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MECHANICA

Mechanical Engineering Department

About the Department

The Department of Mechanical Engineering started the journey in 1999, and successfully completed 22 years with excellence. Presently, the department is the largest in the institute having 46 faculty members. The department offers two UG courses, one in Mechanical Engineering and another in Mining Machinery Engineering. Faculty members of the department have guided more than 200 PhD students so far. The UG and PG students are working with the faculties in the fields of microfluidics, aero-acoustics, bubble dynamics, biomechanics, robotics, renewable energy, tribology, refrigeration, CFD, Fluid-structure interactions, Turbomachinery, modern-manufacturing, fluid power, mining machinery along with conventional thermal engineering and machine design. Department students are associated with the Robotics Club, Smart Manufacturing, ASME students' chapter and other professional bodies. The department's UG and PG students are associated with several national and international research and consultancy projects funded by several agencies and industries. Also, a good number of them complete their research internships abroad.

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Recent Publications

B. K. Choure, **T. Alam**, R. Kumar. Journal of Energy Storage, 102, 113981, 2024.

S. K. Mishra and **S. Sen**. Physics of Fluids, 36(7), 073614, 2024.

Rakesh Kumar, Aditya K. Nag, S. Sarkar, Renewable Energy, ELSEVIER, 232, 121110, 2024.

K. Tripathi, **A. Bhandari**. Physics of Fluids, 36(9), 091919, 2024.

S. K. Dutta, **D. K. Mandal**. Physics of Fluids, 36, 062109 (1-13), 2024.

K. C. Tripathy, Md. Sirajullah, **D. K. Mandal**, **A. Bhandari**. Physics of Fluids, 36, 011912, 2024.

S. Chakraborty, V. T. Mantripragada, A. Chakravarty, D. Goswami, **A. Poddar**, Computer Methods and Programs in Biomedicine, 257, 108437, 2024.

R. Bajaj, K. B. Mardi, A. K. Srivastava & **A. R. Dixit**, International Journal of Advanced Manufacturing Technology, 134, 3531–3549, 2024

A. Kumar, K. Sharma & **A. R. Dixit**, Polymer Bulletin, 81, 16137–16156, 2024

Neha Chaturvedi, **Swagata Bhaumik**, Rituparn Somvanshi, Physics of Fluids 36, 084114, 2024.

S Maheshwari, A Kumar, PS Chaurasia, T Niranjan, **Z Alam**, S.S. Singh, Rapid Prototyping Journal, 30 (7), 1462-1475, 2024.

S Kumar, S.R. Sahay, **S.S. Singh**, P Rozycki, Polymer Composites, 1-16, 2024.

M. Chavhan, **P.K. Singh**, Applied Thermal Engineering, 256, 124079, 2024.

B. Joshi, T. K. Sengupta, P. Sundaram, **A. Sengupta**, Computers & Fluids, 284, 106442, 2024.

P Ambedkar, **T Dutta**. Applied Thermal Engineering, 257 Part C, 124470, 2024.

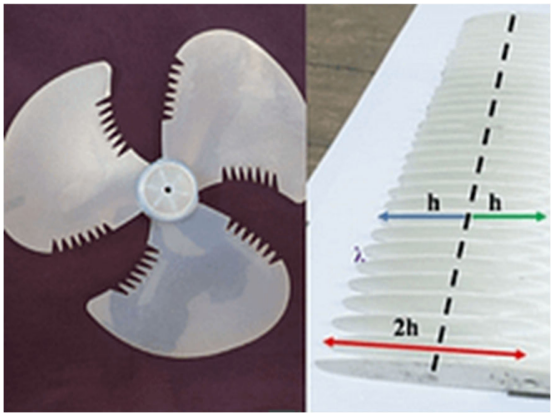
P Ambedkar, **T Dutta**. Chemical Engineering Research and Design. 210, 493-505, 2024.

A. Kumar, **R. Kumar**, Dheeraj Kumar, Sustainable Energy Technologies and Assessments, 70, 103950, 2024.

A. Kumar, **R. Kumar**, Journal of Energy Storage, 101, 113741, 2024.

Major Research Findings

- A fascinating study conducted at Biofluids Research Lab led By **Prof. Ajay Bhandari** elucidates the complex interplay between the retinal artery structural changes (caused by diabetes) and the underlying hemodynamics. To unveil it, particle streak velocimetry experiments are carried out on 3D-printed transparent retinal artery phantoms using blood-mimicking fluid. The study demonstrated how the altered retinal topology, particularly tortuous and narrowed regions, facilitates changed blood flow, thus serving as a reference guide for ophthalmologists to give the tortuous and reduced lumen diameter regions extra care when making intelligent prognoses for diabetic patients. This study was published in Physics of Fluids. In addition, it was selected as a featured article by the editor, and a Scilight story was published.
- A study led by **Prof. Antarip Poddar** finds that higher hematocrit (Hct) levels shorten recirculation zones behind stenoses, stabilize vortices, and increase wall shear stress (WSS), raising the risk of plaque rupture in diabetes but reducing oscillatory shear index (OSI) and plaque formation potential. In contrast, lower hematocrit (Hct) level promotes vortex instability, increases OSI, and expands regions prone to plaque formation. Eccentric stenosis further amplifies flow disturbances, with diabetes suppressing jet instability while anemia increases vortex shedding. Higher Hct levels reduce flow fluctuations over the cardiac cycle, shorten jet length, and promote flow symmetry, indicating that blood viscosity plays a critical role in altering flow dynamics and disease progression.
- Researchers from IIT (ISM), led by **Prof. Subramanian Narayanan**, have designed an advanced airfoil inspired by barn owl wings to reduce aircraft noise significantly. The DST supports the team's innovative design incorporating wavy serrations at the leading and trailing edges, unlike traditional serrated airfoils. This unique structure has demonstrated notable noise reduction across various frequencies, with potential applications in aircraft wings, wind turbines, and fan blades. The leading-edge serrations reduce turbulence interaction noise, while the trailing edge serrations target self-noise emissions. Early tests indicate up to a 4-decibel noise reduction, offering a breakthrough in aerodynamic noise control. The team has effectively minimized broadband noise through extensive theoretical and experimental work, promising substantial advancements in quiet aerodynamic design.
- A research team led by **Prof. Ajit Kumar** from the Department of Mechanical Engineering has developed a multi-armed drilling system that significantly enhances mining productivity while lowering operational costs. The new machine features a central mast connected to four extendable boom arms, each of which holds a drill. This innovative design allows for the flexible adjustment of the boom arms, enabling simultaneous drilling of multiple holes based on specific mining requirements. The key advantage of this system over traditional machines is its ability to drill four holes at once, which reduces downtime caused by machine repositioning. This results in improved efficiency and faster drilling, cutting down on the overall time spent on drilling tasks. The team also highlighted that the machine's ability to replace four separate drills with a single unit lowers maintenance costs and boosts fuel efficiency. Additionally, the need for less frequent repositioning reduces the overall maintenance demands of the machine.



Patents

- Ashish Siddharth, **Arun Dayal Udai, and Ajay Bhandari**, Method and Equipment for Ocular Surgery and Drug Delivery (Filed). Application No: 202431060703.

- Amit Rai Dixit, Annada Prashad Moharana, Ratnesh Raj, Automatic Fibre Placement in Vat-photopolymerization Additive Manufacturing Process for Composite Material Fabrication, Application Number: 20243107179, Patent Status: Published

R&D Project

- Prof. Ajit Kumar (Principal Investigator) and Prof. Niranjan Kumar (Co-Principal Investigator) have been awarded a research and development project titled "Development of Energy Efficient Ergonomically Designed (EEED) Chair Lift Man Riding System." The project has secured a funding of ₹53.95 lakhs from CMPDI, Coal India Limited, under the Ministry of Coal, Government of India.

Individual faculty achievement

- Prof. Somnath Chattopadhyaya and Prof. Alok Kumar Das attended the BIS Convention for Mechanical Engineers on 20-21 September 2024 at Goa and presented the activities related to BIS of IIT(ISM) Dhanbad. Only three out of 92 institutes (with whom BIS signed the MOU) were invited to present their cases.
  Reference:
  https://www.services.bis.gov.in/php/BIS_2.0//bisconnect/sfile/sstore2/news_2024-09-30.pdf
- Prof. Somnath Chattopadhyaya became a member of the Editorial Board of a Polish Journal “Advances In Science and Technology Research Journal” (SCOPUS Indexed). This journal is under the supervision of Polish Academy of Science (PAN).
- Prof. Ajit Kumar was inducted as an executive member of the National Academic Council of the Fluid Power Society of India (FPSI) for 2024-26. FPSI, established in 1973, aims to promote the potential of the fluid power industry to all stakeholders.
- Prof. Subramanian Narayanan was appointed as Associate Editor for the ASME Journal of Engineering and Science in Medical Diagnostics and Therapy.
- Prof. Ajay Bhandari was awarded “Gullapalli Young Investigator Award” at Sign 2024 Conference, Hyderabad for outstanding research work in the field of Computational Oncology and awarded 1000 USD cash prize.

International Collaboration

The University of Akron (UA) and the Indian Institute of Technology (Indian School of Mines) Dhanbad (IIT(ISM)) have entered into a Memorandum of Understanding (MoU) aimed at enhancing academic collaboration and fostering innovation in conventional and Advanced Manufacturing, Precision Engineering and Surface Finishing, and Industry 4.0 Technologies. The MoU was signed by a representative of the University of Akron and IIT(ISM)] during a virtual ceremony, marking the beginning of a strategic partnership between the two renowned institutions. This collaboration will bring together expertise from both universities to advance research and innovation in cutting-edge areas of manufacturing and engineering.

EDP course on “Condition-Based Maintenance

Department of Mechanical Engineering organized 5-day EDP course on “Condition-Based Maintenance: Integrating Oil Analysis, Vibration Analysis, and Tribology which was coordinated by Prof. Subrata K Ghosh at IIT (ISM) Dhanbad from 23-27 Sept 2024.

New instrumental facility

An experimental facility with a low-speed open-circuit wind tunnel for the UG teaching lab was installed in the Department of Mechanical Engineering.

Executive Development Programme (EDP) on ‘Quality Engineering and Management (QEM)'

Department of Mechanical Engineering organized 5-days long Executive Development Programme (EDP) on ‘Quality Engineering and Management (QEM)' at IIT (ISM) - Industry Institute Interaction Facility (IIIF), Delhi from 17-21 September 2024 in Offline mode which was coordinated by Prof. N. K. Singh. In this event, Prof (Retd.) S P Mukherjee, Former Centenary Professor of Statistics and Former Dean of the Faculty of Science of Calcutta University, a Legendary Statistician and International Quality and Reliability Expert, inaugurated the function in online mode as Chief Guest on 17.09.2024 at 11:30 am.

Editorial Team

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