

MECHSTREAK

TECHNICAL MAGAZINE OF THE DEPARTMENT OF MECHANICAL ENGINEERING

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TECHNICAL ARTICLES



SUSTAINABLE
ENGINEERING



EMERGING ENERGY
TECHNOLOGIES



STUDENT ACHIEVEMENTS
& EVENTS

Federal Institute of Science And Technology (FISAT)®

Hormis Nagar, Mookkannoor P O, Angamaly, Ernakulam Dt., Kerala
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Editor's Note

It is with great pride and gratitude that we present Volume 4 of MECH STREAK. This edition reflects the continuous efforts to create a meaningful platform that encourages learning, creativity, and the sharing of knowledge through a well-curated magazine.

This volume features a collection of student technical articles, scientific contributions, and thoughtfully prepared content that showcases innovation, analytical thinking, and academic curiosity. Along with these, the image gallery captures memorable moments, activities, and achievements, preserving the spirit and journey behind this edition.

We sincerely thank all contributors, reviewers, and supporters whose dedication and cooperation made this issue possible. Every article and visual element in this volume stands as a result of teamwork and commitment.

Above all, we express our heartfelt gratitude to Almighty God for His guidance and blessings, which enabled us to successfully complete this volume. We hope that MECH STREAK – Volume 4 serves as a source of knowledge, inspiration, and pride for all our readers.

— Editorial Team



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HoD's NOTE



Dr. Sumanalal MR
Professor

Every new edition of MECHSTREAK reflects the vibrant academic spirit and innovative mindset of the Department of Mechanical Engineering. Volume 4 is yet another milestone that showcases the creativity, technical knowledge, and dedication of our students and faculty. It is heartening to see young engineers expressing their ideas through meaningful technical articles and thought-provoking discussions.

Engineering is not merely about designing machines; it is about solving problems, embracing innovation, and contributing to society. I am confident that the articles featured in this edition will inspire readers to think critically, explore emerging technologies, and pursue excellence in their academic and professional journeys.

I sincerely appreciate the efforts of the editorial team, faculty coordinators, and all contributors whose commitment has made this publication possible. I wish MECHSTREAK continued success and hope it remains a source of knowledge and inspiration for every reader.

Best Wishes,

Dr. Sumanalal MR
Head of the Department
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Mechanical Engineering: Shaping the Future of Technology and Innovation



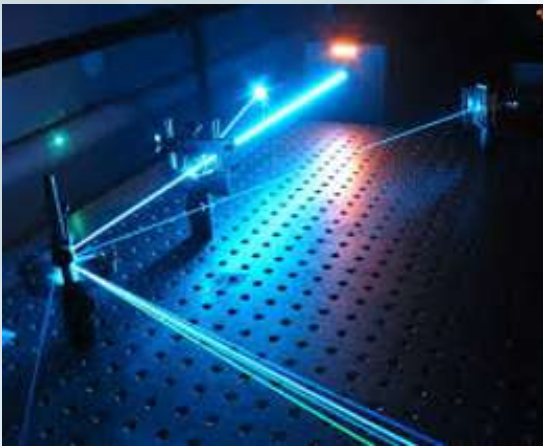
Dr. Rejeesh CR
Associate Professor

The year 2023 marked a transformative phase in science and engineering, driven by rapid technological convergence, sustainability objectives, and advances in digital innovation. Significant progress across both fundamental research and applied engineering has reshaped how systems are conceived, designed, and implemented. These developments have enhanced efficiency, supported sustainable solutions, and strengthened the role of engineering in addressing global challenges.

Key Scientific Advances in 2023

This year, scientific research witnessed several landmark developments that attracted global attention, reflecting a strong focus on speed, scale, and sustainability. One of the most prominent advances was in the field of high-energy laser technology, where scientists achieved the generation of extremely powerful and ultra-fast laser pulses. These breakthroughs have significant implications for high-precision measurement, advanced materials processing, medical diagnostics, and space-related applications. Materials science advanced considerably with the development of innovative synthesis techniques for high-performance materials. Researchers successfully produced synthetic diamonds and ultra-strong composite materials under comparatively moderate conditions, paving the way for lighter, stronger, and more durable components. Such materials are particularly valuable for mechanical engineering applications, where performance, efficiency, and longevity are critical. Manufacturing and construction also experienced notable progress through large-scale additive manufacturing. These technologies promise to reduce construction time, material usage, and waste, while enabling new design freedoms in large engineering systems.

Space exploration also reached historic milestones in 2023. The successful return of samples from the Moon's far side by China's Chang'e 6 mission provided unprecedented geological data, deepening understanding of lunar evolution and planetary formation. These achievements further stimulated advancements in space-grade mechanical systems, robotics, and thermal management technologies. In parallel, artificial intelligence and computational sciences progressed rapidly.



The emergence of AI models capable of generating realistic videos from text, along with developments in neuromorphic computing, signalled a shift toward more efficient and intelligent computing systems. Artificial Intelligence (AI) has emerged as a powerful tool across scientific disciplines. AI-driven simulations now accelerate research by predicting material properties, optimizing system designs, and reducing the need for costly physical experiments. Text-to-video AI models and digital twins became more accurate, allowing engineers to visualize and test designs virtually before manufacturing. These technologies are expected to enhance data interpretation, accelerate scientific discovery, and enable new modes of interdisciplinary research. For mechanical engineering enthusiasts, this emphasizes the importance of learning data analytics, simulation tools, and AI-assisted design methods, alongside core engineering fundamentals.

Focus of Mechanical Engineering Innovations in 2023

1. Additive Manufacturing and Advanced Fabrication



Additive manufacturing continued to advance beyond prototyping into full-scale industrial production in 2023. Metal 3D printing enabled the fabrication of complex aerospace and automotive components with reduced weight and improved structural performance. The adoption of hybrid manufacturing

approaches, which integrate additive processes with conventional machining, further enhanced precision, efficiency, and design flexibility. Large-scale additive manufacturing also supported the efficient production of complex structures while minimizing material waste. The demonstration of the world's largest 3D printers, capable of fabricating massive structural components at unprecedented speeds, marked a major shift in industrial production. Together, these trends underscore the growing importance of Design for Additive Manufacturing (DfAM) as a critical skill for future mechanical engineers.

2. Sustainability and Green Mechanical Engineering

Sustainability emerged as a central focus of mechanical engineering in 2023, guiding the development of energy-efficient systems, environmentally responsible materials, and lifecycle oriented design strategies. Key innovations included advanced heat exchangers, high-efficiency electric motors, renewable energy technologies, and recyclable composite materials. Through these efforts, mechanical engineers are playing an increasingly vital role in mitigating climate change by creating systems that reduce environmental impact without compromising performance. These advancements reflect the broader industrial shift toward sustainable production practices and low-carbon energy solutions.



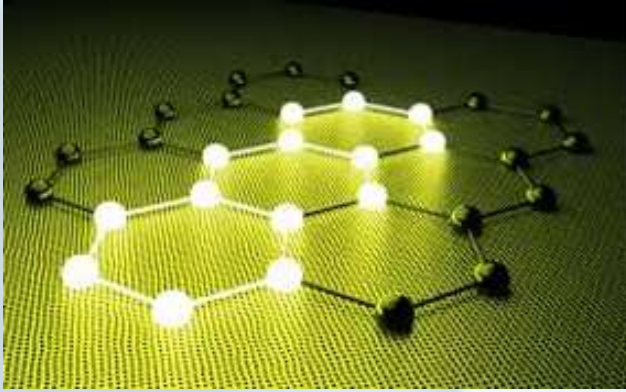
3. Automation, Robotics, and Smart Manufacturing



Industry 4.0 concepts achieved greater maturity in 2023 as smart factories increasingly combined IoT sensors, robotics, artificial intelligence, and machine learning within unified control frameworks. This integration enabled predictive maintenance, real-time process monitoring, and adaptive manufacturing, leading to higher efficiency and operational flexibility. Collaborative robots were widely adopted to work safely alongside human operators, improving productivity while supporting flexible production environments. Mechanical engineering research played a key role in these advances, particularly through progress in adaptable and autonomous robotic systems that integrate mechanical design, sensing, and intelligent control. Beyond factory automation, smart machines equipped with sensors and data analytics transformed the design and operation of mechanical systems across applications ranging from advanced HVAC installations to medical and service robots. Together, these developments highlight the growing influence of data-driven intelligence in modern mechanical engineering.

2. Automation, Robotics, and Smart Manufacturing

4. Advanced Materials and Smart Structures



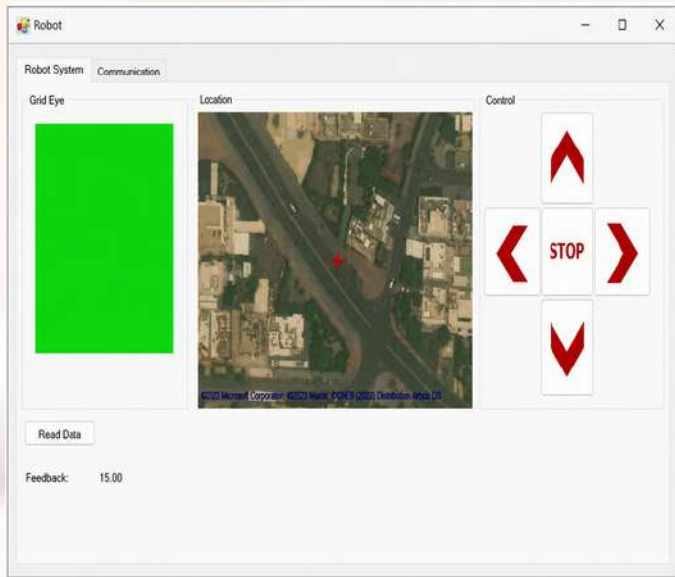
The development of advanced composites, lightweight alloys, and smart materials gained significant momentum in 2023. Materials such as shape-memory alloys, self-healing systems, and vibration-damping composites found increasing use in aerospace, automotive, and biomedical

applications. These innovations enable engineers to design structures that respond to operating conditions, enhancing reliability, performance, and functional efficiency. Collectively, emerging material technologies are equipping mechanical engineers with powerful tools to create stronger, lighter, and more durable machines and systems.

Conclusion

The year 2023 clearly illustrated the combined impact of science and mechanical engineering in advancing innovation and societal well-being. As technologies become more intelligent, sustainable, and interconnected, mechanical engineers continue to play a vital role in developing solutions that strengthen industries, safeguard the environment, and enhance quality of life. The accelerating interaction between fundamental scientific research and engineering practice has significantly shortened the path from discovery to application. Mechanical engineers are central to this transition, applying scientific insights to create sustainable energy systems, intelligent infrastructure, robotics, and advanced manufacturing technologies. Together, these advances reflect the evolving nature of modern science and engineering and emphasize the increasing importance of interdisciplinary collaboration in building a resilient, technologically driven future.

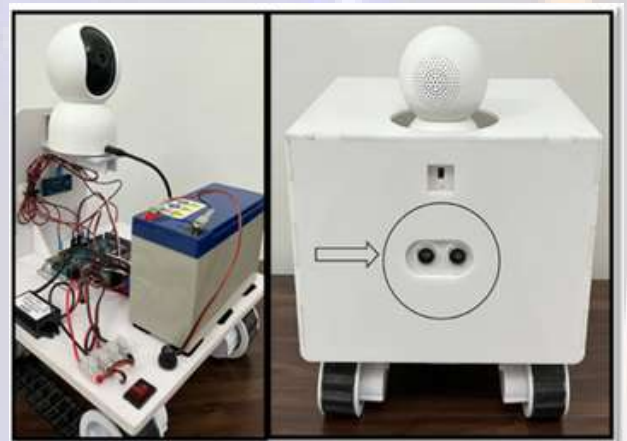
Smart Earthquake Rescue Robot (SERR)



Earthquake rescue operations are extremely challenging due to unstable debris, limited visibility, and high risk to human rescuers. To address these challenges, the Smart Earthquake Rescue Robot (SERR) has been developed as an efficient and safe solution for post-earthquake survivor detection. SERR is a four-wheel mobile robot designed with a reinforced chassis, shock-absorbing suspension, and a low center of gravity, enabling stable movement over uneven rubble. Its lightweight aluminum frame ensures durability while maintaining portability, and a rechargeable battery allows up to three hours of continuous operation.

SERR integrates multiple sensing technologies to prioritize human detection.

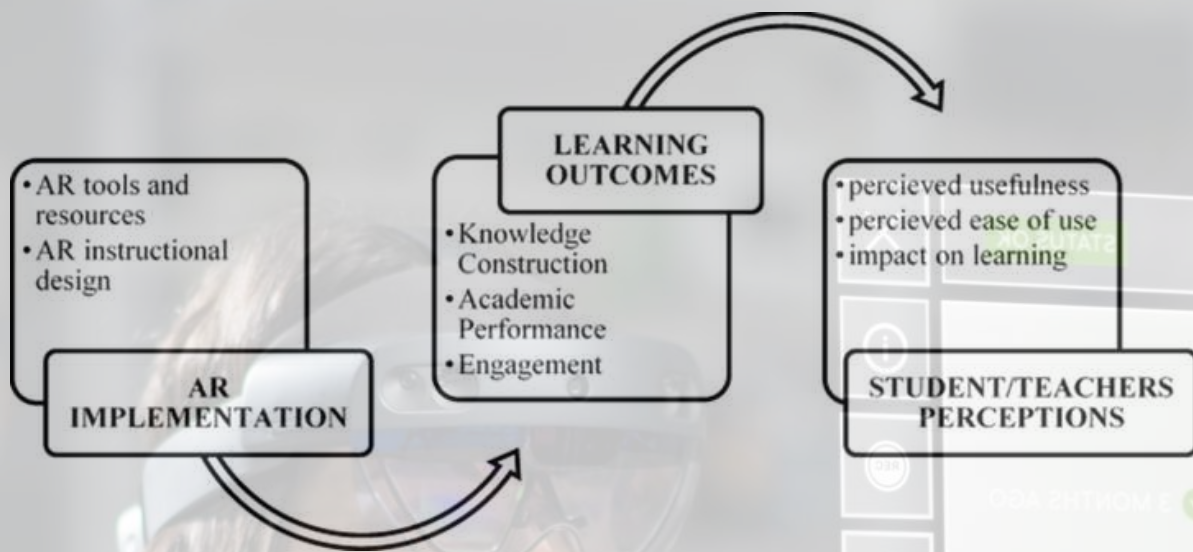
A Grid-Eye thermal sensor identifies living humans or animals by detecting temperature variations, even in cases where victims are unconscious. An ultrasonic sensor enables obstacle detection by halting the robot at a safe distance, while a camera provides real-time video streaming to rescuers through a smartphone application. The system is controlled wirelessly using an RF module connected to a PC and mobile interface, ensuring remote operation and reduced risk to rescue teams.



The robot's workflow includes continuous sensor monitoring, real-time data processing, and dynamic threshold adjustment for reliable obstacle detection. Validated through simulations and prototype testing, SERR demonstrates strong potential to enhance rescue efficiency, improve survivor localization, and support safer disaster response operations.

R. ADWAITH MOHAN
S2 ME A

The Impact of Augmented Reality on Students

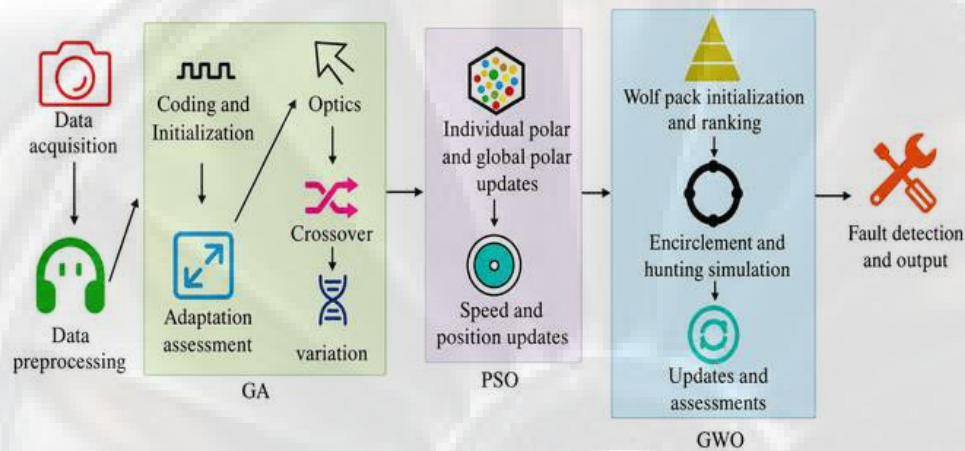


Augmented reality (AR) is transforming the way students learn by blending digital information with the real-world environment. Unlike traditional learning methods that rely heavily on textbooks and static visuals, AR allows students to interact with three-dimensional models, simulations, and virtual overlays in real time. This interactive approach makes abstract concepts easier to understand, especially in subjects such as science, engineering, medicine, and mathematics, where visualization plays a critical role.

One of the most significant impacts of AR on students is increased engagement. By turning lessons into immersive experiences, AR captures attention and encourages active participation rather than passive learning. Students can explore complex structures, conduct virtual experiments, and visualize processes that are difficult or unsafe to replicate in physical classrooms. This hands-on learning improves concept retention and helps students develop stronger problem-solving and critical-thinking skills.

AR also supports personalized learning. Students can progress at their own pace, revisit concepts as needed, and receive immediate visual feedback. For educators, AR provides innovative tools to explain complex topics more effectively and adapt teaching strategies to different learning styles. However, challenges such as high implementation costs, limited access to devices, and the need for teacher training must be addressed. Overall, augmented reality has a positive and lasting impact on students by making learning more engaging, interactive, and effective.

Automated Fault Detection System for Aircraft Turbine Blades



An automatic detection system for aircraft engine turbine blade faults plays a critical role in ensuring flight safety, engine reliability, and cost-effective maintenance. Turbine blades operate under extreme conditions of high temperature, pressure, and rotational speed, making them highly susceptible to faults such as cracks, erosion, corrosion, deformation, and foreign object damage. Early detection of these defects is essential to prevent catastrophic engine failure.

Modern automatic detection systems combine advanced sensors, signal processing, and intelligent algorithms to monitor blade health in real time. Techniques such as vibration analysis, acoustic emission monitoring, thermal imaging, and ultrasonic inspection are widely used to capture fault-related signatures during engine operation. These signals are processed using digital filtering and feature extraction methods to identify abnormal patterns associated with blade damage.

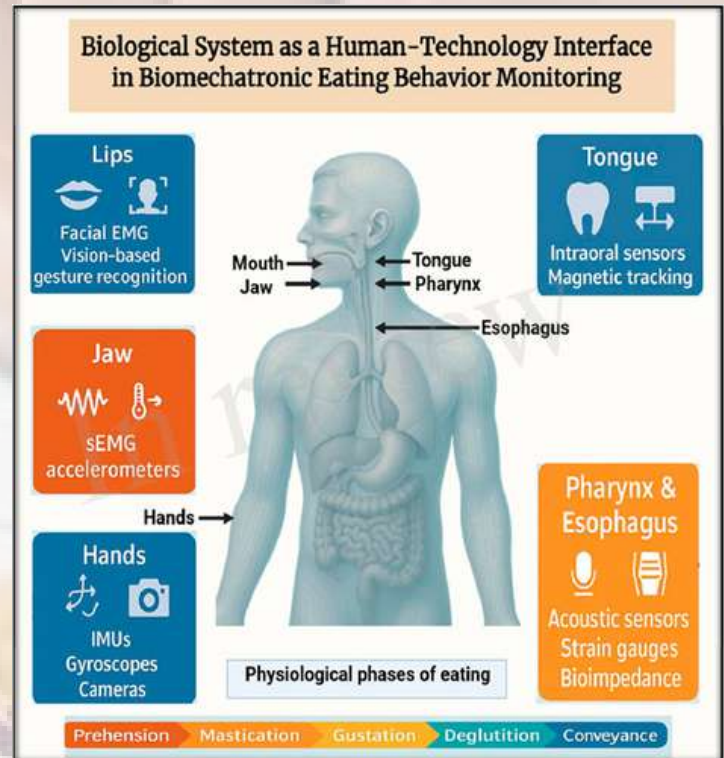
In recent years, machine learning and artificial intelligence have significantly enhanced detection accuracy by enabling systems to learn from historical data and distinguish between normal operating conditions and early-stage faults.

Non-contact inspection methods, including computer vision and infrared thermography, allow rapid and precise fault identification without dismantling the engine, reducing downtime and maintenance costs. Automated systems also support predictive maintenance by estimating remaining useful life and scheduling repairs before failures occur. Overall, automatic turbine blade fault detection systems improve operational safety, enhance engine performance, and support the aviation industry's shift toward smarter, condition-based maintenance strategies.

Real-Time Biomechatronic Monitoring of Eating Behaviour

A biomechatronic system for the real-time monitoring and modulation of eating behavior integrates mechanical design, electronics, sensors, and intelligent control to study and influence human dietary patterns. Such systems combine wearable or implantable sensors with microcontrollers to continuously monitor physiological signals related to eating, such as jaw movement, muscle activity, swallowing patterns, and chewing force. By capturing these signals in real time, the system can accurately detect eating events and analyze eating speed, frequency, and duration.

The collected data are processed using embedded algorithms or machine learning models to identify unhealthy eating behaviors, including rapid eating or irregular meal patterns. Based on this analysis, the system can provide immediate feedback to the user through haptic, visual, or auditory cues, encouraging mindful eating and better portion control. In advanced designs, adaptive control strategies allow the system to modulate feedback intensity according to individual behavior and long-term trends.

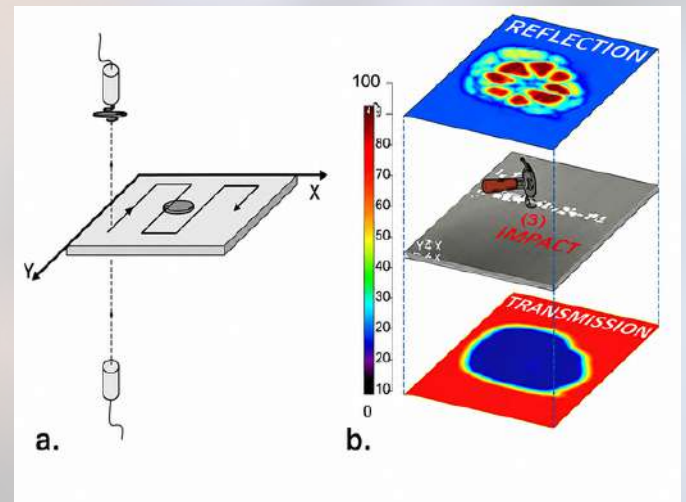


Biomechatronic eating-monitoring systems have strong potential applications in obesity management, metabolic disorder prevention, and behavioral therapy. They also offer valuable data for nutritional research and personalized healthcare. Despite challenges such as sensor accuracy, user comfort, and data privacy, these systems represent a promising approach to promoting healthier eating habits through real-time, technology-driven intervention.

NDT Techniques for Composite Materials

Non-destructive testing (NDT) techniques play a vital role in the inspection and quality assurance of composite materials, which are widely used in aerospace, automotive, marine, and wind energy applications. Composites offer high strength-to-weight ratios and excellent fatigue resistance, but they are susceptible to defects such as delamination, matrix cracking, fiber breakage, and voids that are often invisible on the surface. NDT methods enable the detection of these defects without damaging the component.

Ultrasonic testing is one of the most commonly used techniques for composite inspection, as it can identify internal flaws and delamination with high accuracy. Radiographic testing is effective for detecting voids, inclusions, and fiber misalignment, especially in thick composite sections. Infrared thermography is a fast, non-contact method that reveals subsurface defects by analyzing heat flow variations. Eddy current testing is useful for inspecting conductive composite structures, particularly those reinforced with carbon fibers. Acoustic emission testing allows real-time monitoring of damage progression under load.

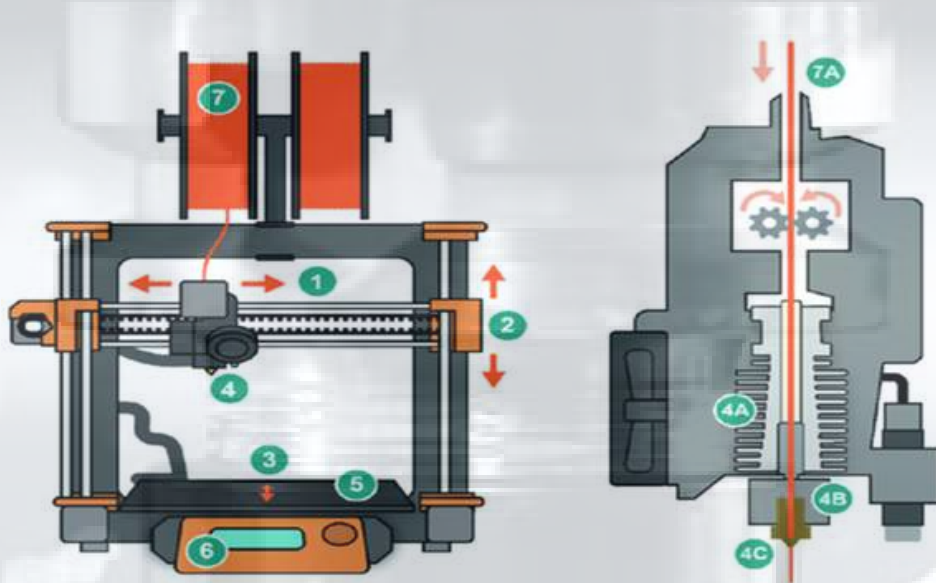


Eddy current testing is useful for inspecting conductive composite structures, particularly those reinforced with carbon fibers. Acoustic emission testing allows real-time monitoring of damage progression under load.

By combining multiple NDT techniques, engineers can achieve comprehensive evaluation of composite structures. These methods improve reliability, extend service life, and ensure safety in critical applications while reducing inspection time and maintenance costs.

ELSA ROSEMARY
S6 ME A

Integration of CAM with Additive Manufacturing



The integration of Computer-Aided Manufacturing (CAM) with additive manufacturing has significantly advanced modern production systems by combining digital precision with manufacturing flexibility. Traditionally, CAM was associated with subtractive processes such as CNC machining, where material is removed to achieve the desired geometry. With the inclusion of additive manufacturing, CAM systems now support hybrid workflows that allow parts to be built layer by layer and finished using machining operations within a single digital environment.

This integration enables efficient toolpath generation for complex geometries that are difficult or impossible to manufacture using conventional methods alone. CAM software can optimize deposition paths, control layer thickness, and manage material usage while coordinating post-processing steps such as drilling, milling, and surface finishing. As a result, manufacturers can achieve higher dimensional accuracy, improved surface quality, and reduced production time.

Hybrid CAM–additive systems are especially valuable in aerospace, automotive, and medical industries, where lightweight structures, internal channels, and customized components are essential. The ability to simulate both additive and subtractive processes within CAM also reduces errors, material waste, and trial-and-error costs. Despite challenges related to software compatibility and process standardization, the integration of CAM with additive manufacturing represents a major step toward intelligent, flexible, and efficient digital manufacturing systems.

Vision

To develop as a center of excellence in Mechanical Engineering, moulding competent engineers with social commitment, capable of undertaking technical responsibilities and innovative challenges.

Mission

M1: To build a strong foundation in Mechanical Engineering and allied areas.

M2: To mould students with good leadership qualities and nurture their entrepreneurship skills.

M3: To encourage the students for finding solutions to real engineering world problems.

M4: To provide a platform for professional development and lifelong learning along with awareness of social responsibilities.

Programme Educational Objective (PEO)

PEO 1: Graduates of the program will emerge as true professionals, capable of designing and analyzing products or processes based on engineering practices and scientific knowledge for the benefit of society.

PEO 2: Graduates of the program will be equipped to shape their career and will be able to take up challenges and find solutions to problems related to Mechanical Engineering or allied fields.

PEO 3: Graduates of the program will succeed in multicultural and multidisciplinary environment, imbibing the spirit of lifelong learning and societal commitment.

