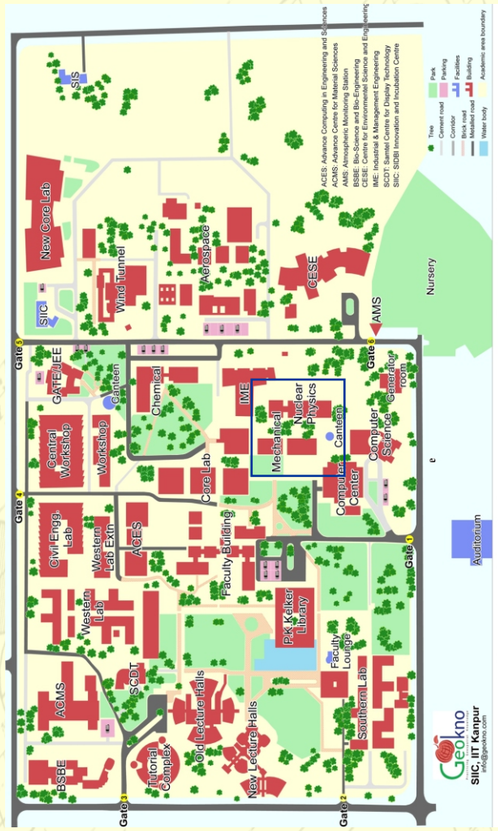
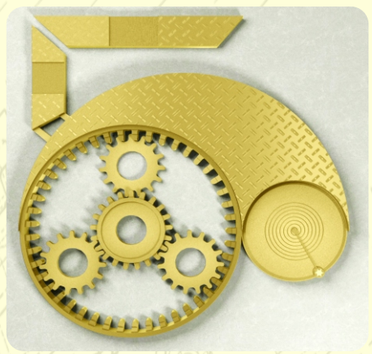
Academic Area





50 years of Mechanical Engineering
IIT Kanpur

LAYOUT DESIGN BY PRITHU PAUL

The Institute

The Indian Institute of Technology Kanpur was founded in 1959. Since then it has emerged as premier center for research and academics. IIT Kanpur nestles in a lush green campus spread over approximately 4.3 square km. The Institute provides extensive research support via centralized research facilities in addition to the department's, and also several recreational avenues.

Research facilities: The P K Kelkar library is one of the best academic libraries in the nation with a collection of more than 3,00,000 volumes and subscriptions to several thousand periodicals. The Computer Centre supports computational activities via hundreds of terminals and the PARAM 10000 supercomputer. It will soon house a high-performance computing facility. IIT Kanpur is extensively networked with institute-wide LAN and Ethernet access available everywhere. Several specialized central facilities are maintained, and these include the National Wind Tunnel Facility, the Advanced Centre for Material Science, a Nano-science centre, the Advanced Centre for Electronic Systems, the Samtel Centre for Display Technology, Centre for Mechatronics, Centre for Laser Technology, Prabhu Goel Research Centre for Computer and Internet Security, and the Facility for Ecological and Analytical Testing.

Recreational opportunities: The campus has one of the best sports facilities in the country, including a full-sized swimming pool, modern courts for squash, badminton, tennis, table-tennis, basketball and volleyball, as well as, lush green fields for athletics, football, hockey and cricket. The green campus allows for long leisurely walks/runs. Culturally, the Institue supports many active clubs that include fine arts, music, literature, dramatics, photography, astronomy, gliding (we have our own private air-strip) and trekking. Nature lovers and photographers will be delighted by the birds, butterflies, neelgai, and other animals that reside within the campus.

Kanpur

Situated on the Ganga□s banks, Kanpur stands as one of India's major industrial centres of historical, religious and commercial importance.

History: The first mention of Kanpur was made in 1579 during Sher Shah's regime. In 1801, Kanpur passed into British hands under a treaty with the Nawab of Awadh. It became British India's important military stations, and played a pivotal role during 1857's Independence War when Nana Sahib took Kanpur. At the time of independence, Kanpur was India's most important industrial city. Nationalists like Chandrashekhar Azad, Bhagat Singh, poets like Balkrishna Sharma "Navin", Shyamlal Gupta `Parshad' and Gopal Das "Niraj", and Hindi literatteurs like Acharya Mahavir Parasad Dwivedi, Ganesh Shankar Vidyarthi, Pratap Narain Mishra, Bal Krishna Sharma and Acharya Gaya Prasad Shukla "Sanehi" are associated with the city.

Sights: Bithoor is located about 10 km from IIT Kanpur. According to mythology, just after creating the universe, Lord Brahma performed the Ashvamedh Yajna at Bithoor and established a shivalingam there. Also at Bithoor is the Valmiki Ashram, where the great sage is supposed to have composed the Ramayana and where Sita was exiled. Bithoor ghat on the Ganga is historical. Jajmau, about 20 km from IIT, has an ancient fort that archaelogical excavations have dated back to the Vedic age. Legend has it that the fort belonged to King Yayati of the Chandravanshi race, the eighth in succession to Lord Brahma. The famous Siddhnath temple of Lord Shiva and the Siddha Devi temple at Jajmau belong to the Buddhist period. The nearby Bhitargaon Temple is an astonishing terraced brick structure fronted by a terracotta panel. Built in the 6th century by the Gupta Empire, it is the oldest remaining Hindu shrine with a roof and a high Shikhar. Other sites include an ancient and beautiful temple on the Ganga at Shivrajpur and the ancient temple at Panki. The Kanpur zoo is famous for its cages designed to provide a natural habitat for the animals, and has a vast variety of animals. The zoo's water supply system is a work of art. The city has one of Asia's biggest zoological garden. Exotic species of flora are present at the Chandrashekar Azad Agricultural Campus. Kanpur is also home to many residential and migratory birds that can be spotted at Bithoor, IIT Kanpur and the Ganga Canal. Finally, Kanpur is well-connected by road and train to nearby Allahabad (Prayāg), Lucknow (Awadh) and Varanasi (Kāshi) and weekend trips are easily arranged.

How to get here?

Overnight Train: New Delhi, Kolkata, Bhopal, Jhansi.
Air (Kanpur Airport): New Delhi.
Air (Lucknow Airport): Mumbai, New Delhi, Kolkata.
(Lucknow airport is a smooth two hour taxi ride from IIT)

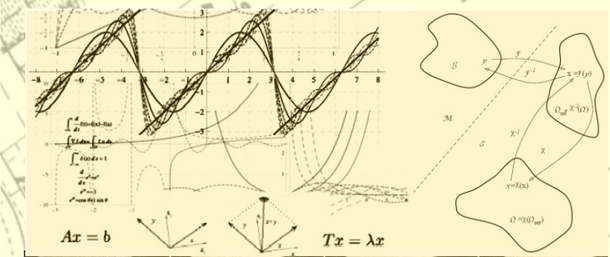
Climate:

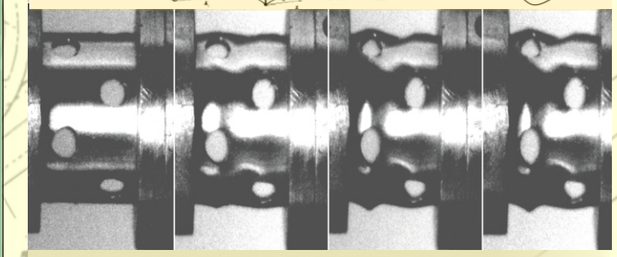
Summer: April to June. High ~ 45° c
Monsoon: July to September
Average rainfall: 885 mm
Winter: December to February. Low ~ 2° c

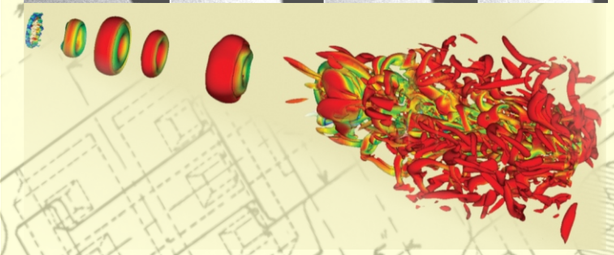
Mechanical Engineering

IIT KANPUR

www.iitk.ac.in/me
+91 512 259 7627 (Office)
+91 512 259 7408 (Fax)







दण्डैश्चचक्रैश्च दन्तैश्च सरणिभ्रमणादिभिः।
शक्तेरुत्पादनं किं वा चालनं यन्त्रमुच्यते ।।
--यन्त्रारणवः (१४ शताब्दि)

That which generates energy or motion by the rotation of shafts, wheels, gears or belts is a machine.

Yantrāṇaravah (14th AD)

The Department

Mechanical Engineering is a fundamental branch in Engineering from which much of modern technological innovation originates. Mechanical engineers routinely find themselves at the forefront of bio-medical, energy, aerospace, robotics, nuclear and geophysical research. The Department of Mechanical Engineering at the Indian Institute of Technology Kanpur aims at creating highly-trained technical manpower, providing technological solutions to societal and industrial challenges, and engaging in frontier engineering research.

Academics

The department offers the following three degree programs:

Doctoral program: Our doctoral program brings together faculty members and motivated graduate students to research and innovate in some of the most challenging problems of engineering science. We are committed to developing researchers and academicians capable of independent and original research of the highest possible quality. Interdisciplinary research is actively encouraged. Thus, in addition to his/her research, care is taken to ensure that Ph. D. students develop a broadbased firm grounding in at least one of the four research areas: Solid Mechanics & Dynamics; Robotics, Optimization & Design; Fluid & Thermal Sciences; and Manufacturing Science. This is done by prescribing required core coursework. Additionally, we make sure that the student is exposed to other scientific and research areas by providing a set of electives comparable with some of the World's top Mechanical Engineering departments.

Admission to the Ph. D. program is open to all candidates with a B. Tech. and/or M. Tech. in any engineering field and/or a M. Sc. degree.

Masters program: A Masters degree takes two years, of which the first year is spent on required coursework and the other is reserved for original research. The coursework provides a strong grounding in fundamentals of basic research methods in his/her chosen discipline. In the case of undergraduate students who continue onto a masters program by opting for the dual-degree option, the first year's coursework overlaps with the B. Tech. program's final year.

Undergraduate program: The four-year long undergraduate program is structured to provide the student with optimal exposure to the vast discipline of Mechanical Engineering. The program culminates with a year-long project where students gather extensive hands-on experience and emerge as confident and well-trained Mechanical engineers.

The department is involved in several other academic activities that include holding regular seminars, short-term courses, workshops and conferences. We maintain a dynamic and creative environment that fosters continuous academic growth.

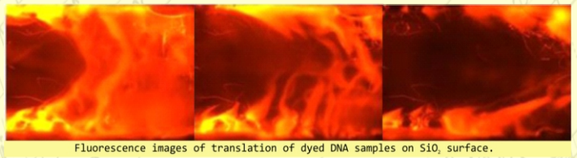
Seminars: The Mechanical Engineering seminar series provides an un-parallelled opportunity to an individual to increase his scientific range. The seminars are held every Monday at 5 p.m., and also offer an ideal platform to initiate inter-disciplinary work cutting across boundaries.

Research

We conduct fundamental and applied research in broad areas of Mechanical Engineering, reaching well beyond traditionally identified domains. Researchers are engaged in extremely diverse, and often inter-disciplinary projects, that include probing the mysteries of the tiny Cell to deciphering the Earth's geophysics; designing Microfluidic sensors to developing the next generation gasturbines; optimizing Fuel Cells to controlling Nuclear Plasmas to meet the nation's energy demands; estimating the strength of tangled Polymer chains to employing sturdy Composites for aerospace sturctures; harnessing Solar power to making engines cleaner for a pollution-free environment; understanding human origins to building Humanoid Robots. The opportunities and challenges are endless!

The department has identified several thrust areas:

Biomedical engineering



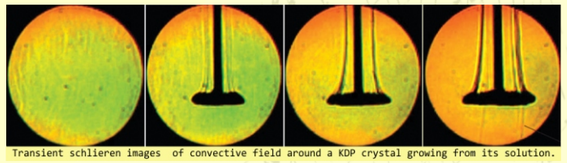
Fluorescence images of translation of dyed DNA samples on SiO_2 surface.

Biomedical engineering is the application of engineering principles and techniques to the medical field. It associates the design and problem-solving skills of engineers with medical and biological sciences to improve healthcare diagnosis and treatment. In this fast-emerging field, the department is involved at several levels. Examples include developing MEMS sensors for pathogen identification, tracer-less diagnostics of bio-molecules, researching biological membranes to ultimately help cure disorders like certain cancers and Alzheimer's disease, and formulating a predictive model for arterial Aneurysms.

Energy systems

Demand for energy resources and the deteriorating environmental quality makes this subject crucial to both our industrial growth, quality of life, and overall sustainability. In this context, the department focuses on exploring and harnessing alternate energy sources such as bio-fuels, solar power, gas hydrates, hydrogen energy, and nuclear power; and making our machines and devices more efficient and cleaner by researching fuel cells, gas turbines, heat transfer systems, and IC-engines.

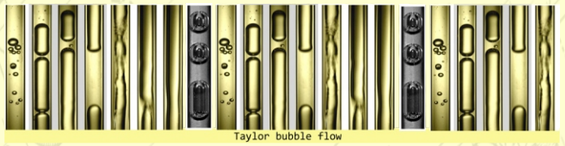
Imaging and non-destructive techniques



Transient schlieren images of convective field around a KDP crystal growing from its solution.

Non-invasive techniques are essential, whether it be for imaging the brain, identifying flaws in an aircraft's fuselage or a nuclear reactor, probing fluids without physical interference, locating impurities in nuclear plasmas, or thermally imaging crystal growth. The department has developed several theoretical and experimental tools to meet this end. Our research encompasses optical techniques such as interferometry and schlieren, particle image velocimetry, laser-based fluorescence, liquid-crystal thermography, infrared thermography, holography, photoelasticty, digital image correlation, ultrasonics, computerized tomography, and error estimation.

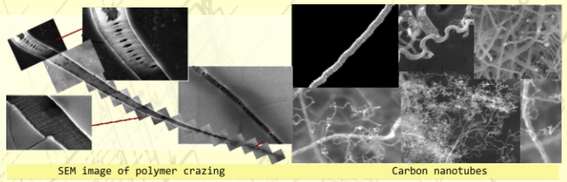
Multiphase flows



Taylor bubble flow

Most flows in nature and in the industry contain two or more constitutents and/or involve the interaction of several different physical fields. Analyzing such systems is extremely challenging. The department has ongoing research in the areas of flow through porous media, reacting flows, nuclear plasmas, granular flows, combustion, boiling and condensation, capillary flows, magnetohydrodynamics, and turbulence modeling. We utilize and develop tools such as computational fluid dynamics, statistical mechanics, kinetic theories for dense gases, and also experimental methodologies like hot-wire anemometer and other imaging techniques employed in various in-house water and wind tunnels. Important areas of application are geophysics, nuclear reactors, gas turbines, heat exchangers, heat pipes, and digital-fluidics

Multiscale mechanics:

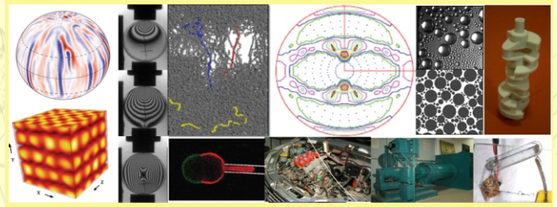


SEM image of polymer crazing Carbon nanotubes

Characterizing and innovating newer and better materials is essential for building futuristic micro-/nano- sized machines, sensors and structures that, in turn, have significant impact in the aerospace, automotive, biomedical, defense and energy sectors. The subject is also extremely relevant to geophysics where multiple scales are ubiquitous. This calls for understanding how finer length and time scales in a material, or a process, affect its macroscopic behavior, and this constitutes the subject of multiscale mechanics.

The department has a large number of mechanicians researching and modeling materials such as carbon nanotubes, nano-polymers and nanocomposites, functionally-graded composites, glassy polymers, polycrystals, hydrogels, foams, thin films, grains and soils. Multiscale processes of interest include manufacturing processes, shear banding, creep, grain boundary mobility, dynamic fracture, dislocation dynamics, void nucelation, crazing, phase transformation, grain segregation and sorting, adhesion, wave scattering, impact, and cratering. We employ and develop analytical and computational frameworks such as molecular dynamics, nonlinear finite elements, Galerkin methods, homogenization, damage mechanics, lattice dynamics, stochastic mechanics, plasticity, and nonlinear continuum thermodynamics; and also experimental tools like the split-hopkinson bar, photoelasticity, digital image correlation, ulta high-speed imaging, laser-doppler vibrometer, and high-resolution microscopes such as SEM.

Research summary



Applied mathematics: Engineering computation; Variational methods; Asymptotic and perturbation methods; Sobolev space & error estimation; Inverse problems.

Fluid mechanics: Turbulence modeling; Computational fluid mechanics; Non-Newtonian fluids; Convection; Experimental techniques; Jets; Two-phase flows; Granular flows; Sloshing; Gas turbines; Fluid Instability and transition.

Geophysics: Magnetohydrodynamics; Planetary dynamos; Asteroids; Sand dunes; Satellites.

Manufacturing technology: Advanced machining processes; CAM; Metal Forming; Micro-/Nano- Fabrication; Nanocomposites; Die and Mould Design; Tribology; Rapid prototyping.

Micro-/ Nano- scale technology: Bio-MEMS; Micro-fluidics; Microsensors; Micro-actuators; Carbon nanotubes; Nanopolymers.

Nonlinear dynamics and Vibration: Time-delayed systems; Stability, Bifurcation & Chaos; Pattern formation; Vibration control; Acoustics; Noise control; Structural vibration; Non-smooth systems.

Optimization and design: Genetic algortihms; Topology optimization; Constrained nonlinear optimization; CAD; Product design; Reverse engineering.

Robotics and Multibody dynamics: Automotive systems; Parallel manipulators, Humanoid robots, Intelligent control systems; Flexible manipulators; Mechanism theory; Compliant mechanisms.

Solid mechanics: Composite materials; Polymers; Dislocation dynamics; Plasticity; Fracture mechanics; Experimental techniques; Impact mechanics; Finite element method; Material modeling; Continuum thermodynamics; Lattice dynamics; Phase transformation; Defects; Thin films; Contact mechanics; Elastodynamics; Fluid-structure interaction.

Thermal Sciences: Computational heat transfer; Boiling; Condensation; Convection; Thermal management; Heat pipes; Combustion; IC engines; Alternative fuels