overview of the design principles, operational mechanisms, and performance impacts of semi-aerofoil structures in high-speed combustion environments.

Keywords: Semi-aerofoil structures, Combustion stabilization, Flame holding, Flow splitters, Aerodynamic shaping

JCET/RAASE2026/ETSDT122

Synergistic Effect of Epoxy Glass Fibre Reinforced Composite Infused with Graphene Oxide

Indhuja M, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

indhuyuvan21@gmail.com

Abstract

The combination of Reduced Graphene Oxide (rGO) and epoxy glass fiber-reinforced composites leads to significant improvements in mechanical, thermal, electrical, and stealth properties. Mechanically, rGO increases flexural strength by up to 62%, tensile modulus by around 27%, and impact resistance. This is mainly due to better crack-bridging, load transfer, and bonding at the microstructural level. Thermally, rGO boosts stability and raises the glass transition temperature because of its barrier effect and high thermal conductivity, which helps with effective heat dissipation. It also adds electrical conductivity to the typically insulating epoxy matrix, allowing for functions like strain sensing and electromagnetic interference (EMI) shielding. Additionally, rGO improves the composite's stealth performance by enhancing microwave absorption and lowering radar cross-section (RCS). This happens due to its electrical conductivity and high dielectric constant, which aid in turning electromagnetic energy into heat. SEM analysis shows even rGO dispersion and strong interfacial adhesion. Both are essential for maximizing performance. Overall, rGO serves as a multifunctional nano-reinforcement, resulting in lightweight, high-performance composites that are perfect for aerospace, defense, and other engineering applications.

Keywords: Reduced Graphene Oxide (rGO), Synergistic Effect, Composites Materials, Radar cross-section (RCS), Composites

JCET/RAASE2026/ETSDT123

Flow Splitter Integration for Pressure and Velocity Regulation in Scramjets

Aswin Raj T K, Dr. Gokul Nath R

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

tkasin1213@gmail.com

Abstract

The efficiency of the operation of Scramjet (Supersonic Combustion Ramjet) engines is heavily reliant on the effective control of airflow parameters, such as pressure and velocity, in the combustor. This seminar report summarized research undertaken into the use of flow splitters as a passive way to control airflow parameters in air-breathing propulsion engines at high-speed. Flow splitters are placed in positions such as the engine inlet or isolator section to divide and steer incoming supersonic airflow, allowing the engine to avoid retention issues due to shock-induced flow separation, total pressure loss, and unsteady flow in the combustor. This work shows that the role of flow splitters, its impact on pressure and velocity regulation, can, stabilize combustion, and improve the efficiencies of the scramjet engine. This work represents an enhancement for future designs of scramjet systems to achieve sustained supersonic flight.

Keywords: Scramjet, Airflow, Combustor, Propulsion, Shock- induced flow separation

JCET/RAASE2026/ETSDT124

Hybrid Composites in Aircraft Interiors and Structural Components

Agnesh M C, Prajeesh Raj V

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

mcagnesh@gmail.com

Abstract

Hybrid composites represent a significant advancement in material science, engineered by combining two or more distinct fiber types - such as carbon, glass, aramid, or natural fibers - within a single matrix to achieve synergistic mechanical properties. Here it focuses on the strategic implementation of these materials to replace traditional metals in the aerospace industry, aiming to achieve substantial weight reduction, improved fuel efficiency, and lower emissions. A primary area of focus is sandwich hybrid structures, which bond high-strength fiber-reinforced face sheets to lightweight cores like honeycomb or foam, resulting in superior stiffness-to-weight performance and enhanced thermal and acoustic insulation. The versatility of hybrid composites allows for the customization of specific properties such as impact resistance, vibration damping, and fire compliance, making them suitable for both primary structural components - including fuselage skins and wing panels - and interior parts like floor panels and tray tables. While challenges such as delamination risks and higher initial production costs persist, the integration of eco-friendly reinforcements and innovative manufacturing techniques like additive manufacturing remains essential for developing next-generation, high performance, and sustainable aircraft

Keywords: Hybrid Composites, Sandwich Hybrid Composites, Aircraft Interior Components, Aircraft Structural Components, Matrix Materials, Fiber Materials

JCET/RAASE2026/ETSDT125

Design and Simulation of PID Based Altitude Control of UAV Using MATLAB

Mohammed Sameer T K, Arsha M R, Ashifa Yasmin V A, Jessica Varghese, Keerthana Anup

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

sameertk@jawaharlalcolleges.com

Abstract

A quadcopter is a type of Unmanned Aerial Vehicle (UAV) that uses four propellers to generate lift and control its motion. This configuration allows the vehicle to perform vertical take-off and landing, making it suitable for operating in limited or confined spaces. In this project, a classical PID controller is designed and simulated to control the altitude of a Crazyflie quadrotor using the Newton–Euler modeling approach. The PID controller is chosen because it is simple, widely used, and easy to implement in practical control systems. To study the behavior of the quadrotor, a nonlinear dynamic model is developed that represents its motion, particularly its altitude and position dynamics. Using the Newton–Euler formulation, the control strategy is designed to ensure stable hovering and accurate altitude control during vertical take-off. The controller is implemented in MATLAB/Simulink, and its parameters are tuned through a trial-and-error approach to obtain satisfactory performance. The simulation results indicate that the quadrotor successfully reaches the desired altitude and maintains it with very small overshoot and almost no steady-state error. This shows that a classical PID controller can effectively provide stable altitude control for basic quadrotor operations.

Keywords: Unmanned Aerial Vehicle (UAV), Quadcopter, Newton–Euler approach, PID controller, MATLAB/Simulink

JCET/RAASE2026/ETSDT126

Exploring Riblet and Dimple Synergy: Boosting Lift to Drag Ratio in Aircraft Wings

Chandana T Sudheer, Kailash Karunakaran

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

chandanasudheer8504@gmail.com

Abstract

In this research, it is found that using riblet and dimpled surface textures on an aircraft wing together provides a synergistic aerodynamic effect that will dramatically increase the wing's lift-to-drag (L/D) ratio. Riblets are very small grooves that mimic some natural designs to help smooth out the turbulent boundary layer flow and reduce skin friction drag. The intended function of dimples is to provide micro-vortices that increase the kinetic energy of the boundary layer to delay flow separation and reduce the amount of pressure drag caused by the flow going over the entire surface of the wing. By using riblets and dimples together, these passive lightweight microstructures alter different boundary layer flow mechanisms in a synergistic way ultimately producing a more controllable and energised turbulent flow. Based on empirical and numerical data collected from both wind tunnel testing and computational fluid dynamics they show that riblets and dimples alone reduce drag and improve lift; however, using the two together will produce up to 15% less total drag and an increase in the L/D ratio between 10- 20% compared to a smooth surface. Therefore, using riblets and dimples together will not only lead to improved aerodynamic performance and increased flight distance, but it will also lead to reduced fuel consumption and reduced emissions, thus providing riblet-dimple modifications as an attractive option in the quest for sustainable aviation improvement

Keywords: Riblets, Dimples, Boundary layer control, Passive flow control, Lift-to-drag ratio, Aerodynamic drag reduction

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Superhydrophobic Surfaces for Ice Prevention

Abhishek A

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

ab1he777178@gmail.com

Abstract

Ice formation on critical surfaces such as aircraft wings, wind turbines, power lines, and heat exchangers can compromise safety, efficiency, and structural integrity. Superhydrophobic surfaces, inspired by natural water-repellent systems like lotus leaves, provide a promising passive solution to mitigate ice formation. These surfaces combine low surface energy with micro- and nanoscale hierarchical roughness, creating a Cassie–Baxter state where air pockets reduce solid–liquid contact, delay nucleation, and promote droplet mobility. This report presents a comprehensive review of the principles, mechanisms, fabrication techniques, and characterization methods of superhydrophobic surfaces, emphasizing their anti-icing performance. Key fabrication approaches, including chemical coatings, etching, laser texturing, and hybrid methods, are discussed along with metrics such as water contact angle, sliding angle, and ice adhesion. Applications in aerospace, renewable energy, power transmission, self-cleaning, and water harvesting are highlighted. Challenges related to durability, mechanical wear, chemical degradation, environmental exposure, and cost are addressed, alongside future research directions focusing on robust, self-healing, multifunctional, and eco-friendly coatings. Overall, the report underscores the potential of superhydrophobic surfaces as an energy-efficient, versatile, and innovative approach to ice mitigation, while identifying critical limitations and pathways for industrial and environmental Implementation.

Keywords: Superhydrophobic surface, Ice formation, Energy efficiency, Natural water repellent

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Role of Core Materials and Nano-Additives in Enhancing Sound Insulation of Aerospace Panels

Daniel Shibu Varghese, Dr. A Anu Kuttan

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

danielshibuv@gmail.com

Abstract

Noise control and acoustic comfort have become key concerns in modern aerospace engineering, especially as aircraft evolve toward lightweight and sustainable designs. This study focuses on developing lightweight, mechanically robust sandwich composite panels capable of enhancing sound insulation in aircraft cabins. The research integrates hybrid composites - combinations of synthetic and natural fibers - with nano-additives and lightweight core materials to optimize sound insulation, particularly in the mid-frequency range of 500–2000 Hz, where passenger comfort and speech intelligibility are most affected. Traditional aircraft panels primarily use aluminium or honeycomb cores, which, while structurally efficient, often fail to provide sufficient acoustic damping without compromising weight and cost. The proposed solution utilizes hybrid composite structures made of glass fiber and jute fiber as skin layers, coupled with PET foam as the core material. The hybrid nature of the design leverages the mechanical strength of synthetic fibers and the natural damping properties of jute fibers, while the foam core provides both structural stability and sound absorption. Furthermore, nano-additives such as carbon nanotubes (CNTs) and graphene are incorporated to enhance the viscoelastic properties of the matrix, improve interfacial bonding, and increase the sound transmission loss (STL). These nanoparticles dissipate acoustic energy at the molecular level, leading to improved vibration damping and stiffness. The results of this study show that PET foam cores achieve a 20–30% increase in sound absorption compared to traditional honeycomb cores, while nano-additives further enhance STL by 10–15%. The hybrid panels are also approximately 30% lighter than conventional aluminum panels, aligning with aerospace trends toward sustainable, energy-efficient, and environmentally friendly materials. This report presents an in-depth discussion of the design, materials, and mechanisms involved in enhancing sound insulation through hybrid composites and nano-additives, highlighting their potential to revolutionize future aerospace cabin structures while maintaining compliance with stringent regulatory standards.

Keywords: Noise Control, Acoustic Comfort, Nano Additives, Hybrid Composites, Sound Insulation

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Design of a Passive End-Stroke Hydraulic Cartridge to Prevent Bottoming-Out in Telescopic Landing Gear

Mohammed Sameer T K, Kiran K J, Peramasani Pragna, Sivani P Raj, Sneha J

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

sameertk@jawaharlalcolleges.com

Abstract

Oleo-pneumatic landing gears systems which are mostly found in airplanes absorb the landing energy impact by the combination of compressed gas springs and hydraulic damping. In high landing rates, however, the range of conventional telescopic shock absorbers can be large and bottoming-out and large peak impact loads may occur. Even though the prior investigations have been dedicated to the enhancement of damping properties and the maximization of the stroke length, the analysis of passive processes that lead to the increased energy absorption during the end-stroke has not been thoroughly studied. In this work, reducing the strength of a landing landing gear strut is suggested through the provision of a passive hydraulic end-stroke cartridge in an oleo-pneumatic landing gear strut that enhances the energy dissipation during extreme landing conditions. In MATLAB, a simplified lumped-parameter nonlinear dynamic model, which is based on mass spring damper dynamics, is developed to model the behavior of the landing gear system. The controlling differentiation equation is resolved using numerical methods to estimate the strut response on impact. Besides that, a 3D CAD model is developed to show how the landing gear strut will be configured with the proposed cartridge. The results of simulations suggest that the presence of the hydraulic end-stroke cartridge causes the displacement to decrease at the peak and avoid bottoming-out in hard landing conditions, which enhance the overall impact absorption performance. This is an active modification which offers a practical and efficient improvement upon traditional oleo-pneumatic landing gear systems.

Keywords: Oleo-pneumatic landing gear, Telescopic shock absorbers, Damping, Cartridge, Bottoming, MATLAB

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Importance of Vibration Damping in Aircraft Structures

Nadamwar Yashaswi Mahesh, Prajeesh Raj V

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

yashaswinadamwar102@gmail.com

Abstract

The presence of vibration in aircraft structures is a constant phenomenon due to aerodynamic forces, the propulsion system, the environment, and the mechanical equipment on board the aircraft. If uncontrolled, these vibrations can cause structural fatigue, increased noise, passenger discomfort, and deteriorate the reliability of sensitive systems in different avionics. As the aviation technology is advancing and the need for lightweight and fuel-efficient aircraft is increasing, controlling vibrations has become one of the most important drivers for the design of aerospace structures. Improved vibration control also enhances structural integrity and improves aircraft durability, safety, and passenger comfort. This report discussed the study vibration implementation in different aircraft structures and different strategies to control vibration. It presents an overview of concepts related to vibration control and describes their significance in aerospace engineering. This study also classifies different vibration types and describes the principal sources of vibration in aircraft, e.g. propulsion system, aerodynamic forces, the landing gear assembly, the environment, and the auxiliary onboard equipment. This report aims to address various control strategies, as well as mechanisms to control vibration of structural systems. The report goes on to discuss various damping materials, including conventional metals, composites, and smart materials with enhanced vibration control capabilities. Among the various methods available for predicting vibration response, the report emphasizes the importance of analytical and numerical, and in particular, modal and finite element methods. The report also describes the experimental methods used to validate the analytical models. The overall focus of the report is on the need for the combination of advanced materials and modern analytical methods to obtain effective vibration control in contemporary aircraft structures.

Keywords: Structural vibrations, Smart materials, Shape memory alloys, Basalt fibre, Vibration damping

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Conceptual Empennage Design to Study its Downwash Characteristics and Reduce Induced Drag

Maria Issac, Nithya Niji, Sanjana K, Ziya Prakasan

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

mariapuravath04@gmail.com

Abstract

The empennage configuration of UAV's has a major role in determining it's stability and control. A U boom having non-conventional empennage configuration often experience limitations due to interference from wing wake and strong downwash region which inturn increases the induced drag. In this project ,we aim to design and analyse a conceptual design of split loop empennage which is a non planar tail configuration which helps to mitigate these effects and reduce induced drag.The proposed design includes the horizontal and vertical stabilizers which are designed into a symmetrical split loop structure. This results in better flow fields and reduces wingtip vortices and induced drag is reduced without affecting the stability of the UAV.The analysis of split loop shows greater advantage over conventional U boom configuration. This is a promising alternative for modern UAV designs.

Keywords: Split-loop empennage, Non-planar tail configuration, UAV stability and control, Induced drag reduction, Wing wake interference mitigation

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Carbon Black as a Functional Additive in Composite Materials

Abdul Wasif Khan

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

abdulwasifkhan005@gmail.com

Abstract

Carbon black, a fine elemental carbon powder produced through the incomplete combustion of hydrocarbons, serves as a critical multifunctional additive in the advancement of composite materials. This document explores the manufacturing processes—primarily the Furnace Black Process—and the unique properties that make carbon black indispensable in sectors such as electronics, automotive, and aerospace. By enhancing electrical conductivity, mechanical reinforcement, thermal conductivity, and UV protection, carbon black significantly improves the durability and performance of polymer, rubber, thermoset, and cementitious composites. Research highlights indicate that optimizing factors such as particle size, loading levels, and dispersion quality is essential for maximizing material efficiency. Recent studies demonstrate that incorporating carbon black into epoxy resins can enhance flexural strength and impact resistance, while its use in hybrid systems can lower percolation thresholds for improved conductivity. Despite challenges like particle agglomeration and viscosity impacts, the integration of carbon black with emerging technologies—such as graphene hybrid fillers and self-sensing "smart" composites—presents a pathway toward more sustainable and innovative material solutions. This synthesis underscores carbon black's role as a cornerstone of modern material science, driving progress in aeronautical safety and environmental sustainability.

Keywords: Carbon Black, Pyrolysis, Reinforcing Filler, Aggregate Structure, Aromatic Feedstock, Conductivity

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Polyurethane Form and Cork Cores in Composite Panels for Cabin Noise Reduction

Akash K, Dr. A. Anu Kuttan

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

akashkrish011@gmail.com

Abstract

Aircraft cabin noise greatly impacts passenger comfort, crew performance, and the overall in-flight experience. As aerospace design shifts toward lightweight structures to improve fuel efficiency and cut emissions, materials that effectively reduce noise without adding weight are necessary. Composite sandwich panels present a promising solution. They combine strong outer skins with lightweight core materials. Among potential cores, polyurethane foam and cork have received attention for their mechanical strength and sound-damping qualities. Polyurethane foam has a cellular structure with adjustable density and stiffness. This allows for efficient vibration dissipation and sound absorption, especially at mid- to high-frequency ranges produced by engines and airflow turbulence. However, its effectiveness at lower frequencies may fall short. Cork, sourced from Quercus suber, has a closed-cell structure, low density, and excellent natural damping properties. This makes it effective for sound absorption across a wider frequency range, including low frequencies. Studies suggest that hybrid systems, which combine foam and cork, can improve sound performance while preserving structural efficiency in quieter, lightweight aircraft cabin structures.

Keywords: Aircraft Cabin Noise, Composite Sandwich Panels, Polyurethane Foam, Cork Core Materials, Acoustic Damping, Sound Transmission Loss

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Design and Analysis of Morphing Wing Configuration using NACA 4412 Airfoil

Ninitha Biju, Pattil Yashwanth Reddy, Sneha M, Vismaya V

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

ninithabiju7@gmail.com

Abstract

The increasing demand for higher aerodynamic efficiency, reduced fuel consumption, and improved flight performance has led to the development of advanced wing concepts, among which morphing wings represent a promising solution. A morphing wing is designed to change its shape during flight allowing the aircraft to adapt to varying aerodynamic and operational conditions such as takeoff, cruise, and landing. Unlike conventional fixed-geometry wings, morphing wings enable continuous aerodynamic optimization, minimizing performance compromises across different flight regimes. In this project, the NACA 4412 airfoil is selected as the baseline configuration due to its high lift capability, cambered profile, smooth stall characteristics and suitability for low to moderate Reynold's number flows. The project involves the design of a baseline wing using the NACA 4412 airfoil, followed by the implementation of morphing techniques like camber variation.Geometric modifications are applied to the airfoil to simulate morphing behavior while maintaining aerodynamic smoothness and structural feasibility. Aerodynamic analysis is carried out using computational tools to evaluate key performance parameters such as lift coefficient, drag coefficient and lift to-drag ratio. The aerodynamic performance of the morphing wing is systematically compared with that of a conventional fixed wing to quantify the benefits of morphing. The study highlights how morphing wings can enhance lift during low-speed operations and reduce drag during cruise, leading to improved overall aircraft efficiency. This project demonstrates the practical application of advanced aerodynamic design. computational analysis, and smart wing concepts, contributing to future developments in UAVs military aircraft, and next- generation aerospace systems.

Keywords: Morphing wing, Airfoil, Camber Variation

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Joule Heating Mechanism in Carbon Based Composite Materials for De-Icing

Afna V S

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

afnavs824@gmail.com

Abstract

The Joule heating mechanism in carbon-based composites as a cutting-edge and energy-efficient method for de-icing applications is the main topic of this presentation. In the aviation, transportation, and energy industries, ice buildup on aerodynamic and structural surfaces still presents serious safety and performance issues. By directly turning electrical energy into heat using conductive filler networks, Joule heating provides a controlled and quick thermal response in contrast to traditional chemical or mechanical approaches. The electrical and thermal properties of polymer and carbon fiber composites are affected by carbon-based fillers like graphene, carbon black, and carbon nanotubes. The effects of various manufacturing methods, such as layer-by-layer assembly and direct mixing, on heating performance are examined. It is possible to engineer carbon-based composites to create materials that are sustainable, lightweight, and able to actively remove ice.

Keywords: Joule heating, Carbon black, Carbon based composites

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Design and Working Principles of Modern IMU and its Sensors

Ageela Shaji

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

jce22ao013@jawaharlalcolleges.com

Abstract

Inertial Measurement Units (IMUs) are essential electronic systems employed for motion detection in fields like navigation, robotics, aerospace, and wearable technology. In this seminar report, we look at the design and working of modern Inertial Measurement Units (IMU), which combine accelerometer, gyroscopes and magnetometers to measure linear acceleration, angular velocity and magnetic fields respectively to find its orientation and movement in three-dimensional space. The detailed working principles of each sensor are discussed as follows: Accelerometers measure inertial mass displacement by capacitive, piezoelectric or piezoresistive mechanism; Gyroscopes sense Coriolis effect in MEMS technology as well optical types (ring laser, fiber-optic type); Magnetometers detect the magnetic field of the earth for absolute heading. They can be categorized as scalar magnetometer and vector magnetometer. It discusses sensor limitations (noise, bias drift, and environmental interference), as well as calibration methods (for example Kalman filters, bias and scale factor corrections, temperature compensation). It offers a side-by-side analysis of IMU grades—consumer, tactical and navigation—highlighting differences in performance measures such as bias stability, random-walk behavior, cost and types of applications. IMUs are compact, provide real-time data and can function in GPS-denied environment, but suffer from problems such as error accumulation and need calibration. Recent literature regarding advanced calibration methods highlights how sensor fusion can maximally enhance navigation accuracy, while emphasizing the necessity of sufficient grade selection in practical implementation.

Keywords: IMU, GPS, MEMS, INS, GNSS

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Flora Tester and Learner (AI Based System)

Nakshatra S V, Nethra S P, Narmatha R

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

nakshatrameena6@gmail.com

Abstract

Flora refers to the plant life that grows in a particular region and plays an important role in maintaining ecological balance and biodiversity. Understanding plants, their growth conditions, and their interaction with the environment is essential for agriculture, environmental protection, and sustainable development. This project proposes the development of an AI-based system called “Flora Tester and Learner,” designed to function as an intelligent assistant that provides information about plants and agriculture when users ask questions. The Flora Tester and Learner system uses artificial intelligence and a plant knowledge database to deliver clear and useful information about different plants. Users such as farmers, students, researchers, and gardening enthusiasts can obtain details about plant features, scientific and common names in different regions, suitable seasons, soil requirements, and suitable areas for cultivation. The system can also provide information about plant diseases, symptoms, and preventive measures to support healthy plant growth. Another important function of this system is to support agricultural knowledge and plant cultivation practices. It can guide users on the steps required to grow plants, proper watering methods, sunlight requirements, and the use of bio-fertilizers and chemical fertilizers to improve soil fertility. The system can also provide information about hybrid plant varieties, growth and development stages, and modern agricultural techniques that help increase plant productivity. In addition, the Flora Tester and Learner system can share knowledge about the medicinal uses of plants, their economic value, and possible plant-based business opportunities such as plant nurseries, organic farming, and medicinal plant cultivation. It can also introduce users to emerging scientific ideas such as artificial photosynthesis and advanced farming technologies that may help improve agriculture in the future. This project aims to create a smart and user-friendly AI platform that makes plant-related knowledge easily accessible. By combining botanical knowledge with artificial intelligence, the Flora Tester and Learner system can help users learn more about plants, improve agricultural practices, and promote environmental awareness and sustainable development.

Keywords: Plant diseases, Cures, Complete info, AI based systems

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Aerodynamic Analysis and Drag Reduction Strategies for Hyperloop Pods in Near-Vaccum Tubes

Aarya R Nair, Akhil Krishna S R, Eashwar M R

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

reyanair1@gmail.com

Abstract

The Hyperloop system is an advanced concept of high-speed transportation on the ground, where the pods move within the low-pressure tube at near-transonic speeds. Though the environment is close to vacuum conditions, the aerodynamic issues arise due to the confined flow of the fluid. There is also the pressure increase on the nose of the pod and the risk of choking based on the blockage ratio. The paper presents the computation of the aerodynamic performance improvement of the Hyperloop pod using the nose surface porosity.

Keywords: Hyperloop Transportation, Pod Aerodynamics, Low Pressure Tube flow, Chocked flow, Pressure Distribution

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Multi Sensor Fusion Algorithms for Reliable Navigation

Arathi K C

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

arathikc5335@gmail.com

Abstract

Reliable navigation is essential for modern autonomous systems, ranging from aircraft, spacecraft, and unmanned aerial vehicles (UAVs) to self-driving cars, underwater drones, and mobile robots. Traditional navigation methods such as GPS provide high accuracy but are limited in environments where signals are obstructed, degraded, or intentionally denied. In such scenarios, Inertial Measurement Units (IMU) comprising accelerometers, gyroscopes, and magnetometers play a crucial role in enabling continuous motion tracking and orientation estimation. But each of these sensors has inherent limitations as they are susceptible to drift due to noise and can be impacted by environmental interference. In order to address these issues, multi-sensor fusion techniques are utilized. sensor fusion includes fusing readings from different sensors to utilize their complementary strengths as well as reduce weaknesses. Fusion approaches of centralized, distributed and hybrid along with Kalman filter, particle filter and Bayesian networks provide accurate state estimation under uncertain and noisy scenarios. This paper discusses the principles, fusion techniques, and algorithms with applications to aerospace, robotics, autonomous navigation, and defense. By integrating multi-sensor fusion, navigation systems have higher accuracy, robustness and reliability to work properly in GPS-denied and complex environments.

Keywords: IMU, UAV, GPS, Autonomous navigation, Kalman filter

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Flexural Tensile and Impact Strength Testing of Hybrid Composite Laminates

Adarsh N

Department of Aeronautical Engineering Jawaharlal College of Engineering and Technology, Palakkad, Kerala

nadarsh2004@gmail.com

Abstract

The evaluation of flexural, tensile, and impact strength properties is essential for understanding the mechanical performance of hybrid composite laminates used in structural applications. Hybrid composites are formed by combining two or more types of reinforcing fibers, such as glass, carbon, or natural fibers, within a single matrix system to achieve improved mechanical characteristics and cost efficiency. This study focuses on the experimental investigation of flexural strength, tensile strength, and impact resistance of hybrid composite laminates fabricated using suitable manufacturing techniques such as hand lay-up or compression molding. Standard testing procedures are followed to determine the load-bearing capacity, stiffness, energy absorption capability, and fracture behavior of the laminates under different loading conditions. The tensile test evaluates the ultimate tensile strength, modulus of elasticity, and elongation at break, indicating the material's ability to resist axial loads. The flexural test measures bending strength and flexural modulus, which are critical for applications involving transverse loads. The impact test assesses the toughness and energy absorption capacity of the composite when subjected to sudden loading. The results provide a comparative understanding of mechanical behavior and demonstrate the advantages of hybridization in enhancing overall structural performance for aerospace, automotive, and marine applications.

Keywords: Hybrid Composite Laminates, Tensile Strength, Flexural Strength, Impact Resistance, Mechanical Properties, Fiber Reinforced Composites, Structural Applications, Composite Materials Testing

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Dimples on Aircraft Wings: Types, Mechanism and Performance Enhancement

Anupama P, Kailash Karunakaran

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

panupama953@gmail.com

Abstract

The design of aircraft wings now incorporates dimples as a new aerodynamic feature which draws inspiration from the traditional golf ball design. The dimpled design creates an effect which energizes the boundary layer that exists as the airiest layer of air that touches the surface of the wing. The process generates small vortex structures which appear at the wing's skin. Vortices work to mix fast air from the free-stream with air that moves slowly in the boundary layer, which results in a delay of flow separation. The airflow breaks away from the wing during flow separation, which creates large wakes that increase pressure drag. Dimpels create a strong reduction of separation which results in lower pressure drag and better lift-to-drag (L/D) ratio in aircraft operations. Dimples possess value because they enable various design modifications. Engineers can change the shape from round shapes to square shapes and teardrop shapes while they select from small sizes to large sizes and shallow depths to deep depths with close space patterns and wide space patterns to study airflow. The different setups result in various vortex formed and pressure distributed through the system. Shallow dimples which stick close together work well for keeping streamwise vortices attached, while larger dimples need depth to produce stronger spanwise vortices which operate better in high-lift situations. The advantages of this product received confirmation through wind tunnel experiments and computational fluid dynamics (CFD) tests that used large eddy simulation (LES) models. The research results show that optimal dimple designs bring a 10 to 20 percent boost in airfoil performance at high angles of attack and during transitional flow stages which occur between takeoff and landing. Experimental dimple designs have been tested through real-world scenarios, which include dimpled patterns above flat surfaces.

Keywords: Boundary Layer Energization, Flow Separation Delay, Vortex Structures, Pressure Drag Reduction, Lift-to-Drag Ratio

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A Study of the Fabrication and Performance of Nitinol-Based Damping Composites

Amal Krishna K, Prajeesh Raj

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

amalkrishnak31@gmail.com

Abstract

Vibration control is a huge deal in aerospace and structural engineering. Too much shaking can quickly lead to structural fatigue, reduced performance, passenger discomfort, and in the worst cases, complete system failure. The trouble is that conventional materials like regular metals and polymers simply don't have enough built-in damping on their own. They let vibrations travel too freely, which is why researchers have been turning to advanced smart materials for better solutions. One of the most promising is Nitinol, a shape memory alloy that stands out because of its incredible superelastic behaviour and natural ability to dissipate energy. In this seminar, I'm excited to share our work on fabricating and testing Nitinol-based damping composites. The core idea is to combine Nitinol wires or thin strips with traditional fibre-reinforced polymers to create a hybrid material that actively fights vibrations. We carefully designed the material composition, choosing specific Nitinol percentages and fibre orientations to get the best balance of strength, lightness, and damping. The fabrication process involves precise embedding techniques: we lay up the carbon or glass fibre layers, strategically place the Nitinol elements, apply resin, and cure everything under controlled temperature and pressure to ensure perfect bonding without damaging the alloy's special properties. To evaluate real-world performance, we used standard vibration testing methods, especially impulse hammer testing. This lets us strike the composite panels and record their dynamic response — how quickly the vibrations die down and how much energy is absorbed. We also measured natural frequencies and damping ratios across different configurations. The results are impressive. Damping ratios improved by up to 40-50% in our tests, all while keeping the structure lightweight. This makes Nitinol-based composites ideal for aircraft fuselage panels, helicopter blades, satellite structures, automotive chassis components, and even high-precision machinery. They offer a practical way to build lighter, quieter, and more durable systems without adding extra mass or complex dampers.

Keywords: Nitinol, Damping Composites, Shape Memory Alloy, Vibration Control, Smart Materials, Composite Fabrication, Impulse Hammer Test, Aerospace Structures.

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History and Evolution of Composite Materials Over Aircraft Fuselage

Amruthesh V S

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

amrutheshvs@gmail.com

Abstract

The evolution of aircraft fuselage materials represents a relentless quest for lighter, stronger, and more durable structures, moving away from the early constraints of wood, fabric, and aluminum. While aluminum alloys offered significant strength, they eventually reached their limits due to weight penalties, susceptibility to fatigue cracking, and the constant threat of environmental corrosion. This led to a transformative shift toward composite materials, beginning with the introduction of fiberglass in the 1940s and progressing to the high-performance Carbon Fiber Reinforced Polymer (CFRP) era. These modern composites have revolutionized aerospace design by offering unmatched strength-to-weight ratios and the flexibility to tailor material properties to specific load paths, allowing engineers to create optimized structures that are both lighter and more resilient. The industry's maturity is best exemplified by flagship aircraft like the Boeing 787 and Airbus A350, where composites now make up 50% or more of the structural weight. These advancements were made possible by manufacturing breakthroughs such as Automated Fiber Placement (AFP) and the use of massive autoclaves to cure entire fuselage sections, which significantly reduce the need for rivets and fasteners. Despite these gains, the transition brings new operational realities; composite structures are prone to barely visible impact damage (BVID) and require specialized, often costly, repair techniques compared to traditional metals. Looking toward the horizon, the focus is shifting to sustainable aviation through the development of self-healing composites, recyclable thermoplastics, and Shape Memory Alloys (SMAs). These next-generation materials aim to autonomously repair micro-cracks and enable adaptive, morphing structures that further enhance aerodynamic efficiency. Ultimately, the journey of composite evolution continues to push the boundaries of innovation, ensuring that the next generation of aircraft is not only higher-performing but also more environmentally responsible.

Keywords: Composite Materials, Aircraft Fuselage, Carbon Fiber Reinforced Polymer (CFRP), Material Evolution, Monolithic Structure, Non-Destructive Testing (NDT), Nanocomposites, Self-Healing Materials, Shape Memory Alloys (SMA), Sustainable Aviation.

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AI Based Predictive Maintenance System for Turbofan Engine

Nehal Ann Joy, Shiya Rukkiya, Fathimath Afira K K

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

shiyarukkiyamn7@gmail.com

Abstract

Reliability of Aircraft Engines: Workshop Synopsis Airframe safety and reduction of operational cost rely on aircraft engine reliability. Classic, traditional maintenance mechanisms (reactive maintenance and scheduled preventive maintenance) are inefficient since they either act only after a failure occurs or conduct their operations regardless of the actual state/condition of the system. Predictive maintenance is more effective as it predicts the health condition of equipment using data-driven techniques and provides insight on potential failures in advance. This project implements Artificial Intelligence–powered predictive maintenance system for a turbofan engine using machine learning techniques. This system is using datasets CMAPSS (NASA's Commercial Modular Aero-Propulsion System Simulation) comprising of engine running parameters and a variety of sensor readings that were recorded over several operational cycles from simulated engines. In our case, both data sets have values between 0 and I which is why we can directly feed them into the HMM learning model. .The code implements a Long Short-Term Memory (LSTM) neural network using TensorFlow in Python to analyze time-series sensor data and predict the Remaining Useful Life (RUL) of the engine. Deep learning algorithms (e.g., confidence-boosted LSTM networks) can also be used to extract relevant composite features for predicting system lifetime based on residuals and/or degradation data. It is based on an algorithm that uses historical engine performance data to learn patterns about its operation and predict the life of stages remaining before failure. In addition, the developed system provides graphical visualization using Matplotlib for displaying engine health trends and prediction results. An outage notification mechanism is also integrated into the framework when the predicted RUL becomes less than a maintenance alarm threshold. It enables maintenance staff to intervene before critical failures arise. This analysis generated useful information from the data, as well as being able to quantify that data with accurate figures. This proposed predictive maintenance system is the type of tool that will help break the cycle of unexpected failures and excessive downtime while improving overall maintenance processes in modern aerospace systems.

Keywords: Predictive Maintenance, Remaining Useful Life (RUL), LSTM Neural Network, NASA CMAPSS Dataset, Aircraft Engine Monitoring, Machine Learning.

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Expander Cycle Propulsion for Advanced Upper Stage Rockets

Shalima L Madhu, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

shalimalmadhu@gmail.com

Abstract

The expander cycle is an important rocket engine cycle for cryogenic propulsion because of its high efficiency, reliability, and multiple restarts capability.This paper discusses on its working principle and variation of thermodynamic properties throughout its cycle.Thr importance of this cycle in cryogenics especially for space missions is focused.In addition,the difference between two expander cycles such as closed and open cycles are highlighted to show their operational difference.Finally, recent developments such as the use of LOX–methane propellants, hybrid expander concepts, and advanced manufacturing techniques are explored. These advancements show that the expander cycle continues to play an important role in the development of next-generation reusable and sustainable launch vehicles.

Keywords: Expander cycle, Cryogenic, Rocket engine cycle, Propulsion, Expander bleed cycle

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Experimental Investigation on Concrete with Partial Replacement of Cement by Rice Husk Ash

Ranjeet Kumar, Nitesh Kumar, Sandeep Kumar, Helen Rose A, D Mythili

Department of Civil Engineering, Excel Engineering College, Komara Palayam, Tamil Nadu

ranjeetkumar121356@gmail.com

Abstract

Concrete is one of the most widely used construction materials in the world, but the production of cement leads to significant environmental pollution due to high carbon dioxide emissions. In recent years, researchers have focused on using agricultural waste materials as partial replacements for cement to produce eco-friendly and sustainable concrete. Rice husk ash (RHA), a by-product obtained from burning rice husk, contains a high amount of silica and shows excellent pozzolanic properties. This study focuses on the experimental investigation of concrete cubes by partially replacing cement with rice husk ash at different percentages. The concrete cubes are prepared and tested for compressive strength at different curing periods such as 7 and 28 days. The main objective is to evaluate the mechanical properties, workability, and durability of concrete with rice husk ash. The results help in identifying the optimum percentage of RHA replacement that provides better strength and sustainability. The use of RHA not only improves the strength and durability of concrete but also reduces environmental pollution, promotes waste utilization, and lowers construction costs. This study contributes to the development of sustainable construction materials. This Project presents the study of Rice Husk Ash and problems of disposal of the Marble of RHA are also sort out to some extent. Compressive strength test are conducted on RHA mortar. The cube with RHA in various percentage, then properties like compressive strength are studied. Compressive Strength Test will carry for all the mix proportions and for all the replacement For compressive strength test will testing for 7, 14 and 28 days for all the replacements. The study giving comparative results for mortar compressive strength test. In this project we use mortar proportion 1:3, 1:4 and 1:5 and its replaced with R.H.A 0%, 5%, and 10%.

Keywords: Rice Husk Ash, Concrete, Partial Replacement of Cement, Sustainable Construction, Compressive Strength, Pozzolanic Material, Waste Utilization, Eco-friendly Concrete, Cement Replacement, Mechanical Properties of Concrete

JCET/RAASE2026/ETSDT147

Development of Climate-Responsive Flexible Pavement Using Phase Change Materials

Binusha Joby, Fathima Hibah Abbas, Irfan Rahman A, Anila S Unni, Sreya V

Department of Civil Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

sreyavsnair007@gmail.com

Abstract

Rapid climatic changes and temperature fluctuations have significantly affected the long-term performance of flexible pavements, leading to cracking, rutting, and early distress. This project focuses on the development of a climate-responsive pavement system by incorporating Phase Change Materials (PCMs), fly ash, and crumb rubber into the subgrade layer of black cotton soil. Paraffin wax is selected as the PCM due to its optimal melting point, high latent heat storage capacity, and economic availability. The objective of this study is to improve both thermal regulation and strength characteristics of subgrade soil under tropical climatic conditions. Laboratory investigations are carried out in accordance with IS codes to determine the physical and engineering properties of untreated and treated soil, including Atterberg limits, compaction, specific gravity, unconfined compressive strength, and California Bearing Ratio (CBR). The modified soil samples are then subjected to thermal analysis using MATLAB to evaluate temperature variation and heat transfer across the subgrade layer. This integrated approach aims to reduce temperature-induced deformation, enhance load-bearing capacity, and extend pavement life. The outcome of this study is expected to contribute to the development of climate-adaptive pavement materials suitable for environmental conditions.

Keywords: Phase Change Materials, Paraffin Wax, Black Cotton Soil, Crumb Rubber, Fly ash

JCET/RAASE2026/ETSDT148

Realtime Project Cost Estimation Using Geospatial Tool

Anjana K S, Anju V, Malavika V V, Vinil Raj, Chitra K G

Department of Civil Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

kgchithra@jawaharlalcolleges.com

Abstract

Earthwork estimation is a crucialstep in highway construction as it directly influences project cost, planning, and resource management. Accurate estimation of cut and fill quantities is essential for the proper design and execution of highway projects. Traditional methods mainly rely on field surveys and manual calculations, which can be time-consuming and may lead to inaccuracies. With the advancement of geospatial technologies, Digital Elevation Models (DEMs) and Geographic Information Systems (GIS) provide a more efficient and reliable approach for terrain analysis and earthwork estimation. This study focuses on the earthwork estimation of a proposed greenfield highway alignment from Puthusseri West to Malampuzha Village-2 (10km). A Digital Elevation Model is generated to represent the terrain elevation of the study area. The DEM creation and spatial analysis are carried out using GIS, which provides tools for terrain modeling and volume calculation. Additionally, Google Earth Pro is used to identify and verify the reduced levels (RL) along the road alignment and to visualize the terrain conditions of the project area. By analyzing the elevation differences between the existing ground level and the proposed road formation level, the cut and fill volumes are estimated using GIS-based techniques. This approach improves the accuracy and efficiency of earthwork estimation compared to traditional methods and supports better planning and design of highway infrastructure. Keywords: GIS, DEM, Estimation, interpolation, terrain.

Keywords: GIS, DEM, Estimation, Interpolation, Terrain

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Automated Detection of Rose Leaf Diseases Using AI and Image Processing Techniques

Abdul Adhil M, Alwin Joshy, Amal Krishna Rajagopal, Sree Sankar J

Department of ECE, Nehru College of Engineering & Research Centre, Thrissur, Kerala

sreesankar.ambatt@gmail.com

Abstract

Rose plants are highly susceptible to various fungal and bacterial diseases that significantly affect their growth and aesthetic value. Traditional methods of disease identification rely on manual inspection, which is time-consuming and requires expert knowledge. With the advancement of Artificial Intelligence (AI), image-based disease detection has emerged as an efficient and automated solution. This paper presents a comprehensive review of AI-based image analysis techniques for detecting leaf diseases in rose plants. It focuses on image processing methods, machine learning algorithms, and deep learning approaches such as Convolutional Neural Networks (CNNs). The study also discusses advantages, challenges, and future research directions in this domain.

Keywords: Artificial Intelligence, Leaf Disease Detection, Rose Plants, Image Processing, Deep Learning, CNN

JCET/RAASE2026/ETSDT150

Hybrid Composite Material for Aircraft Cabin Noise Reduction: Design and Performance Evaluation

Sivani P M, Dr. A Anu Kuttan

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

Aircraft cabin noise is a significant challenge in modern aviation. It directly affects passenger comfort, crew efficiency, communication clarity, and long-term health. The main sources of noise come from engine and aerodynamic vibrations, structural vibrations, airflow disturbances, and onboard systems. Traditional materials like aluminum and glass wool provide structural support, but they have limited abilities to dampen vibrations and insulate against sound, especially with strict weight limits in aircraft. As a result, developing lightweight, highperformance, and sustainable acoustic materials is necessary. This study looks into using hybrid composite materials to reduce noise in aircraft cabins. It does this through improved structural design and evaluating acoustic performance. Hybrid composites are made by combining two or more different reinforcing fibers within one matrix system to take advantage of their complementary features. By mixing synthetic fibers, such as glass or carbon, with natural fibers like jute, flax, or cork in sandwich panel structures, it is possible to achieve a better strength-to-weight ratio, improved damping features, and focused noise reduction in the mid-frequency range of 100 to 2000 Hz, which is common in aircraft cabins. The research looks at ways to combine materials like interply and intraply and interlaminar configurations. It also looks at how the direction of the fibers and the thickness of the layers and the type of core material and how the layers are bonded together affect how well the material blocks sound. To see how well these materials work the researchers use methods like Sound Transmission Loss and sound absorption coefficient measurements and modal and vibration analysis and Finite Element Statistical Energy Analysis modeling. New developments in using fibers to make composites are showing good results. These materials can help reduce vibration and are better for the environment. They can also meet the standards for fire safety. Keep their strength when treated properly. The researchers found that hybrid composite panels are a choice for making aircraft interiors. They are light and cost effective and good for the environment. These materials could be used in aircraft and business jets and urban air mobility systems and helicopters and military aircraft. Hybrid composite panels are a solution for next generation aircraft interiors. They provide a lightweight and cost effective and environmentally responsible solution. Hybrid composite panels have a lot of potential for use, in aircraft.

Keywords: Hybrid Composites, Aircraft Cabin Noise, Acoustic Insulation, Vibration Damping, Sound Transmission Loss, Sandwich Panels

JCET/RAASE2026/ETSDT151

Solid Fuel Grain Geometries in Hybrid Rocket Engines

Abhay Sapnesh Valiya Parambath, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

Solid fuel grain geometry is a critical design parameter in hybrid rocket engines, directly influencing their performance, stability, and safety. This report provides a foundational overview of various grain geometries and their operational effects. It explores how different shapes—including cylindrical, star, and finocyl impact the burning surface area, which in turn determines the thrust-time profile. By examining the advantages and disadvantages of each configuration, this analysis highlights the complex trade-offs between simplicity, thrust control, and manufacturing challenges. The report concludes that a thorough understanding of grain geometry, combined with advancements in material science and computational modeling, is essential for optimizing hybrid propulsion systems for a new generation of aerospace applications.

Keywords: Hybrid Rocket Engines (HRE), Solid Fuel Grain, Thrust-Time Profile, Regression Rate, Burning Surface Area (Ab), Computational Fluid Dynamics (CFD), Aerospace Propulsion

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Decades of Change: The Rise of Biofuels in Aviation

Surya K S, Dr. Sujesh G

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

The aviation industry is under increasing pressure to reduce carbon emissions while meeting global connectivity demands. Over the past decade (2015–2025), Sustainable Aviation Fuels (SAFs) have emerged as a practical alternative to fossil-based jet fuel, offering up to 80% reduction in lifecycle greenhouse gas emissions and full compatibility with existing aircraft engines. This study reviews key SAF technologies - HEFA-SPK, FT-SPK, ATJ, CHJ, and PtL - and traces major milestones, including early transatlantic biofuel flights, ICAO's CORSIA framework, and large-scale production initiatives. Case studies from KLM, United Airlines, and Qantas demonstrate SAF's feasibility for both long-haul and ultra-long-haul operations. While SAFs provide clear environmental and economic benefits, challenges such as high costs, feedstock limitations, and infrastructure gaps remain. The findings emphasize that sustained investment, innovation, and global policy alignment are critical to making SAFs a cornerstone of aviation's transition toward net-zero emissions.

Keywords: HEFA-SPK, FT-SPK, ATJ, CHJ, PtL

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Performance Parameters of Hybrid Rocket Engines

Anusha Rajesh, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

Hybrid rocket motors use a solid fuel combined with a liquid or gaseous oxidizer, making them safer and more versatile than traditional propulsion systems. A list of primary parameters controls their performance, such as total impulse, specific impulse, effective exhaust velocity, propellant use, combustion efficiency, as well as different thrust and mass ratios. All parameters contribute in distinctive ways to assessing efficiency, stability, and mission capabilities. This report consistently addresses these performance parameters, their importance, and their mutual dependence. It further discusses current research studies exploring enhancements in regression rates, combustion stability, and injector designs. The analysis suggests that understanding and optimizing performance parameters are key to the development of cost-effective, efficient, and reliable hybrid propulsion systems for space and defense missions.

Keywords: Hybrid Rocket Engines (HRE), Performance Parameters, Specific Impulse (Isp), Regression Rate, Combustion Efficiency, Oxidizer-to-Fuel (O/F) Ratio, Total Impulse, Thrust-to-Weight Ratio

JCET/RAASE2026/ETSDT154

Design and Analysis of Shawt-Savonius Horizontal Axis Wind Turbine

M Ramkumar, Kailash Karunakaran

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

The increasing global demand for renewable energy solutions has intensified research into efficient, low-cost wind energy systems suitable for urban and low-wind environments. The Savonius Horizontal Axis Wind Turbine (SHAWT) presents a promising alternative to conventional wind energy technologies by utilizing drag-based aerodynamic principles and horizontally mounted Savonius blades. This project explores the design, working mechanism, and performance optimization of SHAWT, focusing on critical design parameters such as blade shape, overlap ratio, rotor size, and tip speed ratio (TSR). Computational and experimental insights highlight its superior self-starting capability, compact size, and suitability for distributed power generation. The study further examines potential applications, performance enhancements, and real-world deployment strategies, underscoring SHAWT's role as a sustainable solution for decentralized renewable energy generation.

Keywords: Savonius rotor, Horizontal axis wind turbine, Renewable energy, Tip speed ratio, Urban wind harvesting

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Tribological Study on Wear of Composites

Pravya P S, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

Epoxy glass fiber reinforced composites enhanced with reduced graphene oxide (rGO), focusing on wear performance under ASTM G99 pin on disc testing conditions. Composite samples with varying rGO content were fabricated and tested to assess their wear rate and coefficient of friction under different loads and sliding speeds. The incorporation of rGO was found to improve wear resistance significantly by forming a stable transfer film and enhancing load-bearing capacity at the sliding interface. The improved interfacial bonding between the epoxy matrix, glass fibers, and rGO contributed to reduced material degradation and better energy dissipation during sliding. These results highlight the effectiveness of rGO as a nano reinforcement for improving the durability and tribological performance of fiber-reinforced polymer composites in high-friction applications.

Keywords: Epoxy composites, Reduced graphene oxide, Wear performance, Pin-on-disc testing, Tribological behavior

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Future Impacts of Savonius Horizontal Axis Wind Turbines

Patil Devyani Amod, Kailash Karunakaran

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

The urgent need for sustainable energy solutions has accelerated research into innovative wind turbines design, Among these, the Savonius Horizontal Axis Wind Turbine (SHAWT) has emerged as a promising technology due to its ability to operate efficiently under low wind conditions, simple construction. And low maintenance requirements. Unlike conventional Horizontal Axis Wind Turbines (HAWT), SHAWTs adapt the drag-based Savonius rotor into a horizontal configuration, combining compactness with energy efficiency. This seminar explores the potential applications of SHAWTs in powering remote airstrips, unmanned aerial vehicles (UAVs), and green aviation infrastructures. Through a review of existing research and technological advancements, the report highlights the advantages of SHAWTs in future aeronautical and renewable energy applications. The study also emphasizes their educational value for engineering students and their potential to play a pivotal role in advancing sustainable aviation and achieving global carbon-neutral goals.

Keywords: Sustainable energy, Savonius wind turbine, Low wind performance, Green aviation, Renewable energy applications

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Classification of Hybrid Rocket Engines and Regression Rate Enhancement Techniques

Abhiram B, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

Hybrid rocket propulsion offers a unique combination of safety, cost-effectiveness, and performance by integrating a solid fuel with a liquid or gaseous oxidizer. This study presents a systematic classification of hybrid rocket engines based on oxidizer type, fuel type, feed system, grain geometry, and injector mechanisms. It further emphasizes the limitations of conventional regression rates and explores various enhancement techniques such as port geometry modification, vortex induction, liquid-layer entrainment, and catalytic additives. Each method is analyzed in terms of combustion efficiency, thrust-time characteristics, and practical applicability, with paraffin wax and HTPB highlighted as primary fuel candidates. The findings indicate that regression rate enhancement plays a critical role in improving thrust performance and combustion stability, making hybrid propulsion a promising alternative for future space missions and advanced aerospace applications.

Keywords: Hybrid Rocket Propulsion, Regression Rate Enhancement, Combustion Efficiency, Thrust Performance, Grain Geometry, Paraffin Wax Fuel, Injector Design

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Parameters Affecting the Efficiency and Performance of Savonius Horizontal Axis Wind Turbines

Jovin Joseph Sartho, Kailash Karunakaran

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

The Savonius Horizontal Axis Wind Turbine (SHAWT) offers a simple yet effective way to harness wind energy, especially in areas where wind speeds are too low for traditional turbines. Unlike conventional designs that rely on lift, SHAWTs use curved, S-shaped blades to capture the wind's drag and convert it into rotational motion, which is then turned into electricity. Because of this design, they are easy to start on their own, even in light winds, and require no external power to begin generating energy. This paper explores the main factors that influence how well a SHAWT performs - such as the tip speed ratio, starting torque, blade shape, and curvature, overlap ratio, number of blades, and even environmental conditions like wind direction and turbulence. By understanding and optimizing these parameters, we can significantly improve the turbine's efficiency and energy output. Overall, SHAWTs provide a dependable, low-cost, and sustainable solution for small-scale power generation, making them an excellent choice for urban, remote, or off-grid locations.

Keywords: Savonius Horizontal Axis Wind Turbine (SHAWT), Wind Energy, Drag-based Turbine, Tip Speed Ratio, Energy Efficiency

JCET/RAASE2026/ETSDT159

Phase Change Materials for Passive Anti-Icing Applications

Abhinav Das, Dr. Sujesh G

Department of Aeronautical Engineering, Jawaharlal College Of Engineering And Technology, Palakkad, Kerala

Abstract

Ice accumulation on critical surfaces poses significant safety and operational challenges in aerospace, renewable energy, transportation, and infrastructure systems. Traditional de-icing methods, such as chemical sprays or electrical heating, are often energy-intensive, costly, and environmentally harmful. This report explores the use of Phase Change Materials (PCMs) as a sustainable, passive anti-icing solution. PCMs function by absorbing and releasing latent heat during phase transitions, maintaining surface temperatures above freezing without external energy input. The report provides a comprehensive overview of PCM types organic, inorganic, and eutectic their thermophysical properties, and advanced integration techniques including microencapsulation, macroencapsulation, and porous matrix embedding. Applications of PCMs in aerospace, wind energy, power transmission, infrastructure, marine, and automotive systems are discussed, highlighting their potential to enhance safety, reduce energy consumption, and minimize environmental impact. Challenges such as low thermal conductivity, phase segregation, and material costs are addressed through recent developments in nano-enhanced composites, shape-stabilized materials, and hybrid passive-active systems. The report concludes that PCMs represent a versatile, energy-efficient, and environmentally friendly technology, capable of providing autonomous thermal regulation and significant operational advantages across multiple industries exposed to cold climates.

Keywords: Phase change materials, Anti-icing technology, Thermal energy storage, Microencapsulation, Sustainable de-icing

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Mechanical and Thermal Behavior of Epoxy Glass Fiber Reinforced Composite

Nanda Devi K U, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

Epoxy glass fiber reinforced composites (GFRP) are among the most widely used advanced materials in modern engineering due to their remarkable mechanical and thermal characteristics. These composites are formed by combining a thermosetting epoxy resin matrix with high-strength glass fibers, resulting in a material that exhibits high tensile strength, stiffness, and durability while maintaining a low density. The epoxy matrix provides load transfer, adhesion, and resistance to environmental degradation, while the glass fibers contribute significantly to mechanical reinforcement and dimensional stability. The report explores various fabrication techniques such as hand lay-up, vacuum bagging, resin transfer molding, and pultrusion, each influencing the composite's final properties and performance. The mechanical behavior of epoxy glass fiber composites is defined by their excellent tensile, flexural, and fatigue resistance, making them suitable for structural applications where weight reduction and strength are critical. Thermal behavior studies reveal that while the epoxy matrix limits high-temperature performance due to its glass transition temperature, the glass fibers enhance thermal stability and reduce expansion. The literature review highlights innovations such as nanoparticle and hybrid reinforcements to improve performance and recyclability. Overall, epoxy glass fiber composites demonstrate outstanding potential for applications in aerospace, automotive, marine, electrical, and construction industries, combining efficiency, reliability, and sustainability.

Keywords: Epoxy glass fiber reinforced composites, Hand lay-up, Glass fibers

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Aerodynamic Components for Motorsport Cornering

Krishna M P, Dr. A Anu Kuttan

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

This paper presents a detailed exploration of aerodynamic components used in motorsport vehicles to enhance cornering performance. Motorsport cornering demands optimized stability, grip, and high-speed maneuverability, all of which are significantly influenced by vehicle aerodynamics. The study categorizes aero devices into passive and active components, each contributing uniquely to aerodynamic balance and control. Passive components - including front splitters, rear diffusers, fixed rear wings, canards, undertrays, and wheel vents - deliver consistent downforce and airflow management to improve tire contact and vehicle stability in high-speed turns. Active aerodynamic systems such as adjustable rear wings, moveable front flaps, active ride height systems, air brakes, and blown diffusers dynamically respond to driving conditions, optimizing downforce distribution and drag reduction in real time. Through reviewing literature and analysis, this paper highlights how combining passive and active aerodynamic strategies enables motorsport vehicles to maximize cornering speed, improve handling precision, and enhance safety. The integration of computational fluid dynamics, simulations, and adaptive aero control illustrates cutting-edge engineering approaches shaping the future of motorsport aerodynamics.

Keywords: Angle of Attack, Drag, Motorsport aerodynamics, Cornering performance, Passive aero components, Active aerodynamic systems, Downforce optimization

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Geospatial and AI-Enabled Assessment of Urban Heat Island Dynamics for Sustainable Urban Climate Resilience

K G Chithra[1,2], N Srimathi[1], C Gajendran[2]

[1]Department of Civil Engineering, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu

[2]Department of Civil Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

kgchithra@jawaharlalcolleges.com

Abstract

Urban Heat Island (UHI) effects have emerged as a critical environmental challenge in rapidly urbanizing regions, significantly impacting thermal comfort, energy consumption, and public health. This study presents an integrated approach combining geospatial analysis, remote sensing, and artificial intelligence (AI) techniques to assess and mitigate UHI intensity in urban environments. Using satellite-derived land surface temperature (LST) data and GIS-based spatial analysis, urban hotspots are identified and correlated with land use/land cover (LULC) patterns, vegetation indices, and built-up density. The research incorporates AI-driven predictive modeling to analyze temporal variations in urban temperature and forecast future UHI scenarios under different urban growth conditions. Case-based insights from South Indian cities highlight the influence of reduced green cover, increased impervious surfaces, and unplanned urban expansion on localized heat intensification. The study further evaluates the effectiveness of mitigation strategies such as urban greening, cool roofing materials, and sustainable urban design interventions. Additionally, the integration of real-time environmental monitoring using low-cost sensors and automated data workflows enhances the accuracy and responsiveness of urban climate assessment systems. The proposed framework demonstrates how applied science and engineering approaches can support evidence-based urban planning and policy formulation aimed at climate resilience. This work contributes to the broader agenda of sustainable development by offering scalable, technology-driven solutions to mitigate UHI effects, thereby improving urban livability and environmental sustainability.

Keywords: Urban Heat Island, Geospatial Analysis, Remote Sensing, Artificial Intelligence, Urban Climate Resilience, Sustainable Urban Planning

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Design and Optimization of Advanced RF Antenna Systems for Sustainable and High-Efficiency Wireless Communication

C Mahendran

Department of Electronics and Communication Engineering, Alagappa Chettiar Government College of Engineering and Technology, Karaikudi, Tamil Nadu

mahendrangc@gmail.com

Abstract

The rapid expansion of wireless communication technologies necessitates the development of high-performance, energy-efficient, and sustainable radio frequency (RF) systems. This study explores the design and optimization of advanced antenna architectures tailored for next-generation communication networks, including 5G and emerging IoT ecosystems. Emphasizing compactness, bandwidth enhancement, and radiation efficiency, the research integrates innovative materials, miniaturization techniques, and computational modeling approaches to improve antenna performance under diverse operational conditions. The proposed work investigates novel antenna geometries and feeding techniques to achieve improved gain, reduced power consumption, and enhanced signal reliability. Simulation and experimental validation are carried out using state-of-the-art electromagnetic tools to evaluate parameters such as return loss, VSWR, radiation pattern, and efficiency. Furthermore, the study addresses sustainability by incorporating eco-friendly substrates and energy-aware design strategies, aligning with global goals for green communication infrastructure. This research contributes to the advancement of applied sciences by bridging theoretical RF design with practical engineering solutions, enabling scalable and sustainable wireless systems.

Keywords: RF Antenna Design, Wireless Communication, Sustainable Engineering, 5G Technology, IoT Systems, Electromagnetic Simulation, Energy-Efficient Design, Smart Systems, Applied Electronics, Green Communication

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GIS-Based Assessment of Island Carrying Capacity for Sustainable Resource Management in the Andaman and Nicobar Islands, India

M Melsingh Salvious[1], E Arunraj[1], C Gajendran[2]

[1]Division of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu

[2]Department of Civil Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

salvious@gmail.com

Abstract

Small island ecosystems are inherently fragile and highly susceptible to environmental degradation due to limited resources, ecological sensitivity, and increasing anthropogenic pressures. The Andaman and Nicobar Islands represent a unique case where rapid tourism growth, infrastructure expansion, and climate-induced stressors necessitate a scientific evaluation of carrying capacity to ensure sustainable development. This study proposes a Geographic Information System (GIS)-based multi-criteria framework to assess the ecological and infrastructural carrying capacity of selected islands within the archipelago. Key parameters considered include land use/land cover (LULC), freshwater availability, waste assimilation capacity, biodiversity sensitivity, coastal vulnerability, and tourism intensity. Spatial datasets derived from remote sensing and open-source geospatial platforms are integrated with weighted overlay analysis to delineate zones of permissible, restricted, and critical ecological stress. The analysis reveals that several high-tourism zones are operating beyond their sustainable thresholds, particularly in terms of freshwater demand and solid waste generation. Scenario-based modeling further highlights the potential impacts of unregulated development and climate change factors such as sea-level rise and coastal erosion. The study emphasizes the role of GIS-enabled decision support systems in balancing development and conservation priorities. The proposed framework offers a scalable and data-driven approach for policymakers and planners to regulate tourism, optimize infrastructure, and protect ecologically sensitive zones. By integrating applied geospatial science with sustainability principles, this research contributes to advancing resilient island management strategies aligned with national and global environmental goals.

Keywords: Island Carrying Capacity, GIS Analysis, Andaman and Nicobar Islands, Sustainable Island, Environmental Planning

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Comparative Evaluation of Salt-Based Stabilization Techniques for Expansive Black Cotton Soil: Toward Sustainable Geotechnical Applications

Mamidala Prudhvi[1], C Gajendran[2]

[1]Division of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu

[2]Department of Civil Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

prdhvraj383@gmail.com

Abstract

Expansive soils such as black cotton soil (BCS) pose significant challenges to civil engineering infrastructure due to their high swelling–shrinkage behavior, low shear strength, and poor load-bearing capacity. These characteristics often lead to structural instability, pavement failure, and increased maintenance costs. Recent research has explored the use of chemical stabilizers, particularly salts, as cost-effective and sustainable alternatives to conventional additives. This study presents a comparative analysis of various salts, including sodium chloride, calcium chloride, and sea salt, for stabilizing black cotton soil. The stabilization mechanism primarily involves cation exchange, reduction in diffuse double layer thickness, and flocculation of clay particles, resulting in improved soil structure and reduced plasticity. Experimental findings from previous studies indicate that salt-treated soils exhibit decreased plasticity index, reduced swell potential, and enhanced compaction characteristics. Furthermore, improvements in California Bearing Ratio (CBR) and unconfined compressive strength (UCS) have been observed with optimal salt dosages. Among the salts, calcium chloride demonstrates superior performance due to its higher ionic valency and moisture retention properties, while sodium chloride and sea salt offer economical advantages for large-scale applications. However, excessive salt content may lead to long-term durability concerns and environmental implications such as soil salinity. In line with current research trends, the study highlights the integration of salt stabilization with sustainable practices, including the use of industrial by-products and hybrid stabilization techniques. The findings emphasize the potential of salt-based stabilization as a low-cost, scalable, and eco-efficient solution for subgrade improvement in developing regions. This research contributes to the advancement of applied geotechnical engineering by promoting innovative, resource-efficient strategies for managing problematic soils under sustainable development frameworks.

Keywords: Black cotton soil stabilization, salt stabilization, calcium chloride, sodium chloride, expansive soil, sustainable geotechnics

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Integrating Sustainable Water Systems and Emerging Contaminant Analysis Using Applied Engineering Approaches for Environmental Resilience

P P Sivan[1], C Gajendran[2]

[1]Department of Civil Engineering, Government College of Engineering, Thrissur, Kerala

[2]Department of Civil Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

ppsivan@yahoo.com

Abstract

The increasing stress on water resources, coupled with the emergence of complex contaminants such as microplastics, necessitates innovative and interdisciplinary engineering solutions. This study synthesizes recent advances in sustainable water management, environmental monitoring, and applied engineering techniques, drawing on case studies from South Indian river basins and decentralized treatment systems. Recent investigations highlight significant microplastic contamination in freshwater sediments, with concentrations ranging from 500 to 6500 particles per cubic meter, emphasizing the urgency of advanced analytical and mitigation strategies. In parallel, low-cost and decentralized greywater treatment systems demonstrate promising potential for water reuse, achieving substantial reductions in key physicochemical parameters such as turbidity (74%) and biological oxygen demand (64%), thereby contributing to sustainable urban water cycles . The integration of geospatial analysis, filtration-based treatment technologies, and data-driven environmental assessment provides a holistic framework for addressing water scarcity and pollution challenges. Furthermore, applied computational approaches, including fuzzy logic and environmental modeling, enhance decision-making in infrastructure resilience and environmental risk assessment. The convergence of these methodologies supports the development of scalable, cost-effective, and environmentally sustainable solutions aligned with global sustainability goals. This work contributes to the broader discourse on engineering and technology for sustainable development by demonstrating how applied science and engineering innovations can effectively address emerging environmental challenges, ensuring resilience and resource efficiency in rapidly urbanizing regions.

Keywords: Sustainable Water Management, Microplastics Pollution, Greywater Treatment, Environmental Monitoring, Applied Engineering Technologies, Water Resource Sustainability

JCET/RAASE2026/ETSDT167

Lox-Methane: A Sustainable Solution for Upper Stage Rocket Engine

Arunima T, Rinchu P

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

The advancement of space exploration demands propulsion systems that are efficient, reusable, and sustainable. Liquid Oxygen (LOX) combined with Liquid Methane (LCH4) has emerged as a promising propellant combination for upper stage rocket engines. Unlike conventional propellants such as LOX–LH2 or LOX–RP-1, LOX–Methane offers a balanced compromise between performance, storability, and operational simplicity. With a vacuum specific impulse of 350 seconds, higher density than hydrogen, and a higher boiling point that simplifies cryogenic storage, methane provides practical advantages for long-duration missions. Its clean combustion minimizes coking, thereby supporting engine reusability and reducing refurbishment costs. Moreover, methane's potential for in-situ resource utilization (ISRU), particularly on Mars through the Sabatier process, makes it highly suitable for future interplanetary missions. Current global developments, including engines like SpaceX's Raptor, Blue Origin's BE-4, and ESA's Prometheus, demonstrate the growing adoption of LOX–Methane technology. Despite challenges such as lower performance compared to hydrogen and limited flight heritage, ongoing research continues to strengthen its role as a sustainable solution for future reusable and deep-space propulsion systems.

Keywords: Lox-Methane engine, specific impulse

JCET/RAASE2026/ETSDT168

A Theoretical Overview of Rear Wing Configurations and Their Impact on Downforce

Ushass Vijayan, Dr. A Anu Kuttan

Department of Aeronautical Engineering, Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Abstract

The rear wing is one of the most critical aerodynamic components in high-performance vehicles, especially in motorsport and sports car design. Its configuration directly influences downforce generation, drag characteristics, and overall vehicle stability at high speeds. This seminar provides a comprehensive theoretical overview of various rear wing configurations, exploring their design principles, aerodynamic behavior, and performance implications. The study examines single- and multi-element wings, fixed and adjustable configurations, and the effects of geometric parameters such as aspect ratio, angle of attack, and endplate design. The objective is to understand how different configurations balance the trade-off between downforce and drag to optimize vehicle performance. Additionally, the seminar discusses recent advancements in computational fluid dynamics (CFD) and experimental studies that enhance understanding of airflow separation, pressure distribution, and vortex generation around the rear wing. By synthesizing these theoretical concepts, the seminar aims to highlight the significance of rear wing design in improving cornering ability, traction, and overall aerodynamic efficiency. The findings emphasize that optimal rear wing configuration is crucial for achieving a balance between stability and speed, contributing to improved vehicle handling and performance in both racing and road applications.

Keywords: Angle of Attack, Drag, Downforce

JCET/RAASE2026/AASMT201

Bioformulation Technology for Microbial Biopesticides: Enhancing Stability and Field Performance

Ishan Tiwari

Government Agriculture College, Karauli, Rajasthan

ishanggc@gmail.com

Abstract

The increasing demand for sustainable crop protection has accelerated the development of microbial biopesticides as environmentally safe alternatives to synthetic chemicals. Microbial biopesticides work well in labs, but they aren't used much in the field because they don't last long, don't stay stable in the environment, give inconsistent results, and are hard to keep alive while being stored. Bioformulation technology plays a crucial role in addressing these issues by ensuring the survival of microbes, the stability of their useful substances, and their effective delivery. This presentation talks about new developments in different types of formulations, like carrier-based, liquid, encapsulated, and nano-enabled ones, that aim to improve how long beneficial microbes and their helpful substances last. The focus is on protective carriers, polymer coatings, oil-based mixtures, and additives that help products last longer and release their benefits steadily in the soil around plant roots. The presentation also highlights the influence of formulation parameters on root colonisation, pathogen suppression, and systemic resistance induction. Optimised bioformulations not only make disease control more effective in greenhouses and fields but also ensure reliable results in different farming climates. Bringing together microbiology, formulation science, and farming tests is important for creating effective and market-ready microbial biopesticide products. Advancements in bioformulation technology will be critical for reducing chemical pesticide dependency and promoting sustainable agricultural systems.

Keywords: Agriculture, Biocontrol, Wilt, Metabolites

JCET/RAASE2026/AASMT202

The Exploration of Ultrasound Parameters Affecting the Stability of Biodiesel Fuel

V Rohini[1], N Kavitha[2]

[1]Department of Physics, Nehru Institute of Engineering and Technology, Coimbatore, Tamil Nadu

[2]Department of Chemistry, Nehru Institute of Engineering and Technology, Coimbatore, Tamil Nadu

rohiniphysics81@gmail.com

Abstract

Biodiesel is becoming more popular as a substitute for traditional fossil fuels due to the growing need for clean and renewable energy sources. Compared to diesel derived from petroleum, biodiesel is non-toxic, biodegradable, and able to lower greenhouse gas emissions. However, oxidation and storage stability are two of the main issues with biodiesel, which over time may have a detrimental impact on fuel quality and engine efficiency. Ultrasonic processing has become a popular method for increasing the production of biodiesel and improving its physicochemical characteristics in recent years. This study examines how important ultrasonic parameters affect biodiesel fuel stability. During the manufacture of biodiesel, the study focuses on critical ultrasonic parameters such temperature, irradiation period, frequency, and power. These factors have a major impact on the cavitation effect produced by ultrasound, which improves reaction kinetics and mixing efficiency during the synthesis of biodiesel. Physicochemical measurements, including as oxidation stability, viscosity, acid value, and density, were used to assess the stability of biodiesel samples that were produced under various ultrasonic settings. According to the experimental findings, optimal ultrasonic settings increase mass transfer and homogeneity of the reaction mixture, producing biodiesel with better stability properties. Additionally, the study suggests that extended exposure or extreme ultrasonic power may cause biodiesel components to degrade, which could have a negative impact on fuel stability. Finding the ideal range of ultrasonic parameters is therefore crucial to producing biodiesel with better fuel quality and storage stability. The results of this study shed light on the function of ultrasonic processing in the manufacturing of biodiesel and show how it can enhance fuel stability. All things considered, this study provides insightful information about how to optimize ultrasonic parameters to create stable, superior biodiesel that is appropriate for long-term storage and effective engine performance.

Keywords: Fuel quality improvement, biodiesel, oxidation stability, cavitation effect, ultrasonic processing

JCET/RAASE2026/AASMT203

Spatio-Temporal Assessment of Groundwater Quality in Kerala Using Entropy Weighted Water Quality Index (EWQI) and Self-Organizing Map (SOM)

Anjali J Nair, Rajesh Reghunath, Ajayakumar A

Department of Geology, University of Kerala, Kariavattom Campus, Kerala

anjalijnair2018@gmail.com

Abstract

Groundwater is the primary source of drinking and domestic water in Kerala, its quality is increasingly threatened by rapid urbanization, agricultural intensification, and changing climatic conditions. Continuous monitoring and scientific evaluation of groundwater quality are therefore essential for sustainable resource management. The present study evaluates the spatio-temporal variation of groundwater quality in Kerala using the Entropy Weighted Water Quality Index (EWQI) integrated with Self-Organizing Map (SOM) analysis. Groundwater quality data from 2019 and 2023 were analyzed using major physicochemical parameters, including pH, electrical conductivity, total dissolved solids, total hardness, major cations, and anions. The entropy weight method was applied to determine the relative importance of each parameter and to compute EWQI values for assessing drinking water suitability. The spatial distribution of groundwater quality was mapped using GIS to identify regional variations. To identify hidden patterns among water quality variables, the Self-Organizing Map (SOM), an unsupervised machine learning technique, was employed. SOM clustering classified groundwater samples into distinct quality zones and helped evaluate temporal variations between the two study periods. The results reveal significant spatial heterogeneity in groundwater quality, with localized deterioration in certain areas due to anthropogenic activities and hydrogeological factors. Although most samples fall within the good-to-moderate quality categories, some zones show poor quality and require focused management. The integrated EWQI–SOM approach effectively simplifies complex hydrochemical data and supports sustainable groundwater monitoring and management in Kerala.

Keywords: Groundwater quality, EWQI, Self-Organizing Map, GIS, Spatio-temporal analysis

JCET/RAASE2026/AASMT204

Chromatic Polynomial of a Graph

Asha S

Sree Buddha College of Engineering, Pattoor, Alappuzha, Kerala

ashasureshd@gmail.com

Abstract

A graph coloring is an assignment of colors to the elements (vertices, edges, or faces) of a graph subject to a certain constraints. A proper coloring is a way of coloring the vertices of a graph such that no two adjacent vertices share the same color. The chromatic polynomial of a graph count the number of possible proper colorings of a graph using given number of colors. In this paper we study definition, properties and methods for determining chromatic polynomial of a graph. Examples of standard graph such as complete graph, path graph and cycle graphs are discussed to illustriate the concept.

Keywords: Graph, Graph coloring, Chromatic number, Chromatic polynomial, complete graph, path graph, cycle graph.

JCET/RAASE2026/AASMT205

Acoustic Behaviour Ammonium Thiocyanate in 2-Propanol + Water Mixtures at Different Temperatures

Siju N Antony[1], Shivakumar H R[2], Surekha M[2]

[1]Saintgits College of Engineering, Kottayam, Kerala

[2]KVG College of Engineering, Sullia, Karnataka

drsijunantony@gmail.com

Abstract

Acoustic properties of ammonium thiocyanate in 2-propanol + water were studied. Key Acoustic parameters such as adiabatic compressibility, intermolecular free length, specific acoustic impedance, relative association, solvation number, apparent molar compressibility, and apparent molar volume were computed. Gucker and Masson's relations have been verified. The research establishes that the variation of ultrasonic velocity with concentration is governed by the mole fraction of 2-propanol in the solvent mixture. Ultrasonic velocity found to peak at a specific mole fraction of 2-Propanol, pointing to strong solvent-solvent interactions. The study uses acoustic parameters to explain ion-ion, ion-solvent, and solvent-solvent interactions.

Keywords: Ultrasonic Velocity, Ammonium Thiocyanate, 2-Propanol

JCET/RAASE2026/AASMT206

Synthesis, Characterisation and Biological Investigation of Novel Charge Transfer Complexes of p-Toluidine

Aneesa Anto[1], Suchitra Rejith[2], Dr. Prasad P[2]

[1]NSS College of Engineering, Palakkad, Kerala

[2]Jawaharlal College of Engineering and Technology, Palakkad, Kerala

aneesaanto987@gmail.com

Abstract

Charge Transfer (CT) complexes are known to be formed by the interaction of an electron donor and an electron acceptor, leading to a partial transfer of electronic charge between two molecular entities. The charge transfer complex has been found to be of great interest due to its potential applications in a number of areas, ranging from organic semiconductors to optoelectronics, photocatalysis, biosensors, and in biological processes like drug-receptor interactions and antimicrobial agents. In the present study, two novel charge transfer complexes were synthesized using p-toluidine as the electron donor and quinhydrone and picric acid as π-electron acceptors in a 1:1 molar ratio. The charge transfer complexes were obtained by mixing p-toluidine with quinhydrone and picric acid in suitable solvents and then refluxing them to obtain crystals by slow evaporation. The physical properties of the charge transfer complexes like color, solubility, and melting point were determined.

Keywords: Charge transfer complex, electron donor, electron acceptor, pi electron acceptor, refluxing

JCET/RAASE2026/AASMT207

Novel Applications of Dipyrromethane

Suchitra Rejith[1], Dr. Prasad P[1], Aneesa Anto[2]

[1]Jawaharlal College of Engineering and Technology, Palakkad, Kerala

[2]NSS Engineering College, Palakkad, Kerala

suchitramannath@gmail.com

Abstract

Dipyrromethane (DPM) and its derivatives are becoming important building blocks in modern chemistry. They have flexible structures, strong coordination abilities, and adjustable electronic properties. Traditionally, they are known as key precursors in making porphyrins and related macrocycles. However, researchers are now looking into a range of new uses for dipyrromethanes in materials science, sensing, catalysis, and biomedicine. Recent developments show that functionalized dipyrromethanes can work as effective ligands for transition-metal complexes. This enables catalytic processes like oxidation, cross-coupling, and photoredox reactions. In materials chemistry, scientists are studying dipyrromethane-based frameworks for creating supramolecular structures, organic electronic materials, and light-harvesting systems. These applications benefit from their conjugated structures and adjustable photophysical properties.

Key words: Dipyrromethane, macromolecular precursors, coordination chemistry, supramolecular chemistry, photophysical properties

JCET/RAASE2026/AASMT208

Bridging the Gap: Dataset Acquisition Challenges for Field-Deployable VOC Sensor Arrays in Precision Agriculture

Dr. Prasad P[1], Suchitra Rejith[1], Aneesa Anto[2], Dr. Savitha M B[3]

[1]Jawaharlal College of Engineering and Technology, Palakkad, Kerala

[2]NSS Engineering College, Palakkad, Kerala

[3]Sahyadri College of Engineering and Technology, Mangaluru, Karnataka

drprasadp4486.bsh@jawaharlalcolleges.com

Abstract

Identifying plant diseases early on using volatile organic compounds (VOCs) is an innovative way to approach the management of crops. VOCs have shown great promise as a tool to diagnose diseases using sensor array technology (like electronic noses and colorimetric sensors) when in controlled laboratory conditions; however, there are significant barriers associated with the transfer of these technologies to the field resulting from bottlenecks associated with data acquisition. The review assesses the challenges associated with generating datasets of VOCs in the field, with the main barriers being: high levels of signal interference caused by existing environmental background chemical noise, varying baseline readings caused by temperature and humidity, and photo-degradation of chemo-responsive devices due to ultraviolet (UV) exposure. In addition, there is a lack of standardized, large-scale open source agricultural chemical datasets that would otherwise enable the training and validation of robust machine learning classifiers. The review discusses techniques to mitigate these challenges such as algorithmic filtering techniques to remove noise, the use of highly stable nanomaterial-based chemical sensors, and synthetic data generation to augment and increase training sets. Ultimately, the review serves as a roadmap for engineers of diagnostic tools, which rely on VOC profiles, to develop accurate, timely diagnosis of plant diseases in an unpredictable agricultural ecosystem that will sustain agricultural productivity and provide global food security.

Keywords: Volatile Organic Compounds (VOCs), Sensor Arrays, Precision Agriculture, Data Acquisition Bottlenecks, Plant Disease Diagnostics

JCET/RAASE2026/AASMT209

Harnessing Analytical Instrumentation for Biochemical Dataset Construction in Early Plant Disease Diagnostics

Dr. Savitha M B[1], Dr. Prasad P[2]

[1]Sahyadri College of Engineering and Technology, Mangaluru, Karnataka

[2]Jawaharlal College of Engineering and Technology, Palakkad, Kerala

drprasadp4486.bsh@jawaharlalcolleges.com

Abstract

To support the shift from visual identification of plant diseases based on symptoms observed to visual detection of plant disease using predictive biochemical modeling, a fundamental component is the quality of the underlying data. The following review describes the critical role of analytical instrumentation in developing valid and reliable, high-dimensional biochemical datasets that are required for the diagnosis of plant diseases at an early stage. We analyze the complete data acquisition pipeline, with attention paid to how highly specific laboratory snapshots can be integrated to profile plant stress responses. In this regard, we examine the utility of rapid screening methods such as Thin-Layer Chromatography (TLC) to allow for efficient mapping of the early accumulation of defense-related secondary metabolites and phytoalexins before visual symptoms appear. We also assess the utility of advanced thermal analysis techniques including Thermogravimetric Analysis (TGA) and Differential Thermal Analysis (DTA) to determine the degree of structural and compositional degradation of infected plant biomass, thereby adding key physical data points to diagnostic datasets. We also address the significant bottlenecks in standardizing these various instrumental outputs for seamless integration and processing by predictive machine learning algorithms. Finally, this framework provides a comprehensive understanding of how the standardization of and bridging between different types of analytical datasets will accelerate the development of accurate and automated disease detection systems in applied agricultural science.

Keywords: Biochemical Datasets, Analytical Instrumentation, Thin-Layer Chromatography (TLC), Thermal Analysis (TGA/DTA), Early Disease Diagnostics

JCET/RAASE2026/AASMT210

Role of Exponential Family Distribution in Statistical Inference

Ramya R, Sathyajith, Dayana K, Dhanya P B, Vishnudatha K, Fathimathul Farsana, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

rramya@jawaharlalcolleges.com

Abstract

The distributions named Normal, Exponential, Poisson, Gamma are generally referred to as Exponential family distribution, this family allow efficient estimation of parameters using methods such as maximum likelihood estimation. In many cases, the information contained in a sample can be summarized through simple statistics such as the sample mean or the total count, which makes statistical analysis computationally efficient. Thus this family has an important role in statistical inference and estimation theory. Statistical inference focuses on drawing conclusions about unknown population characteristics using observed data. In exponential family the normal distribution is commonly used to model continuous measurements such as height, temperature, or measurement errors, where as Poisson distribution is used to describe count data, such as the number of events occurring within a fixed time interval., exponential distribution in models like waiting between times and gamma distribution in stochastic process. Because of their common structure, these distributions provide a unified framework for modeling and analyzing different types of data.The exponential family framework forms a theoretical basics for generalized linear models (GLMs), which are widely used in modern data analysis. GLMs extend classical linear regression by allowing different probability distributions to model different types of response variables, such as discrete, proportions, or continuous data. It servers as fundamental tools in statistical modeling, data science, and machine learning due to its mathematical simplicity, nowadays also statisticians use this to analyze diverse datasets within a consistent theoretical framework.

Keywords: Statistical Inference, Maximum Likelihood Estimation, Exponential Family Distribution (Normal, Poisson), Generalized linear model.

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Numerical Method for Partial Fraction in Fluid Mechanics

Dhanya P B, Sathyajith, Dayana K, Ramya R, Vishnudatha K, Fathimathul Farsana, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

pbdhanya@jawaharlalcolleges.com

Abstract

The Partial differential equations (PDEs) play a fundamental role in modeling physical phenomena such as fluid flow, heat transfer, electromagnetic fields, and wave propagation. In fluid dynamics equations such as the Navier–Stokes equations describe the motion of viscous fluids and capture the complex interplay between momentum, pressure, and viscosity. However, analytical solutions to these equations are rarely obtainable except in highly simplified scenarios, necessitating the use of numerical methods for practical analysis. Numerical approaches to PDEs aim to approximate continuous physical systems through discrete computational models. Several numerical methods transforms the obtained differential equations into algebraic systems that can be solved using iterative computational algorithms. One such method is Finite difference method. The finite difference method estimates derivatives using simple differences on a regular grid of points. It's an easy way to solve PDEs in straightforward shapes. Nowadays powerful computers have supercharged numerical simulations, letting us tackle super complex fluid problems in fields like aerospace engineering, weather forecasting, and environmental modeling. These methods connect pure math theory with real-world computing, making them essential tools for today's scientists and engineers.

Keywords: Partial Differential Equation, finite Element methods, Finite difference Method, Numerical Simulation, Cumputational Fluid Mechanics

JCET/RAASE2026/AASMT212

Spectral Graph Theory and its Application

Dayana K, Sathyajith, Dhanya P B, Ramya R, Vishnudatha K, Fathimathul Farsana, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

dayanak@jawaharlalcolleges.com

Abstract

The relationship between the structural properties of graph and the eigenvalues and eigenvectors of matrices associated with them such as adjacency matrix, incidence matrix, Laplacian matrix and soon is referred to as spectral graph theory. This interplay between combinatorics and linear algebra provides deep insights into the behavior of complex networks and has become an essential analytical framework in modern applied mathematics. The difference between degree matrix and adjacency matrices plays a central role in spectral analysis. Its eigenvalues encode important information about graph connectivity, expansion properties, and diffusion dynamics. Spectral techniques are particularly powerful in applications involving clustering and algorithms such as spectral clustering utilize eigenvectors of the Laplacian to embed nodes in a lower-dimensional space, where geometric separation reveals underlying group structures. This approach has proven highly effective in image segmentation, pattern recognition, and large-scale data analysis. This also provides valuable tools for studying random walk, diffusion processes and synchronization phenomenon on networks The eigen structure of graph operators governs the rate at which information or influence propagates through a network, making spectral analysis indispensable in fields such as epidemiology, communication networks, and distributed computing. In machine learning, spectral embeddings enable the representation of high-dimensional graph data in compact feature spaces suitable for classification and clustering tasks. Thus this enhance the scope of spectral methods. As this a combination of algebraic and combinatorial perspectives, it provides a powerful mathematical language for understanding the structure and dynamics of complex interconnected systems

Keywords: Graph theory, Eigenvalue Analysis, Spectral clustering, Network Dynamics.

JCET/RAASE2026/AASMT213

Generalized Matrix Inverses

Vishnudatha K, Sathyajith, Dayana K, Dhanya P B, Ramya R, Fathimathul Farsana, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

vishnudatha4450.maths@jawaharlalcolleges.com

Abstract

The concept of matrix inversion occupies a central role in linear algebra and its applications across scientific computing, data analysis, and engineering systems. For a non-singular square matrix, the classical inverse can be computed through well-known methods such as the adjoint–determinant formula or Gauss–Jordan elimination. However, many practical problems involve matrices that are either singular or rectangular, for which a conventional inverse does not exist. This limitation has motivated the development of generalized matrix inverses, mathematical constructs that extend the idea of inversion to a broader class of matrices. Rather than these classic methods, methods like SVD, Moore-Penrose are significant pseudoinverse one of it done by decomposing a matrix into orthogonal singular vectors and singular values, it reveals the intrinsic rank structure of the matrix and allows the construction of the pseudoinverse through reciprocal transformations of nonzero singular values., it provide numerical and geometrical stability, where as the other method ensuring consistency with classical inversion when the matrix is nonsingular while providing least-squares solutions for underdetermined or overdetermined linear systems. Complementing decomposition-based approaches, iterative matrix inversion methods provide efficient alternatives for large-scale computations. One is Newton-Schulz iterative method, it starting from an initial approximation, then refines the estimate through successive updates that quadratically converge toward the true inverse under suitable conditions(it is a rapid convergent method). Such iterative methods are particularly valuable in high-dimensional computational settings, where direct inversion computation is not possible. Another iterative method is Quasi-Newton method, which approximate the Hessian matrix. This work explores the transition from classical inversion techniques to modern generalized inverse methods, there by building crucial bridge between theoretical linear algebra and practical numerical algorithms used in large-scale data analysis, machine learning, and engineering computation.

Keywords: Matrix inverse, Gauss-Jordan, Quasi-Newton, SVD

JCET/RAASE2026/AASMT214

Wavelets Transform in Signal and Image Processing

Sathyajith M, Dayana K, Dhanya P B, Ramya R, Vishnudatha K, Fathimathul Farsana, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

Sathyajithm4536.maths@jawarharlalcolleges.com

Abstract

As classical Fourier analysis decomposes signals into globally defined sinusoidal components, but wavelet analysis enables simultaneous localization in both the time and frequency domains thus making wavelet theory an important framework for analyzing signals. Multiresolution analysis (MRA) is most prominent one in it which decomposes function space into nested subspaces representing different levels of resolution. MRA analysis has 2 fundamental functions one the father wavelet which capture the low frequency(or coarse) of a signal which contains the smooth representation at the given level and the other is mother wavelet capture the high frequency of the signal which contain all details of the signal. Now through systematic dilation and translation of the mother wavelet, one constructs a family of basis functions to represent a complex signals Mathematically, multiresolution analysis establishes a sequence of nested subspaces in where each space corresponds to a particular scale of approximation. The scaling function generates the approximation space , while the mother wavelet spans the orthogonal complement, capturing the details lost when moving from a finer resolution to a coarser one. This decomposition leads naturally to the Discrete Wavelet Transform (DWT). The algebra of mother and father wavelet which is in usefull of separation of signal to approximation and detailed ,which has application in image processing, this structure facilitates compression algorithms such as JPEG2000, while in signal processing, it enables denoising and feature extraction in biomedical signals such as ECG. It also useful engineering applications, influenced numerical solutions of differential equations, data compression techniques, and modern machine learning architectures.

Keywords: Wavelets Transforms, Multiresolution analysis (MRA), Image processing, signal processing, biomedical images, Fourier analysis, Discrete Wavelet Transform (DWT)

JCET/RAASE2026/AASMT215

Optimization for Machine Learning

Fathimathul Farsana, Sathyajith M, Dayana K, Dhanya P B, Ramya R, Vishnudatha, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

fathimathulfarzanakt.4527.maths@jawaharlalcolleges.com

Abstract

Machine learning is a method of training the machine with previous known data in order to predict future data. By the several least square methods like fitting of parabola or other, we can form a equation for the given set of known dataset, now as training the machine we can lead to errors here comes the role for optimization. Optimization helps to minimize the error, for this we consider the Taylor series expansion of the function and equate the first derivative to 0 (at critical points the value of first derivative will be equals to zero) using different kind of iterative approximation methods like Newton-Rapson or Hessian matrix methods like Quasi-Newton or even Lagrange method can be used to find the point of where the minimum occurs thereby getting a perfect weights to thereby finding a best fit to the function. More Advanced methods Like Neural Network structure can be formed to optimized the functions. Machine Learning is the growing trend of todays era like in Artifical Intelligence and several other more than in computer engineering mathematics plays a vital role in Artifical Intelligence by means of optimization methods like Conjugate Gradient descent or Stochastic gradient descent.

Keyword: Machine learning, Optimization, Taylor series, Newton-Rapson, Hessian matrix, Quasi-Newton, Lagrange method, Neural Network, Artificial Intelligence

JCET/RAASE2026/AASMT216

Selection of Specific Infrared Ray's Wavelength to Detect Skin Cancer using Photoacoustic Device

Logambal S[1], Dr. Suneetha Harlapur[2]

[1]Department of Basic Science & Humanities (Biology), Vemana Institute of Technology, Bengaluru, Karnataka

[2]Department of Electronics and Communication Engineering, Vemana Institute of Technology, Bengaluru, Karnataka

logambal.siva@gmail.com

Abstract

Photoacoustic imaging is a hybrid technique that passes laser light on tissue and measures optically induced ultrasound signal. It is a non-invasive new technique and its clinical applications is useful to diagnose the cancerous cell. Skin cancer occurs when abnormal cells in the epidermis, the outermost layer of the skin, grow at an out-of-control rate. These abnormal cells are usually caused by exposure to the sun and lead to tumours in the skin. One of the most prominent features of photoacoustic imaging is its ability to characterize tissue, leveraging differences in the optical absorption of underlying tissue components such as haemoglobin, lipids, melanin, collagen and water among many others. This paper presents, infrared rays between 700 to 900nm was produced simply by incidence of light on a cancerous tissue, as result tissue temperature raises, and thermally it expands and retract will then generate ultrasound waves. It gave different ultra sound waves according to the tissues components concentration such as haemoglobin, lipids, melanin, collagen level and water among many others. It was recorded and analysed by using ML models. In this paper, this phenomenon has been extensively investigated and continue with comparative analysis with different type of skin cancer cells and normal cells. In this review, the state-of-the-art photoacoustic imaging techniques and some of the key outcomes pertaining to different cancer applications in the clinic are presented. Outcome of this paper was working non-invasive photoacoustic imaging cancer cell biosensor, it provides reliable cancer cell monitoring and improved patient compliance.

Keywords: Photoacoustic Imaging, Skin Cancer, Tissue Components, Infrared Rays, Ultrawave Sounds, ML Models

JCET/RAASE2026/AASMT217

Abelian Groups

Priya R

Sree Buddha College of Engineering, Pattoor, Kerala

bs.priyar@sbcemail.in

Abstract

n	1	2	3	4	5	6	7	8
No of abelian groups upto isomorphism of order p^n	1	2	3	5	7	11	15	22

If m and n are relatively prime, the number of abelian groups upto isomorphism of order mis r and the number of abelian groups of order n is s, then the number of abelian groups upto isomorphism of order mn is rs. This result can be generalised for a finite number of products.

Examples

1) The number of abelian groups upto isomorphism of order 72. $72=2^3 \text{ X } 3^2$. 2^3 and 3^2 are relatively prime. So number of abelian groups upto isomorphism of order. $2^3 \text{ X } 3^2$ is (number of abelian groups of order 2^3) X (number of abelian groups of order 3^2) = 3 X 2 = 6. (Since for n=3, no of abelian groups = 3, and for n = 2, the number of abelian groups = 2)

2) The number of abelian groups upto isomorphism of order 108. $108 = 2^2 \text{ X } 3^3$. There are 6 abelian groups upto isomorphism of order 108.

3) The number of abelian groups upto isomorphism of order 360.$360=2^3 \text{ X } 3^2 \text{ X } 5$

There are 6 abelian groups upto isomorphism of order 360.

Keywords: Abelian groups, Isomorphism, Non-isomorphism, Group

JCET/RAASE2026/AASMT218

Energy of a Graph

Harsha E P, Suchitra Rejith, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

harshaep99@gmail.com

Abstract

Graph theory is an important branch of mathematics with various applications in science, chemistry, and computer science. One of the major concepts of spectral graph theory is the definition of the energy of a graph. It is defined by Ivan Gutman in 1978. The energy of a graph is defined as the sum of absolute values of eigenvalues of its adjacency matrix. In this paper, a brief introduction to the concept of graph energy and its properties is given. It explains how eigenvalues of its adjacency matrix are used to calculate the energy of a graph. It is mentioned that there is a special class of graphs known as equienergetic graphs. Despite their different structures, they have the same energy. Graph energy has various applications in chemical graph theory, especially with regard to molecular structures and stability. It is also used to understand complex networks.

Keywords: Graph Energy, Spectral Graph Theory, Adjacency Matrix Eigenvalues, Equienergetic Graphs, Chemical Graph Theory

JCET/RAASE2026/AASMT219

Nonlinear Dynamics and Chaos in Driven Anharmonic Oscillatory Systems

Devika R Nair, Dr. Usha K, Dr. Rajita Ramanarayanan

Department of Physics, Government Victoria College, Palakkad, Kerala

rnairdevika06@gmail.com

Abstract

Nonlinear oscillatory systems exhibit a wide range of dynamical behaviors including periodic motion, quasiperiodicity, and chaos. In this work, the emergence of complex dynamics in nonlinear oscillatory system is investigated through numerical simulations of several representative models. The study begins with a simple anharmonic oscillator containing a cubic nonlinear term. Phase-space trajectories show that, despite the presnece of nonlinearity, motion remains regular, indicating that nonlinearity alone is not sufficient to produce chaotic dynamics. The system is then extended to a driven anharmonic oscillator by introducing external periodic forcing term. The governing nonlinear differential equations are solved numerically to analyze the evoltion of the system with the variation of forcing amplitude. The dynamical behavior is investigated using time-series analysis, phase-space trajectories, Poincaré sections, Lyapunov exponents, and bifurcation diagrams. These tools reveal the transition from regular motion to increasingly complex and chaotic behavior as the control parameter is varied. The results are also compared with the Duffing oscillator, a classical nonlinear model widely used in the study of chaotic oscillations. Further, the dynamics of a double pendulum are examined as a representative nonlinear coupled system demonstrating sensitive dependence on initial conditions. The results illustrate how the combined effects of nonlinearity and external forcing lead to the emergence of chaotic behavior in oscillatory systems. The study also demonstrates the usefulness of phase-space trajectories, Poincaré sections, Lyapunov exponents, and bifurcation diagrams in analyzing nonlinear dynamical behavior.

Keywords: Nonlinear dynamics, Anharmonic oscillator, Chaos, Poincaré section, Bifurcation analysis

JCET/RAASE2026/AASMT220

Eco-Friendly Approach to Nickel Oxide Nanoparticles Synthesis: A Study Using Black Tea Extract

Saynora U S, Shamna Seri N, Hetha K P, Arathy P, Malavika P, Megha R Guptha, Nafiha Banu K, Dr. Rajita Ramanarayanan

Department of Physics, Government Victoria College, Palakkad, Kerala

saynoraus@gmail.com

Abstract

Nanoparticle synthesis is one of the futuristic research areas, owing to its unique physiochemical properties like high surface to volume ratio, quantum-size effects and enhanced reactivity. In this work we discuss preparation of NiO nanoparticles using black tea extract, which acts as reducing, capping and stabilizing agent. The synthesized NiO nanoparticles were characterized using UV-Vis spectroscopy, FTIR, and XRD analysis indicating the formation of NiO nanoparticles. The morphology of the synthesized sample was observed using SEM analysis. The photodegradation study of methylene blue by NiO nanoparticles was conducted in acidic, basic and neutral conditions .The study showed a promising value of 91% dye degradation in basic conditions. Overall, the synthesized nanoparticles displayed good photocatalytic properties, highlighting their suitability in waste water management industry.

Keywords: Nanoparticles, Photocatalysis, NiO nanoparticles, Photodegradation, Waste water treatment

JCET/RAASE2026/AASMT221

Advancements in Prosthetic Limbs

Javeriya, Dr. Laxmikant Kulkarni

Department of Humanities, Ballari Institute of Technology and Management, Ballari, Karnataka

javeriya2194@gmail.com

Abstract

The last few years have witnessed a fascinating convergence of emerging scientific knowledge, cutting-edge technology, enhanced public awareness, and increasing funding for the advancement of sophisticated artificial limbs. Research in prosthetics may be divided into three broad areas: limb interface systems, control systems, and mechatronics. Research into improving limb interface systems has concentrated on the application of computer technology to enhance the fitting of the prosthetic socket and to achieve a direct skeletal attachment through Osseo integration. Research in the area of control systems has enabled the development of Targeted Muscle Reinnervation (TMR), which provides intuitive and simultaneous control along with sensory feedback. It has also enabled the development of a powerful combination of neural interfaces and machine learning for neural decoding. Research in the area of mechatronics has concentrated on increasing power-to-weight density through the application of lithium-ion batteries and enhancing transmission through continuously variable transmission (CVT) and the application of collaborative robots (cobots). Additionally, the advent of fifth-generation technology (5G) and beyond has enabled the development of new manufacturing techniques. Techniques such as multi-material composite molding, enabled by 3D printing technology, have enabled the development of prosthetic devices that possess enhanced stiffness-to-weight ratios. However, there are a number of challenges that need to be addressed. These include the risk of Osseo integration infections. There are also a number of issues that need to be addressed to enhance the quality of life of all end-users. These include the risk of abandonment and health equity.

Keywords: Prosthetics, Osseointegration, Targeted Muscle Reinnervation (TMR), Neural decoding, Mechatronics, 3D printing, Additive manufacturing, Health equity

JCET/RAASE2026/AASMT222

ϱ-Open Sets in Nano Topological Spaces

Dr. Shanmugapriya H

Department of Mathematics, Park's College (Autonomus), Tirupur, Tamil Nadu

shanmugapriyahs@gmail.com

Abstract

The concept of a ϱ operation on a new class of δP_S-open subsets in topological spaces was defined was called ϱ-open sets. Here in this paper we extended the ϱ-open sets in nano topological spaces. The concept of nano ϱ-open sets was introduced along with its properties such as interior and closure, regular space and regular operation of these sets were analysed. An algorithm is developed to find the deciding factors or core to pick the minimum number of attributes necessary for the classification of objects using nano ϱ-open sets.

Keywords: Nano ϱ-open sets, regular space, closure, interior, attributes, objects

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Synthesis and Spectral Investigation of Substituted Pyridine Schiff Bases via Hantzsch Pyridine Synthesis

Mishel Joylin Tauro, Krithika H Bhat, Yashwini, Dandavathi Arunkumar, Seranthimata Samshuddin

Alvas College (Autonomous), Moodbidre, DK, Karnataka

misheltauro75@gmail.com

Abstract

Substituted pyridine derivatives are key heterocycles with applications in medicinal chemistry, materials, and photochemistry. This work synthesizes pyridine-based Schiff bases via Hantzsch pyridine synthesis and investigates their UV-Vis spectral properties. Pyridines were prepared by Hantzsch multicomponent reaction and condensed with furfural, 4-chlorobenzaldehyde, and 4-hydroxybenzaldehyde. Absorption maxima (λmax) were determined to assess substituent effects. Furfural derivative showed intermediate λmax due to furan conjugation. Chloro-substituted analog exhibited hypsochromic shift from electron withdrawal. Hydroxy-substituted showed bathochromic shift via electron donation. Results reveal tunable photophysics for pharmaceutical and materials applications.

Keywords: Pyridine Schiff bases, Hantzsch synthesis, UV-Vis spectroscopy, Substituent effects, Bathochromic shift

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Assessment of Chemical Adulteration in Widely Consumed Ready-To-Eat Condiments

Kavya B, Dr. E Helen Pricilla Bai

Department of Chemistry, Bishop Heber College, Trichy, Tamil Nadu

kavyabalasubramanian22@gmail.com

Abstract

In recent years, the intake of processed foods has increased significantly, specifically in urban areas. And concerns about food quality and adulteration have also become more common. Condiments such as ketchups and sauces are used in daily meals regularly, but these products may sometimes contain chemical additives or adulterants that can affect their safety and quality. The present study focuses on determination of the occurrence of possible chemical adulteration in frequently used condiments. Samples of tomato ketchup, mayonnaise, garlic sauce, green chilli sauce, red chilli sauce, tomato sauce, and soya sauce were selected for investigation. A number of standard laboratory tests were carried out to check parameters such as preservatives, artificial colourants, heavy metals, pH level, and the presence of added starch. These tests were performed to understand the overall quality and benefit of the selected products.The results of the study revealed that toxic heavy metals were not detected in any of the tested samples. However, some level of adulteration was observed in several condiments, mainly due to the presence of excess preservatives, synthetic colourants, and added starch. The use of such additives beyond permissible limits may lead to certain health problems. Consistent intake of these substances can sometimes cause gastric irritation, allergies, asthma, hyperactivity, or digestive discomfort. In extreme situations, extended exposure may also contribute to more serious health effects.Overall, the proposed study indicates the need for regular quality assessment of processed condiments available in the market. Stronger regulatory monitoring, better quality control during production, and improved consumer awareness are crucial to ensure the safety of these widely consumed food products.

Keywords: Food adulteration, Condiments, Chemical analysis, Preservatives, Food safety

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Study of Effect of Alkali Ions on Structural, Optical and Electrical Properties of Boro-Germanate Glasses

Swathi K[1], Dr. Shankar P[2], Dr. Jayasheelan A[3], Dr. Hanumantharaju N[3], Dr. N Sivasankara Reddy[4]

[1]Department of Physics, Vemana Institute of Technology, Bengaluru, Karnataka

[2]Department of Physics, Sai Vidya Institute of Technology, Bengaluru, Karnataka

[3]Department of Physics, Maharani Cluster University, Bengaluru, Karnataka

[4]Department of Physics, Presidency University, Bengaluru, Karnataka

swa555thi@gmail.com

Abstract

The Boro-Germanate glasses have gained significant attention in recent times due to its potential applications in the field of solid-state ionic devices and electrochemical applications. Especially in recent times, boro-germanate glasses are extensively used in solid state lithium ion batteries and optical lenses. In this study boro-germanate glasses with various concentrations of lithium oxide and zinc oxide are prepared by melt-quenching technique. The main objective of this work is to study the influence on structure, physical and electrical properties by varying the concentration of lithium and zinc ions. Density measurement was calculated along with molar volume by the Archimedes principle. FTIR studies were performed to study the structural changes in the glass of various concentrations. Electrical conductivity which includes AC and DC conductivity is performed to observe the behaviour of the conductive nature of ionic glasses and its variation with different concentrations of ions. Dielectric relaxation behaviour is also studied which justifies it's potential use in the solid state batteries. In review of this study it is found that there is significant contribution and variation in the properties of boro-germanate glass by changing the concentration of ions. Lithium and sodium ions significantly changed the electrical properties which imply that there is an increase in conductivity with an increase in the concentration of ions. This suggests that boro germanate glasses can be used in the potential applications of solid state batteries.

Keywords: Melt-quenching, Archimedes principle, FTIR, AC and DC conductivity, Dielectric relaxation.

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Carbon Nano's as Smart-Material/s in the Modern Era: Towards Adsorptive Advance/s

Dr. S R Pratap[1], Dr. N Chandrasekhar[1], Dr. C P Chandrappa[2], Dr. H V Jayaprakash[3]

[1]Shridevi Institute of Engineering & Technology, Tumkur, Karnataka

[2]Shridevi Allied Health Sciences, Tumkur, Karnataka

[3]Sri Siddhartha Institute of Technology, Tumkur, Karnataka

prathapsr999@gmail.com

Abstract

Adsorption is a vital and natural physicochemical technique for the purification and separation in waste water management/s. Today, secondary waste generation is a universal concern. This concern can be overcome by the degradation of adsorbed sort/s. A few studies were implemented for the restoration of the adsorbent without adsorption of active sites and recycled for adsorption. In consideration of the monetary approach, recyclability and regeneration of the spent adsorbent were considered as significant technique. The present study highlights the principles/ proposals to eliminate pollutants from the waste water by 3- C Concepts.

Keywords: Carbon nano's, Sustainable Smart-materials, 3- C Concepts.

JCET/RAASE2026/AASMT227

Exploring Vacation Models in Queueing Theory: A Basic Analytical Approach

Dr. Padmapriya V K

IES College of Engineering, Thrissur, Kerala

padmaneeraj@gmail.com

Abstract

Vacation policies are of significant importance in modelling contemporary queueing systems in which server capacity is reduced or completely suspended. In this paper, a comparative study of significant vacation policies, such as classical vacation, multiple vacation, single vacation, working vacation, and Bernoulli vacation, in various queueing systems such as M/M/1, M/G/1, and retrial queueing systems is provided.

Classical vacation policies are those in which server capacity is completely suspended during vacations. In multiple and single vacation policies, server capacity is reduced or suspended in multiple or a single instance, respectively. Working vacation policies are a generalized form of vacation policies in which server capacity is reduced to a certain level during vacations. Bernoulli vacation policies are those in which server capacity is reduced or suspended with a certain probability after completing a service.

A comparative study of various vacation policies is provided in terms of structural characteristics, underlying Markov chain models, stability conditions, queue length characteristics, waiting time characteristics, and performance measures. Emphasis is placed on vacation policies in retrial queues, communication systems, manufacturing systems, inventory systems, and various service systems such as web and file transfer systems.

The comparative analysis highlights the trade-offs between operational efficiency and analytical complexity across different vacation policies. It further identifies suitable modelling contexts for each vacation type and discusses extensions involving priority customers, server interruptions, feedback mechanisms, and impatient customers. Finally, open research challenges and future directions are outlined to guide further developments in vacation queueing theory.

Keywords: M/M/1 queue, M/G/1 queue, Working Vacation, Bernoulli Vacation, Retrial Queueing Systems, Performance Measures

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Graph Theory and its Chemical Applications

Dr. S R Pratap[1,2,3], J Madhavi[2,3], Dr. Venkanagouda M Goudar[2,3], Dr. S H Venkatesh[2,3], Dr. Shobha[2,3]

[1]Shridevi Institute of Engineering &Technology, Tumkur, Karnataka

[2]Sri Siddhartha Academy of Higher Education, Tumkur, Karnataka

[3]Sri Siddhartha Institute of Technology, Tumkur, Karnataka

prathapsr999@gmail.com

Abstract

Chemical graph theory (CGT) is the application of discrete mathematics to chemistry applied to model physical and biological properties of chemical compounds. A variety of topological indices (TI) based on graph theory can model the geometric structure of chemical compounds. Several of these topological indices are used to construct boiling point models for alkanes with 1to12 carbon atoms. The models are used to foretell the boiling points of a set of alkanes with 13 to 22 carbon atoms. Similarly, melting point models are deemed for a family of alkanes having 10 to 20 carbon atoms and only one methyl group.

Keywords: Graph Theory, Topological indices, Structure of chemical compounds.

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Soft Skills Education in Engineering: An Analysis of Kaziranga University in Assam

Bishnu Prasad Gogoi

Kaziranga University, Koraikhowa NH-37, Jorhat, Assam

bishnu@kazirangauniversity.in

Abstract

In today's job market, engineering graduates need more than technical knowledge to obtain employment; there is an increasing demand for "soft skills" (communication, teamwork, problem-solving, adaptability, and professional ethics). This article discusses the impact of soft skills training through organized activity on engineering students' employability opportunities and provides a case study at Kaziranga University (Assam) to illustrate this point. The case study examines how formal training in communication skills, group discussion techniques, mock interviews, and professional behaviour can help engineering students improve their prospects of finding employment by utilizing a combination of methodologies to assess student performance. These methods include observing students during class time; collecting feedback from students; measuring students' performance during mock interviews; and analyzing data collected via surveys. This study addresses the issues students face when it comes to their ability to communicate in English (proficiency) and self-confidence in formal contexts, as well as those faced by students from rural and vagabond cultural backgrounds. In addition, this report also looks at the disparity between graduation expectations from employers and students' preparedness to enter the working world. Finally, the results of this study provide evidence suggesting that systematic, effective training in soft skills enhances students' self-esteem; their ability to articulate themselves; and their professionalism once they enter into the workplace. Despite these positive developments, however, there remain significant barriers to effectively developing and demonstrating these skills (e.g., language barriers, limited opportunities for exposure to real-world environments, and insufficient time spent in practice environments). The study recommends that soft skills should be taught and included in engineering programmes from year one, supported through continuous assessment and experiential learning. The study concludes that soft skills are an integral component of engineering education rather than a separate "addon.". In conclusion, when developing graduates for their future careers, institutions must have a holistic approach to education that interrelates the technical skills learned with communication skills and ethical awareness. As a result, students will be able to successfully navigate the increasingly complicated nature of the modern workplace and be an integral part of successful team efforts across diverse populations.

Keywords: Soft Skills, Engineering, Communication, Adaptability, Ethics

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Artificial Intelligence in Education: Pedagogical Transformation in the Post-Pandemic Era

Dr. Sowmya K N

Department of English, Sadanam Kumaran College, Pathiripala, Palakkad, Kerala

sowmyakalathil@gmail.com

Abstract

The global education system has undergone an immense shift due to COVID-19, moving toward incorporating Artificial Intelligence (AI) into teaching and learning. What started off as temporary remote learning has transitioned into hybrid/digitally augmented models of teaching and learning, with AI becoming a driving force of educational innovation. This article will examine the evolution of AI-enabled education since COVID-19 and evaluate its pedagogical, administrative, and ethical implications. Some examples of new AI tools are adaptive learning systems, intelligent tutoring systems, automated grading systems, and predictive analytics. All of these tools have greatly improved how students learn. These tools give students the ability to receive immediate feedback, create a personalised learning path for themselves, and use data to help them engage, stay at school, and perform academically. Additionally, AI makes education more accessible to all types of learners through assistive technologies, speech-to-text technology, language translation technology, and other accessibility tools that help to meet the educational needs of all types of learners. AI improves how schools run, helps schools operate efficiently, streamlines administrative processes, streamlines instructional tasks, and streamlines performance monitoring. While AI can transform education for students and schools, there are very serious concerns related to the rapid proliferation of AI. These concerns include the issues of data privacy, biased algorithms, unequal access to AI technologies, and academic integrity; all pose ethical challenges to the use of AI for the educational experiences of students, public schools, and other educational institutions. If institutions of education fail to mitigate unethical treatment of students or the development of AI technologies that lead to unjust milestones, they could lose stakeholder trust and create a greater divide in students' access to quality education. Furthermore, educators' roles in technology-enhanced classrooms will shift dramatically as the instruction of students in technology-enhanced classrooms (via AI) becomes more automated. This paper argues that in the post-COVID-19 world, the adoption of AI in education must be applied in a balanced and ethically sound manner, rather than treated as simply a technological novelty.

Keywords: Artificial Intelligence (AI), Post-Pandemic Education, Digital Transformation, Personalized Learning, Adaptive Assessment, Educational Technology.

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Voice of Resistance in Porattu Pattu

Dr. Reshmi Ravindran P, Swapna N R

Department of English, MES Keveeyam College, Valanchery, Kerala

swapna@meskeveeyamcollege.ac.in

Abstract

Porattu Pattu, a powerful yet marginalised folk performance tradition of Palakkad district, represents indigenous knowledge and cultural resistance in the Global South. Rooted in Tamil expressive traditions, this art form is historically associated with Dalit communities and is performed in rural spaces as a satirical critique of social hierarchies, caste oppression, and exploitative structures. Palakkad, being a region historically controlled by caste polarisation, witnessed a society dominated by Brahminical hierarchies that denied Dalit groups education and literacy, branding them as 'puramjanam' (outcastes). Deprived of writing and formal preservation, the community transmitted this art orally across generations. Without elaborate costumes or stagecraft, Porattu Pattu relied on oral songs in which male and female protagonists exchanged their grief, hunger, joys, and, above all, their satirical voices of protest. In this context, the art form became a mode for resisting oppression and destabilising hierarchical constructs through parody and ridicule. Despite its sharp commentary and socio-political relevance, Porattu Pattu has been sidelined within dominant cultural narratives, reflecting processes of neglect by casteist hegemonies. This paper investigates Porattu Pattu as adecolonial performative text that not only preserves community memory but also disrupts hierarchies. The paper foregrounds the necessity of reclaiming indigenous performance practices as crucial to social development, thereby challenging both colonial and Brahminical knowledge systems.

Keywords: Brahminical Hegemony, Polarization, Caste Hegemony, Resistance

JCET/RAASE2026/HSCST304

Computational Stylistics and Literary Linguistics

Janani B

P K Das Liberal College of Arts and Science, Palakkad, Kerala

janani3921@ncas.co.in

Abstract

Computational stylistics and literary linguistics have emerged as significant interdisciplinary fields that combine linguistic theory with computational tools to analyse literary texts in systematic and innovative ways. Traditional literary criticism often relies on close reading and subjective interpretation; however, computational stylistics introduces quantitative methods that enable researchers to examine linguistic patterns, stylistic features, and structural elements within large bodies of texts. The current research looks at how literary authors use linguistic techniques to create a unique narrative voice through corpus analysis, stylometry, frequency analysis, and natural language processing. Computational methods are used in this study to identify unique style characteristics in different types of literature by analysing certain linguistic features, such as word choice, sentence structure, semantics, and discourse organization that are related to the author's style. Scholars and researchers can use digital text corpora analysis to find instances of repetition, thematic emphasis, and stylistic differences from a particular author, all of which could be invisible with standard analytical methods. The study further examines how computational stylistics can help researchers determine authorship and conduct comparative literary analysis. Researchers can use stylometric methods to measure similarities and differences between literary works; they may also help identify the authors themselves through these analyses. The usefulness of stylometric techniques in the study of authorship is evident when used to examine specific examples of texts' authorship that have been disputed or when multiple authors have worked together to produce a text and in studying how literary styles have evolved throughout time. In addition to the way through which computational linguistics and literary studies have developed through the application of technology to enhance traditional methods of authorship and the methods used for evaluating the interpretation of authorship, the use of computationally based techniques provides empirical data from which to derive evidence regarding the construction of texts. Consequently, literary theorists are now able to apply computational methods to develop additional frameworks for understanding how meaning is created through language, style, and form, as well as expand upon the existing frameworks for understanding meaning creation through a combination of qualitative and quantitative analyses of text.

Keywords: Computational Stylistics, Literary Linguistics, Corpus Analysis, Stylometry, Natural Language Processing, Digital Humanities

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Echoes of Mortality: Death and Meaning in “Mrs. Dalloway”

Ashitha K N

NEST Institute of Humanities and Basic Sciences, Payyannur, Kannur, Kerala

ashithakn2013@gmail.com

Abstract

Life and death is an everlasting theme in literature. Death is an enduring theme. Why? The answer is because death stands as the sole absolute. It separates man from life and his loved ones, and separation always proliferates anxiety. Death is the ultimate separation, the ultimate loss. There are many writers who chose life and death as a theme of their works. Among them Virginia Woolf, an established writer, unfolds a peculiar life pattern before readers. In the novel ‘Mrs. Dalloway’, Woolf explores many of life's dualities: life and death, sanity and insanity and more. The main characters, Clarissa and Septimus, serve as the different sides of Woolf. Using them, Woolf expressed her views on death. Consciousness and an internal life are central preoccupations in this novel. ‘Mrs. Dalloway’ is largely made up of the internal thoughts of its various characters. From the interior perspective of the novel, the story travels forward and back in time and in and out of the characters' minds to construct an image of Clarissa’s life and the interwar social structure. This paper tries to interpret the intense desire for death in “Mrs. Dalloway” with Freud’s theories.

Keywords: Death and Morality, Psychoanalysis, Sigmund Freud, Septimus Warrensmith, Clarissa

JCET/RAASE2026/HSCST306

Blossoming Resistance: An Ecofeminist Analysis in Han Kang's Novel "The Vegetarian"

Saniva M T P

NEST Institute of Humanities and Basic Sciences, Payyannur, Kannur, Kerala

shaninoushad81@gmail.com

Abstract

The relationship between feminism and the environment has been discussed widely through writings on ecofeminism and how both are interconnected through the oppression of women by patriarchal systems. Feminist writing often demonstrates the female experience of oppression in ways that parallel or are synonymous with the exploitation of nature. In today's literature, however, writing that depicts women's struggles is no longer an individual portrayal but instead demonstrates and encompasses the larger societal, cultural, and ecological issues. The Vegetarian by Han Kang is an example of this. The book tells the story of Yeong-hye, whose act of refusing to eat meat gives her a way to oppose violent and controlling patriarchal systems that govern her being – even if it does not disrupt the balance of her life or remove those systems. Thus, Yeong-hye becomes an agent of resistance against male power and the world she lives in by refusing to continue functioning within the structured expectations of that society, taking control of her body and, ultimately, her own life. Through this act, the narrative reflects ecofeminist ideas that associate compassion for nature with resistance to patriarchal oppression. The story is told from the points of view of different characters, showing how Yeong-hye's change shakes up the strict rules of her family and society. Her journey reflects the conflict between individual freedom and social conformity, exposing the deeply entrenched structures of gender inequality. By identifying with plants and nature, Yeong-hye symbolically attempts to escape the violence of human relationships and the social systems that create them. This work seeks to examine how the novel represents female resistance through the lens of ecofeminism and analyses how Yeong-hye's transformation challenges patriarchal dominance and reflects a deeper desire for harmony with nature. The study ultimately highlights how the novel presents personal resistance as a broader critique of social and ecological injustice.

Keywords: Ecofeminism, Patriarchal Oppression, Female Resistance, Nature and Identity, Transformation

JCET/RAASE2026/HSCST307

Gamification in Special Education and Inclusive Classrooms

Dr. Josilet Mathew

NEST Institute of Humanities and Basic Sciences, Payyannur, Kannur, Kerala

mathewjosilet@gmail.com

Abstract

The introduction of gamification into 21st-century teaching is transforming the way educators teach students in various types of classrooms. Gamification allows students with diverse, unique cognitive, behavioral, sensory, and socio-emotional needs to learn in a more creative and personalized manner. Through gamification in inclusive/special education classrooms, teachers can help motivate, engage, and support students with disabilities and those with a variety of learning profiles while helping them learn and retain new skills through the use of game elements such as points, levels, storylines/plots, rewards, feedback systems, and cooperative challenges when designing their curriculum. This chapter will explore the theoretical foundation of gamification in inclusive/special education; examples of how this approach has been implemented in practice; ways to incorporate technology into gamification; and measurable outcomes from utilizing gamification, as well as future avenues for research; teacher training/capacity-building; accessibility criteria; and ethical issues associated with implementing gamification in classrooms/learning environments.

Keywords: Gamification, Inclusive Classrooms, Universal Design for Learning, Assistive Technology, Digital Storytelling

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An Enquiry into Green Sustainability Schemes for MSMEs in India

Asha K[1], Dr. Seetha V[2], Dr. Sumesh R[1]

[1]Nehru Academy of Law, Lakkidi, Palakkad, Kerala

[2]Sri Ramakrishna College of Arts and Science for Women, Coimbatore, Tamil Nadu

sumesh.nal@nehrucolleges.com

Abstract

Micro, Small, and Medium Enterprises (MSMEs) are indispensable factor of India's economy, contributing around 30% of GDP and creating employment opportunities for over 110 million people. In spite of this, their environmental impression is significant, with high energy consumption and emissions. This is definitely a serious issue that must be addressed with at most care . To address this, the Government of India has introduced several green sustainability schemes, including MSE-GIFT, NITI Aayog's Green MSME Roadmap, and MSE-SPICE, there are also state level initiatives like energy efficient schemes and for technology upgradation also aimed at promoting energy efficiency, renewable energy adoption, and circular economy practices. This study scrutinizes these schemes, their implementation mechanisms, and their potential impact on MSME sustainability. Using a policy analysis approach, it evaluates effectiveness, challenges, and opportunities for improvement. The key findings of the study are these schemes provide critical financial and technical support, their success depends on the key concepts of awareness, accessibility, and healthy monitoring systems.

Keywords: MSMEs, Green Sustainability, MSE-GIFT, NITI Aayog, Circular Economy, India

JCET/RAASE2026/HSCST309

Between Light and Illusion: Magical Realism in the Night Circus

Smitha Chacko

NEST Institute of Humanities and Basic Sciences, Payyannur, Kannur, Kerala

smithachacko12@gmail.com

Abstract

Magical realism is a literary technique where fantastical or supernatural elements are blended into a realistic, everyday world. These magical moments are treated as normal by the characters and integrated smoothly into the narrative. The genre often delves into themes like identity, memory, culture, spirituality, and the intersection of myth with ordinary life. Erin Morgenstern's The Night Circus can be seen as a striking example of how magical realism has been reshaped for modern readers. Instead of treating magic as simple decoration or escapist fantasy, the novel weaves the extraordinary into everyday reality, creating a world where enchantment feels normal and unquestioned. Through this careful blending of realism and fantasy, Morgenstern remains faithful to the principles of magical realism while also extending the possibilities of the form. The novel ultimately proposes that magical realism does not distance readers from reality but instead enables a deeper engagement with human emotion. The Night Circus offers a layered and sophisticated interpretation of magical realism that extends beyond surface enchantment. Through its blending of the real and the magical, its symbolic spaces, complex characters, fragmented structure, and immersive sensory detail, the novel shows how magical realism can be used to explore perception, power, identity, and the ethics of artistic creation. Morgenstern suggests that although the magic of the circus may be illusory, the emotions it inspires-deeply authentic. The novel therefore affirms that magical realism is not an escape from reality but a deeper mode of engaging with it, securing The Night Circus as an important contribution to contemporary magical realist literature.This paper tries to unravel how fantacy blurs the real in The Night Circus.

Keywords: Magical Realism, fantacy, reality, identity, memory

JCET/RAASE2026/HSCST310

Rendition of Identities: A Discourse on the Classical Art of Kathakali

Sidharth Soman

NEST Institute of Humanities and Basic Sciences, Payyannur, Kannur, Kerala

sidukailasam99@gmail.com

Abstract

This paper attempts a feministic and subaltern reading in Kathakali, the traditional temple art form of Kerala. Even the art was also controlled by the upper class in our society. The style and concept of Kathakali could be traced back to the Hindu epics like Ramayana andMahabharata. The characters of Mahabharata and Ramayana are personifications of God on earth .The Ramayana and Mahabharata were written in Sanskrit, so the illiterate common people cannot understand the intention of these stories. That is why the sanskrit handling upper class got monopoly in this field. In the by gone days the lower class people were not permitted to enter the temple and the realm of upper class so these rules created a detachment in lower class people to the temple oriented art forms. Kathakali is a form of ritual dance drama, originated in the southern Indian state of Kerala during the late sixteenth century. Evolving from earlier forms of dance drama such as Koodiyattam, Ashttapathiyattam, Krishnanattom and Ramanattom was performed in places and temples and at religious festival. Kathakali was traditionally performed during religious festivals. Several Hindu ethnic groups participated in the performance of Kathakali. In the early days, the Nair community dominated because they were often well-trained in the marital art Kalarippayattu, which is used in Kathakali training and in a mild form on the stage. In those times, the women were always controlled by phallocentrism. It was also reflected in the epics .The women are considered as a secondary human in the society so they were highly marginalised. In the case of Kathakali, it is conspicuous. The female actors are not included in this art as the feminine roles are donned by male actors. The male domination is highly evident here. In the story the women were always considered as a pawn or commodity. The characters of Panjali in Mahabharata and Seetha in Ramayana are the best examples for the view of the society about the women. All over in these epics and Kathakali we can see the presence of subaltern and feminism. It portrays the atrocities and the drastic conditions of the society.

Keywords: Kathakali, Subaltern Studies, Feminism, Caste Hegemony, Gender Marginalization

JCET/RAASE2026/HSCST311

The Transformative Power of Literature in Human Life

Nandanan P R

P K Das Liberal College of Arts and Science, Palakkad, Kerala

nandananpr321@gmail.com

Abstract

Literature has always played a significant role in shaping human thought, emotions, and social consciousness. It acts as a mirror that reflects human experiences, cultural values, and societal realities while also guiding individuals toward self-awareness and personal growth. The transformative power of literature lies in its ability to influence the way people think, feel, and understand the world around them. Through stories, poems, dramas, and essays, literature presents diverse perspectives that encourage readers to develop empathy and critical thinking. One of the most important aspects of literature is its capacity to broaden human understanding. By engaging with different characters, cultures, and historical contexts, readers gain insight into lives and experiences that differ from their own. This exposure nurtures compassion and helps individuals appreciate diversity and human complexity. Literature also plays an important role in moral and ethical development. Many literary works explore themes of justice, freedom, love, suffering, and responsibility, which inspire readers to reflect on their own values and choices. Furthermore, literature contributes to emotional and psychological growth. It provides comfort, inspiration, and a sense of connection by articulating feelings that individuals may find difficult to express. Through literary engagement, readers often discover new ways of interpreting their personal struggles and aspirations. In addition, literature has the power to challenge dominant social structures and promote social change by giving voice to marginalized communities and highlighting issues such as inequality, oppression, and injustice. In the modern world, where technology increasingly shapes communication and culture, literature continues to remain a vital medium for intellectual and human development. It not only preserves cultural heritage but also encourages creativity, imagination, and dialogue. Therefore, literature functions as a transformative force that enriches human life by fostering understanding, empathy, ethical awareness, and a deeper connection with society and the self.

Keywords: literature, human development, empathy, social awareness, cultural understanding, transformation, human values, and critical thinking

JCET/RAASE2026/HSCST312

Resistance and Struggle for Emergence - A Study of Transgender Experiences as Portrayed in Revathy's 'The Truth about Me'

Anu Vijayan

Nehru Arts and Science College, Palakkad, Kerala

anuvijayan4084@ncas.co.in

Abstract

This research paper explores the challenges faced by the transgender community in India and their determination to emerge in spite of the familial rejections, societal norms, economic and legal barriers as depicted in Revathy's 'The Truth About Me'. Revathy is the first hijra writer in India. She is an activist working with Sangama, an organization for the sexual minorities. Her autobiography, 'The Truth about Me' deals with the torments of what it is like to be different in a heterosexual world. The book exposes how the hijras are denied their rights in the name of sex, sexuality, caste and religion. Until recently, transgender individuals were relegated to the background. But now their lives and experiences garner increasing attention and favourable coverage by mainstream media. In addition, a number of books have been published about homo, lesbian, and transgender. The wider social understanding of transgender, challenges our social and personal beliefs, that there are only two genders that flow directly and innately from two types of sexed bodies. The study throws light on the pivotal role of the hijra community in providing support and developing sense of belonging in transgender individuals. Revathy, who felt trapped in a male body felt identity crisis. In her never-ending quest for happiness, she fled from her village to big cities like Delhi, Mumbai and Bangalore. In her attempt to be a women, she got her male sexual organs removed. She became a true hijra and decides to champion their cause. Hijras suffer identity crisis, gender violence, and sexual exploitation. Revathy had a first-hand experience of all these. When she was a teen, she experienced identity crisis. When she began to show signs of women, she experienced gender violence and when she did sex-work, she experienced sexual exploitation. Their financial hardships, due to employment discrimination force them into marginalized and dangerous professions. All hijras have the same experience. Revathy's association with Sangama was the turning point in her life. Work in Sangama made her realize that hijras are suffering for no fault of their own. The realization increased her desire to work for the rights of those in her community. The paper highlights the transformative power of advocacy and activism of transgender rights and societal acceptance. Sangama enabled her to continue her struggle and gave her the opportunity to realize her vocation as a social worker. She participated in seminars and workshops and spoke about hijra culture, way of life, the violence and discrimination that they faced. She also spoke about their property rights. She conducted awareness programs about hijras and their problems at colleges. As a spokesperson for hijra rights, she gave interviews to newspaper and spoke at public meetings. She spoke of what she endured in her parent's house, at the hands of rowdies and police, about how the law was not in their favour and about the pain she was experiencing in her marriage at the World Social Forum convened in Mumbai. She wants the hijras to be recognized and treated as fellow humans, with hopes, aspirations and desires. The frankness and fearlessness with which she discusses even the most 'private' aspects of her life as a hijra is striking and admirable. Her critique of social constructions of gender and dominant notions of masculinity is a powerful plea for us to radically reconsider the society's attitude towards hijras. The study finds that the individuals like Revathy' have remarkable resilience and determination in their pursuit of self-acceptance and emergence as genuine individuals. It highlights the need for the society to evolve and become more inclusive and understanding towards the transgender individuals.

Keywords: Transgender, queer theory, marginalization, binary, lgbtq

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The Dual-Edged Sword: A Comparative Analysis of Technological Integration in Global and Regional Cultural Frameworks

Gopika R

Legal Professional, Palakkad, Kerala

gopikaravi02@gmail.com

Abstract

Using current research and local case studies, this study investigates the connection between cultural change and technical advancement. Technology is becoming more than just a tool; it is a "embedded creative agent" that actively influences cultural identities and social norms. The approach emphasizes how digital platforms facilitate cross-cultural communication and the blending of traditions, such as fusion cuisines and new cybercultures, using viewpoints from Actor-Network Theory and Cultural Semiotics. But there are risks associated with these advances as well, such as cultural homogenization and the growing "digital divide," which exacerbates social and economic inequality. Through mass media, technology has helped India experience a cultural renaissance. Traditional folk arts have been brought back to life by electronic broadcasting, which has made them available to a wider audience. With over 253 million households, television is a vital tool for socializing the next generation through epic and historical stories that uphold cultural continuity and national ideals. In addition, over 75% of Indian internet users are young people who actively interact with outside influences in food, fashion, and music to create hybrid cultural manifestations. Digital technology have made it easier for cybercultures—virtual communities that cut beyond geographical boundaries—to form globally.People can create groups, exchange knowledge, and protect endangered languages using online platforms.Indigenous and marginalized people can now directly share their cultural narratives with a worldwide audience by overcoming historical boundaries. There are still difficulties in spite of these opportunities. While unequal access to technology restricts involvement for underprivileged areas, cultural homogenization may allow dominant global cultures to eclipse local identities.Furthermore, the commercialization and virtualization of rituals run the risk of turning cultural customs into commodities.In the end, culture and technology are developing simultaneously. It takes thoughtful integration, inclusive policies, and culturally sensitive teaching methods that enable communities to retain and reinterpret their legacy to ensure that technological advancement enhances rather than diminishes cultural diversity.

Keywords: Cultural homogenization, Digital platforms, technological advancement, cultural change, digital divide

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Beyond Recycling: Shaping the Social Dimensions of Circular Economy

Karthika

Nehru Academy of Law, Lakkidi, Palakkad, Kerala

karthika4312@nal.net.in

Abstract

People talk a lot about the circular economy these days, and for good reason—it's all about cutting down waste, using resources wisely, and keeping the planet in mind. But, there's a big piece missing in most of these conversations: the human element. Too often, the focus stays on green products without much thought for the folks actually making them—their safety, well-being, or working conditions rarely get the attention they deserve. The innovative Inclusive Loop framework explicitly seeks to address this fundamental gap by systematically integrating core principles of fairness, worker empowerment, and broad inclusivity into existing circular economy structures. The framework effectively identifies two essential components for social businesses to thrive sustainably. First, they need to source materials responsibly. That means making sure vulnerable or marginalized workers aren't left behind—they should get fair pay and real legal protections, especially if they're part of complex supply chains. Second, businesses need to create affordable, high-quality products for communities that often get overlooked. By focusing on these dual components, the framework doesn't just talk about fixing the environment—it actually links that goal to social equity and fights against exploitation at its roots. This study makes a strong case that social innovation is more than just a buzzword—it's a way to bring environmental goals and social justice together. It cuts down on the risk of people being exploited as we shift to circular systems. The Inclusive Loop framework doesn't just add to the academic conversation; it builds a solid foundation for circular business models that include everyone. Furthermore, the comprehensive study offers actionable, practical insights for policymakers, industry practitioners, and social entrepreneurs who collectively aim to develop and scale circular economy initiatives that are simultaneously environmentally regenerative, economically viable, and socially inclusive.

Keywords: Inclusive Circular Economy, Social Equity, sustainable development, sociotechnical innovation, circular social enterprises

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A Study of Black Oppression in Tony Morrison's "The Bluest Eye"

Dr. Smitha T G, Rajini K, Karthika K, Suchitra Rejith, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

smitha4036.eng@jawaharlalcolleges.com

Abstract

The narratives of early nineteenth century often highlight the oppressive condition of women, the marginalization, patriarchy, the heroines challenging oppression are included in the broad span of cultural studies. The life of most women in American society during this era, made them into victims as the case with the protagonist of the novel, The Bluest Eye by Tony Morrison. Virginia Woolf's A Room of One's Own critiques the challenging conditions of women in general. The novel tells the story of Pecola Breedlove, a young African-American woman who is marginalized by her community and especially from her own family. Individually and collectively people mark Pecola and her dysfunctional family as falling outside the boundaries of what is normal and, thus, as undesirable. Pecola's story intersects with and contrasts with that of the novel's primary narrator, Claudia MacTeer, whose coming of age, while challenging, is not the alienating, ultimately impossible situation experienced by Pecola, as she becomes the mother of her father's baby. She suffers the racial abuse from her community, therefore, both endurance and resistance are shown by her. This paper aims to reveal the racism and the resistance of black women through this novel of Toni Morrison.

Keywords: Racism, resistance, black oppression, womanism, patriarchy

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The Influence of AI on Creative Writing and Literary Production

Karthika K, Dr. Smitha T G, Rajini K, Suchitra Rejith, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

karthika4288.eng@jawaharlalcolleges.com

Abstract

The rapid development of Artificial Intelligence (AI) has greatly impacted various aspects of human activities, including the field of creative writing and literary creation. The use of AI technology has created new opportunities for creating, editing, and analyzing texts. These new opportunities have greatly impacted traditional concepts of authorship, creativity, and literary creation. The purpose of this paper is to explore the ever-increasing influence of AI technology on the process of writing, publication, and literary creation.AI technology is now being utilized as a collaborative tool that assists writers in creating new ideas, plot development, textual refinements, and literary styles. The use of AI technology has enabled writers to produce texts that are similar to various literary styles. The use of AI technology has enabled writers to break new ground by assisting writers in overcoming various challenges that are associated with literary creation. The use of AI technology has created a new form of co-creator of literary texts. However, there are ethical and intellectual implications involved in the integration of AI technology in creative writing. Questions about originality, authenticity, and copyrighting are now major topics of discussion within the literary world. There are apprehensions that over-reliance on AI technology may lead to a lack of human emotional content that is characteristic of literature. Despite these apprehensions, AI technology is not likely to replace human creativity in any way. Instead, it is redefining the relationship between technology and creativity. The integration of AI technology in creative writing is likely to result in a new form of creativity that combines human imagination with technology. Ultimately, the impact of AI technology on creative writing is a landmark event in the history of literature.

Keywords: Artificial Intelligence in Literature, Creative Writing, AI-Assisted Authorship, Digital Literary Production, Ethics of AI in Writing

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Technology, Culture and Identity: The Impact of Digital Technology on Identity

Drisya M

Nehru College of Architecture, Jawahar Gardens, Lakkidi

drisyamadhu@gmail.com

Abstract

Technology, Culture and Identity: The Impact of Digital Technology on Identity In today's world, science, technology and AI has influenced individuals to such an extend that it is visible even in their identity formation. Social media, virtual communities and AI have created spaces where identity is formed, edited and reshaped. In the current digital world, the identity is not restricted to the traditional factors like interpersonal interactions, culture, society, social roles, etc. Instead, it is formed through interactions with technology and "virtual people". This paper examines the cultural and social implications of digital communication technologies through an analysis based on communication studies and cultural theory. Online platforms encourage individuals to shape their opinions, images and even their "identities" based on the preferences of the digital world. Nowadays, human life is highly influenced by the social media culture or the preferences of the digital world. The resulting digital persona may be entirely different from the real identity of that person. This highlights the role of technological platforms and AI in shaping how individuals understand and present themselves to others. The study explores how digital platforms influence identity formation, social interaction, and cultural expression. Many argues that online platforms and technology provide chances for self-expression and cultural exchange. Technology and social media help people to share their opinions without any control of any power structures, which once tried to silence them. But at the same time, it raises questions about authenticity, privacy and commercialization of personal data. In other words, data collection about the personal aspects of people can transform personal information into marketable information. This paper also analyses the role of digital technology and social media in shaping global cultural exchange. While digital platforms provide a space for cross-cultural communication, exchange of knowledge, etc., they also lead to homogenization and dominance of certain cultural norms. In addition, the study also investigates the idea of digital citizenship and that of "virtual identity" associated with the recent trends in social media, technology and AI By analyzing the impacts of technology on culture and identity, this paper emphasizes the need to understand that digital platforms are not just a technological phenomenon but they are also linked to the cultural and social aspects of human life. The findings of the study suggest that responsible technological development should consider its broader impact on human relationships, cultural diversity, and social values. Keywords: Identity formation, virtual communities, digital world, Artificial Intelligence, social media culture, virtual identity.

Keywords: Identity formation, virtual communities, digital world, Artificial Intelligence, social media culture, virtual identity

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Communication, Language Etiquette and Accountability in Professional Discourse

Rajini K, Karthika K, Dr. Smitha T G, Suchitra Rejith, Dr. Prasad P

Jawaharlal College of Engineering and Technology, Palakkad, Kerala

krajini@jawaharlalcolleges.com

Abstract:

Effective interaction in today's professional scenario is largely influenced by professional communication. This study aims to identify the relationship between accountability and communication in professional discourse, with emphasis on the concept that language communicates and embodies values, as signalled by Grice's Cooperative Principle. It is observed that communication gradually shifted away from ethical responsibility in many professional contexts, especially in institutional and scientific discourses. The study explores how contemporary professions function along a spectrum between corporate and college values, impacting how businesses interact with their stakeholders. It also highlights the significance of language conventions, etiquette, and rhetorical awareness in professional interactions from the perspective of applied linguistics and interdisciplinary approaches. The speech practices in professional contexts are given special consideration, including the significance of upholding polite discourse, adherence to formal communication norms, and evaluative expressions like praise and criticism. The article also discusses problems like language aggression and suggests ways to lessen it. In order to enhance the concept of accountability and efficacy in the field of professional communication, the study emphasizes the necessity of developing interpretive abilities, rhetorical awareness, and ethical communication practices.

Keywords: Communication, discourse, etiquette, accountability, aggression

JCET/RAASE2026/HSCST319

Human Behaviour and Digital Consumption

Garima Bhota

Area Coordinator, National Rural Livelihood Mission (NRLM), Kupviblock, Shimla, Himachal Pradesh

Garimabhota07@gmail.com

Abstract

The shaping of our character has been happening from birth onward. We form our character as we interact with other people through the media we consume on a daily basis— both online and offline. Over time, the environment creates conditioning in children, which has a significant impact on the way they will develop into adults. The moment a baby is born, the outside world begins to shape them in their development. Depending on how the toy was introduced into the baby's life, it could influence how the child develops and interacts when he or she is older. Traditional gender roles can be established through children's play behavior. While basic childhood experiences play an important role in forming personality, there are many other factors that shape who we become. Our education, family background and circumstances, culture, and geographical location all have profound influence on our value systems. One of the new and powerful influences on people today is the internet and its associated World Wide Web. Unlike past years, people today can now access information and entertainment without geographical constraints. Greater access provides more opportunities to learn, be connected, and be exposed to larger amounts of content that has not been filtered or reviewed prior to being presented. Therefore, we need to think about what you choose and whether it will be useful, trustworthy, supportive for our development. The digital environment is prone to comparisons. The outlets tend to portray the ideal one and direct them to compare themselves, their present and past achievements. This leads to a feeling of inadequacy, anxiety, and may lead to mental health concerns. Dopamine, the "feel-good" hormone, is mainly responsible for we behave psychologically. Digital content often provides rapid, temporary forms of gratification and promote ongoing consumption. Mindful engagement with digital media is important so people are consciously forming their lives and not subconsciously being formed by the digital content they consume.

Keywords: Digital consumption, media, behaviour

JCET/RAASE2026/HSCST320

A Study on Consumer Knowledge and Perception to Electronic Bikes in Coimbatore City

Dr. Sruthi V

P K Das Liberal College of Arts and Science, Lakkidi, Palakkad, Kerala

sruthikishoreva@gmail.com

Abstract

This study looks at how aware consumers are of electric bikes (E-bikes) and what they think about them, focusing on Coimbatore city. In recent years, E-bikes have gained popularity among consumers because they can help cut down on air and noise pollution from traditional fuel-powered vehicles. Growing environmental concerns and the desire for sustainable transport have led many to view E-bikes as a viable alternative. The paper focuses on understanding consumer perceptions of E-bikes and how much they know about their benefits and use. The study is descriptive. Primary data came from a structured questionnaire given to 100 respondents, utilizing the convenience sampling method. The collected data were organized, tabulated, and assessed using statistical tools like percentage analysis, weighted average, cross-tabulation, and chi-square test. The results show that electric bikes are slowly gaining acceptance among consumers, and more users are likely to come in the future. The findings also indicate that people are becoming more aware of the availability and benefits of E-bikes.

Keywords: Awareness, Perception, Electric Bikes, Consumers, Coimbatore

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Artificial Intelligence Adoption in MSMEs of Palakkad District: Managerial Perspectives, Opportunities, and Implementation Challenges

Sangeetha Lakshman

P K Das Liberal College of Arts and Science, Lakkidi, Palakkad, Kerala

sangeethajinu03@gmail.com

Abstract

Micro, Small, and Medium Enterprises (MSMEs) play an important role in regional economic development. They create jobs, encourage entrepreneurship, and contribute significantly to local production and trade. Recently, Artificial Intelligence (AI) has become a powerful tool that can improve efficiency, decision-making, and customer engagement across many business sectors. However, the use of AI among MSMEs is inconsistent, especially in semi-urban and developing areas. This study looks at how MSMEs in Palakkad District adopt Artificial Intelligence. It focuses on the views of managers, the opportunities they see, and the challenges they face when implementing AI. The research aims to understand how MSME managers view AI technologies, how much these technologies are integrated into their business processes, and what benefits they expect in terms of productivity, cost savings, market competitiveness, and customer service improvements. The study also investigates the practical barriers that limit AI adoption in the district. These include financial issues, a lack of technical skills, insufficient digital infrastructure, and concerns about data security and workforce adaptation. By analysing the experiences and opinions of MSME managers, the research aims to identify the factors that influence decisions about adopting AI and how ready local businesses are to embrace digital change. The findings should offer useful insights for policymakers, business owners, and technology providers. They will highlight strategies that can help MSMEs in Palakkad District effectively integrate AI. Additionally, this research adds to the existing knowledge on technology adoption in small businesses by providing a regional perspective from Kerala, supporting efforts to promote innovation and sustainable growth in the MSME sector.

Keywords: Artificial Intelligence, MSME, Technology Adoption, Managerial Perspectives, Implementation Challenges

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Sustainable Business Practices and Corporate Social Responsibility

Rejitha A K

P K Das Liberal College of Arts and Science, Palakkad, Kerala

rejithasanthoshak@gmail.com

Abstract

Sustainable business practices and Corporate Social Responsibility (CSR) are now crucial parts of modern organizational strategies. This shift responds to rising environmental concerns, social expectations, and economic challenges. Sustainable business practices involve using methods that help organizations operate in ways that reduce negative impacts on the environment, promote social well-being, and ensure long-term economic health. These practices emphasize responsible resource use, waste and carbon emission reduction, ethical sourcing, and creating environmentally friendly products and services. Corporate Social Responsibility reflects the ethical commitment of businesses to positively impact society while conducting their operations. It goes beyond making profits and highlights the responsibilities organizations have toward their stakeholders, including employees, customers, communities, governments, and the environment. CSR initiatives often involve community development projects, employee welfare efforts, fair labor practices, environmental conservation activities, and support for education and healthcare. Combining sustainable business practices with CSR strategies helps organizations build trust, improve their brand image, and create long-term value for stakeholders. Companies that focus on sustainability and social responsibility are better able to manage risks, follow regulations, and respond to changing consumer preferences that increasingly favor ethical and environmentally conscious businesses. Additionally, sustainable practices support global development goals by tackling issues like climate change, poverty reduction, and social inequality. In today's competitive business landscape, sustainability and CSR are no longer optional; they are essential strategies. Organizations that successfully incorporate sustainability into their main business models can improve their efficiency, foster innovation, and increase loyalty among stakeholders. Therefore, sustainable business practices and Corporate Social Responsibility are vital for promoting responsible growth and balancing economic success with environmental protection and social progress.

Keywords: Sustainable Business Practices, Corporate Social Responsibility (CSR), Environmental Sustainability, Ethical Business, Stakeholder Engagement, Corporate Governance, Sustainable Development, Social Responsibility

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Exploring the Future of Literature Through Human and Machine Collaboration

G Kirubainesan

AJK College of Arts and Science, Coimbatore, Tamil Nadu

kirubainesan@ajkcas.com

Abstract

The rapid advancement of Artificial Intelligence (AI) has brought noticeable changes to many areas of human life, including science, communication, education, and the creative arts. Literature, which has long been regarded as a product of human imagination, emotions, and personal experiences, is also being influenced by the growth of AI technologies. In recent years, AI-based tools have begun to assist writers, editors, and researchers in various literary activities such as content creation, language translation, proofreading, and textual analysis. As a result, the traditional methods of producing and interpreting literary works are gradually evolving in response to these technological developments. Artificial Intelligence has introduced new possibilities for literary creativity through automated writing systems and digital platforms. AI-powered applications can generate poems, short stories, and even complex narratives by analysing large amounts of existing literary data. These systems are capable of recognizing language patterns, narrative structures, and stylistic elements, which allows them to produce text that resembles human writing. Such innovations have expanded the ways in which literature can be created and shared with readers across the world. At the same time, the growing presence of AI in literature raises several important ethical and philosophical questions. Issues related to authorship, originality, and intellectual property have become increasingly significant when machines contribute to the creative process. Some critics argue that excessive reliance on AI might reduce the authenticity and emotional depth traditionally associated with literary works. However, others suggest that AI should be viewed not as a replacement for human creativity but as a supportive tool that can enhance the writing process and inspire new forms of storytelling. The influence of artificial intelligence signals a transformation in the literary world. Rather than eliminating human creativity, AI is likely to encourage a collaborative relationship between human writers and intelligent machines, ultimately shaping a new and dynamic future for literature.

Keywords: Artificial Intelligence, Digital Literature, Literary Creativity, AI-Generated Texts, Human–Machine Collaboration, Authorship and Originality, Intelligent Writing Systems, Literary Innovation, Digital Humanities, Technology and Storytelling

JCET/RAASE2026/HSCST324

The Voice of Resistance: A Feminist Reading of Nawal El Saadawi's Woman *at Point Zero*

Subhash Chandra Bose Y

AJK College of Arts and Science, Coimbatore, Tamil Nadu

Abstract

This article examines Nawal El Saadawi's *Woman at Point Zero* (1975) as a compelling radical feminist narrative that exposes the complex social, cultural, religious, and psychological structures responsible for women's oppression in patriarchal societies. The novel is presented through the voice of Firdaus, a woman awaiting execution who recounts the painful experiences that shaped her life. Her story unfolds as a testimony of suffering, exploitation, and resistance, revealing how patriarchal systems control women from childhood through adulthood. Firdaus's life reflects the harsh realities faced by many women who are denied education, autonomy, and dignity. Through various stages of her life—within the family, in marriage, and in society—she encounters violence, betrayal, and systemic injustice. Saadawi carefully portrays how patriarchal authority operates not only through men but also through social customs and institutional structures that normalize the subordination of women. Religion and cultural traditions, when interpreted through a patriarchal lens, often reinforce these power imbalances, leaving women with limited opportunities to define their own identities. However, the narrative does not remain a simple account of victimhood. Instead, Firdaus gradually develops a deep awareness of the structures that control her life. This awakening transforms her into a symbol of resistance. Her refusal to submit to oppressive systems becomes a powerful assertion of selfhood. In this sense, Saadawi presents liberation not merely as physical freedom but as the courage to recognize injustice and challenge it. Firdaus's final act of defiance symbolizes a profound reclaiming of voice and agency. Her story moves beyond personal tragedy and becomes a universal reflection on women's struggle for autonomy and dignity. When read alongside the feminist perspectives of Virginia Woolf and Elaine Showalter, Saadawi's work highlights the importance of women narrating their own experiences. Ultimately, *Woman at Point Zero* transforms individual suffering into a powerful call for awareness, resistance, and social transformation.

Keywords: Radical Feminism, Patriarchy, Women's Oppression, Female Resistance, Self-Awareness, Liberation, Gender Inequality, Firdaus, Social Injustice, Feminist Consciousness, Narrative of Resistance, Female Identity, Autonomy, Women's Emancipation, Patriarchal Society

JCET/RAASE2026/HSCST325

CSR Communication as a Driver of Brand Trust: An Empirical Study Based on Consumer Survey Data

Preetha P

Department of Commerce, PK DAS Liberal College of Arts and Science, Palakkad, Kerala

Abstract

Corporate Social Responsibility (CSR) communication has become an important tool for shaping how consumers see brands and improving brand performance in socially aware markets. This study looks at how the quality of CSR communication and the perceived credibility of CSR affect brand trust. It also explores whether different levels of consumer exposure to CSR communication affect trust perceptions. We collected primary data using a structured questionnaire from 360 consumers who bought products from the chosen sector within the last three months. We used Pearson correlation analysis to measure the relationships between CSR communication quality, perceived CSR credibility, and brand trust. Additionally, we used one-way ANOVA to compare brand trust among consumers with low, medium, and high levels of CSR communication exposure. The results show significant positive links between CSR communication quality, perceived CSR credibility, and brand trust. Furthermore, consumers who see more CSR communication show much higher levels of trust than those who see less. The study adds to the existing CSR literature by emphasizing that the quality and visibility of CSR communication are vital in building consumer trust and improving brand positioning.

Keywords: CSR communication, brand trust, perceived credibility, consumer perception, corporate transparency

JAWAHARLAL COLLEGE OF ENGINEERING AND TECHNOLOGY

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Contact Us

Hotline

+91 9605 771 555, +91 7510 331 777

Landline

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E-mail

jcetadmissions@nehrucolleges.com

jcetncerc@gmail.com