PANIMALAR ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

PECMEC'24

MECHANICAL ENGINEERING

- DEPARTMENT ACTIVITIES
- STUDENT ACHIEVEMENTS
- ARTICLES

APRIL 2024

PECMEC'24

MECHANICAL ENGINEERING

PANIMALAR ENGINEERING COLLEGE

An Autonomous Institution

[JAI SAKTHI EDUCATIONAL TRUST]

Approved by AICTE | Affiliated to Anna University | Recognized by UGC

All Eligible UG Programs are Accredited by NBA

Bangalore Trunk Road, Varadharajapuram, Poonamallee, Chennai- 600 123

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Congratulations to the editorial team for all oftheir hard work and attention in putting the magazine together.

I am pleased to report that the Mechanical Engineering Department contributes to society by producing competent and innovative professionals.

"Imagination is more important than knowledge," Einstein famously observed.

"Logic will take you from point A to point B, but imagination will take you everywhere."

Develop your imagination!

Dr. C. SAKTHIKUMAR, M.E., Ph.D.,

DIRECTOR

PECMEC'24 demonstrates the students' ability. The goal ofthe college magazine is to bring out hidden talents and abilities, as well as providing a forum for studentsto show...case their literary ability.

I'd want to offer my heartfelt gratitude to all of the contributors to this issue's pieces. This publication is available because of people's willingness to share their expertise, & perspectives with others

Vision of the Department of Mechanical Engineering

The Department of Mechanical Engineering will be globally recognized as a pioneer for its excellence in teaching and research in the field of Mechanical and allied Engineering disciplines.

Mission of the Department of Mechanical Engineering

M1: To provide world-class education and pioneering research opportunities, enabling students and faculty to contribute meaningfully to society through innovation and excellence.

M2: To advance engineering and science by fostering technological innovation, academic excellence, and strong industry collaborations for impactful research and technology transfer.

M3: To develop skilled, innovative, and entrepreneurial graduates who drive national and global sustainable development.

Program Educational Objectives (PEOs) of the Program

PEO1: Technical Competence and Problem-Solving: Achieve success in careers that deal with the design, simulation and analysis of engineering systems, experimentation and testing, manufacturing, technical services, and research to implement effective solutions for real-world engineering challenges.

PEO2: Career Growth and Leadership: To actively embrace impactful leadership roles in the practice of Mechanical Engineering in industry and government organizations (including both traditional and emerging technical areas) as well as in public service organizations.

PEO3: Innovation, Research and Ethical Excellence: Conduct multi-disciplinary research and development (via graduate study or industry) resulting in tangible applications that advance technology and foster innovation in order to compete successfully in the global economy.

PEO4: Lifelong Learning and Societal Contribution: Commit to continuous learning, adapting core knowledge, and competing in the ever-changing multicultural global enterprise to ethically contribute to society.

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and

research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO1: Fundamental Domain Knowledge: Design mechanical systems in various fields of machine elements, thermal, manufacturing, industrial and inter disciplinary fields using engineering/technological tools.

PSO2: Usage of software programs: Resolve new challenges in Mechanical Engineering using modern computer tools and software programs.

PSO3: Continual learning and Research: Develop intellectual and technical solution to complex mechanical problems through continual learning and research.

STUDENT ACHIEVEMENTS

KART RACING CHAMPIONSHIP

Event Name: A National Level Go-Kart Event - 2024
Organized by: Academy of Indigenous Motor Sports & Hindustan Engineering College, Chennai
Participants: Department of Mechanical Engineering Students

The 2024 National Level Go-Kart event, organized by the Academy of Indigenous Motor Sports and Hindustan Engineering College, witnessed thrilling competition among mechanical engineering students. Teams displayed impressive design and racing skills in an intense contest of innovation and precision. The students from the Department of Mechanical Engineering not only showcased their technical expertise but also outperformed their rivals to clinch the title of overall champions. The event celebrated student excellence in automotive engineering and fostered a spirit of innovation and teamwork, reinforcing the importance of hands-on learning in engineering education.

GO KART EVENT

The recent go-kart event was an exhilarating experience that showcased the talent and teamwork of our mechanical engineering students. After months of dedicated effort, meticulous planning, and relentless testing, our team emerged victorious, clinching the first prize!

On race day, excitement filled the air as teams prepared their karts. Our students demonstrated exceptional skill and strategy, navigating the track with precision and determination. Their hard work truly paid off as they crossed the finish line ahead of the competition, earning a well-deserved victory. During the award ceremony, the Secretary and Correspondent took the stage to congratulate the winning team. They praised the students for their innovative designs and collaborative spirit, emphasizing how this victory reflects the essence of our engineering community. “Your commitment and teamwork have not only brought home the trophy but have also inspired us all,” they remarked.

The event fostered camaraderie and a sense of achievement among participants, highlighting the practical applications of their studies. As the team celebrated their success, they set a benchmark for future competitions, demonstrating what can be accomplished through hard work and collaboration. This win is just the beginning, and we eagerly anticipate the team’s future endeavors! Congratulations to all!

Blending the Mechanical and Digital

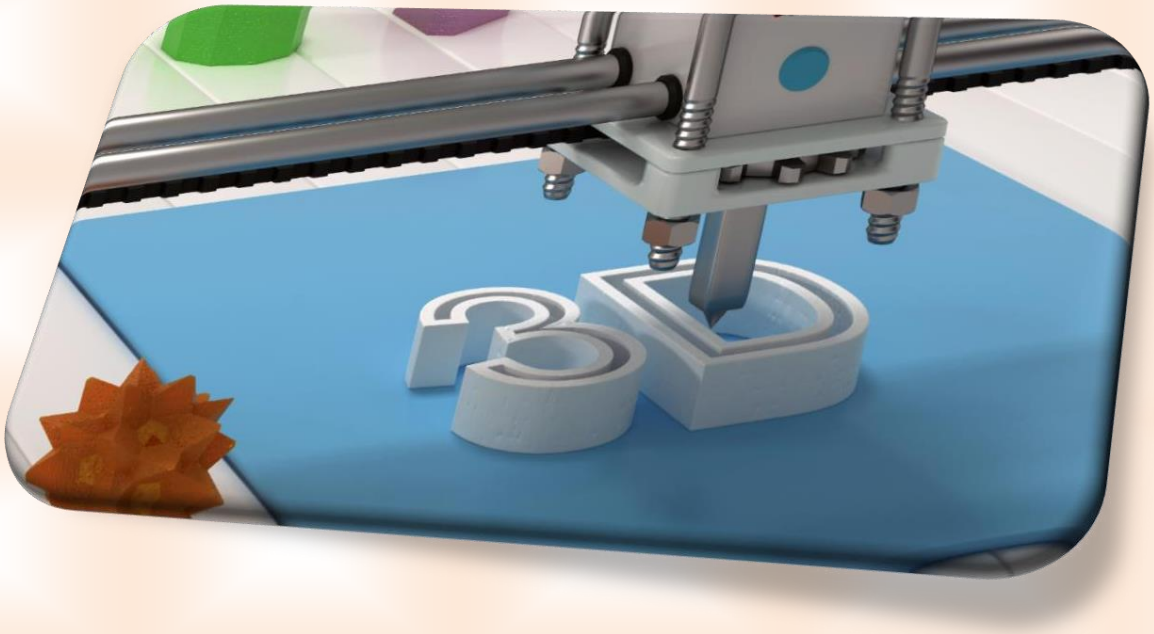
AI, robots, and additive manufacturing will probably be the key technology propelling all engineering specialties over the next decades, software and electrical engineers cannot often implement their concepts without the assistance of mechanical engineers.

This increase in multidisciplinary engineering promises well for the employment outlook of mechanical engineers. However, it will need an industry-wide expenditure on continuous learning, from recent graduates to mid-career technicians to senior experts.

-SANJAY KUMAR K S
FINAL YEAR MECH

Growth of Additive Manufacturing / 3D Printing

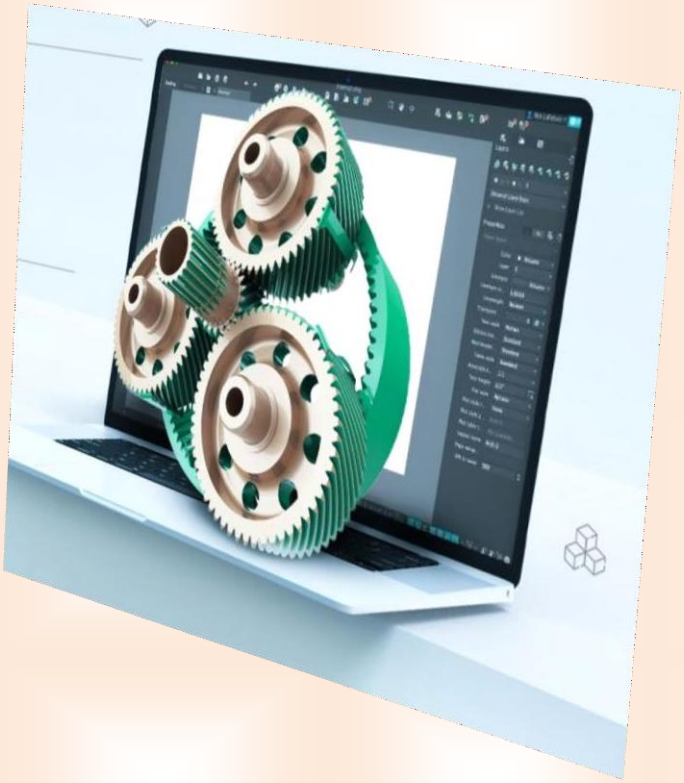
Additive manufacturing, known colloquially as 3D printing, is reshaping manufacturing practices globally with the push toward creating sustainable materials and flexible systems for on-demand 3D printing.



-M. SATHISH
FINAL YEAR MECH

New Uses for CAD

Computer-aided design or CAD is a system that mechanical engineers have used for decades. Instead of just using it for design, it has become a tool for everything from performance simulations and stress tests to generative design and digital twinning.

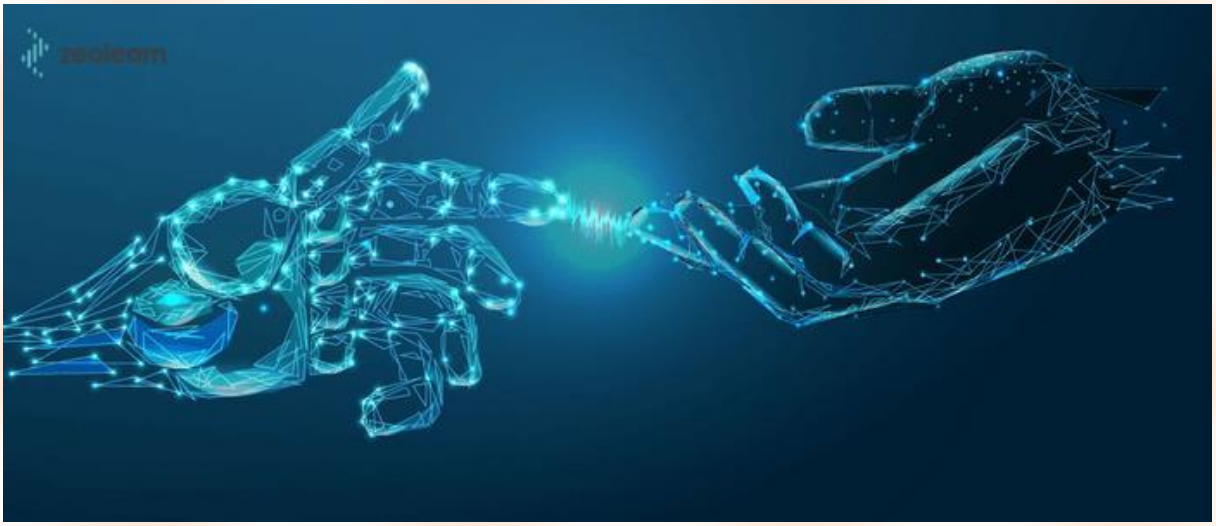


Engineers will find unique new ways and new applications for newer CAD versions in the coming years.

-HIRTHIC RAAJ T
THIRD YEAR MECH

Adopting Digital Twin Technology

Engineers often find themselves drowning in prototypes and physical models while making small changes to the design. Digital twinning is gaining popularity as a tool to reduce the number of physical prototypes necessary to complete a project. A digital twin is a virtual model that accurately represents an item in the physical world.



The digital twin can be equipped with virtual sensors, allowing mechanical engineers to put their products through stress and performance tests without creating a new prototype for each test. All the information collected in the digital space can be used to perfect the twin in the physical world.

-IMMANUVEL E
FINAL YEAR MECH

LATEST INFORMATION

- KARTHICK R
III YEAR MECH

1. Mechanical Engineering Innovations

- **AI-Optimized Turbomachinery**:
  Rolls-Royce unveiled its **UltraFan® engine**, the world's largest and most efficient jet engine prototype, leveraging AI to optimize blade design for 25% greater fuel efficiency. The engine also uses lightweight ceramic matrix composites (CMCs) for high-temperature resilience.
  - *Impact*: Reduces aviation emissions and sets a benchmark for sustainable propulsion.
- **3D-Printed Wind Turbine Bases**:
  GE Renewable Energy partnered with COBOD to 3D-print **concrete bases for wind turbines**, cutting material use by 30% and construction time by 65%. The project aims to scale up for offshore wind farms.
  - *Impact*: Accelerates renewable energy deployment while lowering costs.
- **Heat-Resistant Alloys**:
  MIT developed **AI-designed superalloys** capable of withstanding 1,400°C, ideal for next-gen gas turbines in power plants and hypersonic vehicles.
  - *Impact*: Enhances efficiency and lifespan of high-temperature mechanical systems.

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2. Aerospace & Aeronautics

- **NASA's X-59 Quiet Supersonic Jet**:
  NASA's **X-59 QueSST** completed critical ground tests, aiming to fly at Mach 1.4 without producing disruptive sonic booms. The aircraft uses advanced shaping and propulsion to enable commercial supersonic travel over land by 2030.
  - *Impact*: Could revolutionize air travel by lifting supersonic flight bans over populated areas.
- **Electric Aircraft Breakthroughs**:
  Eviation's **Alice**, the world's first all-electric commuter plane, secured FAA certification for test flights. It promises zero emissions and 440-mile ranges, targeting regional air travel.

- *Impact*: Paves the way for decarbonized short-haul aviation.

- **Reusable Rocket Milestones**:
  SpaceX's **Starship** completed its first integrated flight test, demonstrating rapid reusability for deep-space missions. Meanwhile, Relativity Space's 3D-printed **Terran R** rocket aims to compete in the reusable launch market by 2026.
  - *Impact*: Slashes launch costs and supports lunar/Mars exploration.

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3. Energy & Power Plants

- **Nuclear Fusion Progress**:
  The **ITER project** in France achieved a critical milestone by completing the installation of its superconducting magnets, paving the way for "first plasma" experiments in 2025. Private firms like Helion Energy also reported breakthroughs in **plasma compression** for net-energy-gain fusion.
  - *Impact*: Brings carbon-free baseload power closer to reality.
- **Green Hydrogen Mega-Projects**:
  Saudi Arabia's **NEOM** launched the world's largest green hydrogen plant, powered by 4 GW of solar/wind energy, to produce 600 tons of hydrogen daily by 2026.
  - *Impact*: Targets steel, shipping, and aviation industries seeking fossil-free fuels.
- **Advanced Geothermal Systems**:
  Fervo Energy's **horizontal drilling technology** unlocked geothermal energy in Nevada, generating 3.5 MW of continuous power from previously untappable hot rock formations.
  - *Impact*: Expands geothermal potential beyond volcanic regions.

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4. Power Plant Technology

- **Small Modular Reactors (SMRs)**:
  Rolls-Royce's **470 MWe SMR** received UK regulatory approval for deployment by 2029. Each unit can power 1 million homes and fits on a football field.
  - *Impact*: Offers scalable, low-carbon energy for grids and industrial hubs.
- **Carbon Capture Retrofits**:
  ExxonMobil and Mitsubishi Heavy Industries unveiled a **modular carbon capture**

system for existing gas/coal plants, claiming 90% CO2 capture rates at half the cost of traditional systems.

- *Impact*: Helps aging plants meet net-zero targets.

- **Hybrid Solar-Wind-Storage Plants**:
  China's **Kunming Integrated Energy Project** combines 1 GW of solar, 500 MW of wind, and a 200 MW/800 MWh battery, achieving 95% grid reliability without fossil backups.
  - *Impact*: Proves viability of 100% renewable baseload power.

5. Mechanical Software Advancements

- **Digital Twin Dominance**:
  Siemens' **Simcenter™** introduced AI-powered digital twins for predictive maintenance in power plants, simulating real-time wear in turbines and reactors.
  - *Impact*: Reduces downtime and extends asset lifecycles.
- **Generative Design for Aerospace**:
  Dassault Systèmes' **CATIA Generative Design** enabled Airbus to redesign an aircraft bracket with 45% less weight while maintaining strength, using AI-driven topology optimization.
  - *Impact*: Accelerates lightweight, sustainable component design.
- **Open-Source CFD Tools**:
  The release of **OpenFOAM v11** introduced GPU acceleration, cutting simulation times for aerodynamics and fluid systems by 70%.
  - *Impact*: Democratizes high-fidelity simulations for SMEs and researchers.