Information Brochure

for

Post Graduate Admissions in

Doctor of Philosophy (Ph. D.)

Academic Session: 2015-16, Semester: II

INDIAN INSTITUTE OF TECHNOLOGY KANPUR, KANPUR-208016, UTTAR PRADESH (INDIA)

AEROSPACE ENGINEERING

The Department of Aerospace Engineering offers a comprehensive program of teaching and research at undergraduate and postgraduate levels leading to B.Tech, B.Tech-M.Tech dual degree, M.Tech and Ph.D degrees. Specializations are available in four major streams: (i) Aerodynamics: focusing on High Speed Aerodynamics, Low Speed Aerodynamics, Hypersonics, Experimental Fluid Dynamics, CFD/High Performance Computing, Flapping Flight, (ii) Propulsion: focusing on Turbo machinery, Combustion, Flame, Active and Passive flow Control, Micro Air Vehicles (iii) Structures: with focus on Composite Structures, Smart Structures and Optimization, Computational Mechanics, Fracture Mechanics, Random Vibration, Structural Dynamics and Aeroelasticity, Helicopter Dynamics and Aeroelasticity, Autonomous Helicopter, (iv) Flight Mechanics: including Space Dynamics, Flight Vehicle Guidance and Control, Motion Planning and Cooperative Controls.

The Department has undertaken several consultancy, and sponsored R&D projects funded by agencies such as, Aeronautics R & D Board, Indian Space Research Organization, Aeronautical Development Agency, Department of Science & Technology, Hindustan Aeronautics Ltd., Delhi Metro Railways Corporation, NAL, Indo-French Centre for the Promotion of Advanced Research (IFCPAR),, TERI, PCRA, DRDO etc., have been undertaken by the Department. The major contributions of the faculty are in the design and development of high speed and low speed wind tunnels, flow measurements using hotwire and laser Doppler anemometry, PIV, reacting flow, industrial and wind energy aerodynamics; CFD including subsonic, transonic, supersonic and hypersonic flow computations; unsteady aerodynamic modeling and parametric estimation techniques; satellite dynamics; flight control; rocket propulsion; flow through turbo-machines; combustion, flame; structural dynamics, random vibration, design and optimization of fibre reinforced composite structures for static, dynamic and random loading; adaptive finite element analysis; smart structures; multi scale modeling; damage in composite structures; behavior of adhesive joints; helicopter dynamics, aeroelasticity; modeling of advanced materials, micro/mini air vehicles, autonomous helicopter and insect flight.

FACULTY
Abhishek, Ph.D. (Maryland): Helicopter Aeromechanics, Multibody Dynamics, Micro Air Vehicles.
A C Mandal, Ph.D. (IISc Bangalore): Experimental Aerodynamics, Flow instability and transition, Turbulent Shear flow.
A K Ghosh, Ph.D. (IIT/K): Flight Mechanics, Neural Networks, Flight Testing.
A Kushari, Ph.D. (Georgia Tech.): Propulsion, Combustion, Liquid Atomization, Flow Control.
A Tewari, Ph.D. (Missouri - Rolla): Flight Mechanics, Aeroservoelasticity, Space Dynamics and Control.
Ashoke De, Ph.D(Louisiana State University):CFD, Turbulent combustion, Gas turbine propulsion.
C S Upadhyay, Ph.D. (Texas A&M): Computational Mechanics, Damage Mechanics.
C Venkatesan, Ph.D. (IISc Bangalore): Helicopter Dynamics and Aeroelasticity, Autonomous Helicopter, Smart Structures
D Das, Ph.D. (IISc. Bangalore): Theoretical and Experimental Aerodynamics, Aeroacoustics, Instability and Transition, Vortex Dynamics, Unsteady Aerodynamics, Bird and Insect Flight.
D P Mishra, Ph.D. (IISc Bangalore): Combustion, Atomization, CFD.
D Yadav, Ph.D. (IIT/K): Structural Dynamics, Stochastic Processes, Optimization.

E Rathakrishnan, Ph.D. (IIT/ Madras): Gas Dynamics.

K Poddar, Ph.D. (UC San Diego): Aerodynamics, Turbulence, Low and High Speed Flows.

Mangal Kothari, PhD (University of Leicester): Flight Vehicle Guidance and Control, State Estimation, Motion Planning and Cooperative Control.

P M Mohite, Ph.D. (IIT/K): Damage Mechanics of Composites, Composites, Material Characterization, FEM.

R Kitey, Ph.D. (Auburn): Solid Mechanics, Fracture Mechanics, Optical Metrology, Boundary Element Method.

R Kumar, Ph.D (Penn State): Hypersonics, Rarefied Gas Dynamics, Microfluidics, Molecular Dynamics, Heat Transfer & Thermal Design.

S Mahesh, Ph.D. (Cornell): Material Modeling, Fracture.

S Mariappan, Ph. D. (IIT/Madras): Thermo-acoustic interactions, Rotor aircraft aerodynamics, Optical flow diagnostics, Acoustic measurements

S Mittal, Ph.D. (Minnesota): CFD, Aerodynamics, Shape Optimization.

S Kamle, Ph.D. (Purdue): Experimental Stress Analysis, Smart Structures.

T K Sengupta, Ph.D. (Georgia Tech): Theoretical and Computational Fluid Dynamics, Transition and Turbulence, Aerodynamics.

Vaibhav Arghode, PhD (University of Maryland): Combustion, Heat Transfer, Fluid Mechanics, Experimental Methods, Computational Fluid Dynamics

PROGRAMMES

The M. Tech program is designed to acquaint the student with various aspects of Aerospace Engineering through several courses both introductory and in the specialized area followed by research, leading to a thesis on a topic in the area. M. Tech students have the opportunity to do experiments in the National Wind Tunnel Facility (NWTF) (See FACILITIES below) and acquire actual flying experience in the Flight Laboratory as a part of the curriculum. The Ph.D program is aimed at helping the student acquire proficiency in the chosen area through course work, followed by research leading to a Doctoral thesis.

Candidates for admission in the M.Tech program in Aerospace Engineering at IIT Kanpur must have a Bachelor's degree in Aeronautical/Aerospace, Mechanical, Civil, Chemical Engineering, Naval Architecture, Electrical, Electronics/Electronics and Communication, Automobile, Metallurgy/Metallurgy, Material Science, or 4 year BS degree in Physics & Mathematics. Those for admission in Ph.D must have a Master's degree in the respective disciplines, or a Master's degree in Sciences with a minimum of 3 years of relevant R & D experience in aerospace engineering for sponsored candidates and also a valid GATE/UGC/CSIR score for non-sponsored candidates.

Admissions in M.Tech and Ph.D programs are made to a particular stream, i.e. area of specialization in the department (as given in first para). Also note that problems of multidisciplinary nature can be suitably taken up for thesis.

A student in the M.Tech program is required to complete at a satisfactory level, a minimum of 8 courses and 72 units (two semester load) of research leading to a thesis. A Ph.D student is required to complete a minimum of 4 courses and 72 units (two semester load) of research subject to a minimum total academic load of 4 semesters. He is also required to pass the Ph.D comprehensive examination held on completion of his course work.

In the first semester, a student in the M.Tech program will be registered for 4 courses. At the time of admission he will be assigned to a field of specialization on the basis of his aptitude, background, and availability of the faculty. A thesis supervisor will also be assigned towards the end of first semester. In the second and third semesters, the student

will take four or more elective courses and initiate his research. In the third and fourth semesters he/she will continue research work towards completion of his thesis.

A student in the Ph.D program will register for four elective courses, as advised by D.P.G.C. member belonging to his area of specialization, if thesis supervisor has not been decided at the time of registration. In other cases, he may register for thesis on the advice of supervisor. In the subsequent semester he registers for research and courses as advised by his supervisor. At the end of the course work the student will appear for the Ph.D comprehensive examination, and continue his research towards completion of his Doctoral Thesis.

COURSES

Introduction to Aerospace Engineering, Mathematics for Aerospace Engineers, Aerodynamics-I, Aerodynamics-II, Viscous Flows, Advanced Computational Methods in CFD, Boundary Layer Instability and Transition, Finite Element Methods for Fluid Dynamics, Introduction to Environmental Fluid Mechanics, Wind Engineering, Turbulence, Computational Fluid Dynamics, Turbulent Flows, Perturbation Methods in Fluid Mechanics, Transition and Turbulence, Advances in Turbulent Shear Flows, Continuum Hypersonic Aerodynamics, Advances in Wind Energy Conversion, Advanced Dynamic Stability, Space Dynamics-I, Space Dynamics-II, Introduction to Hypersonic & Trans-Atmospheric Flight, Control Theory, Flight Dynamics, Flight Stability and Control, Fundamentals of Aerospace Propulsion, Applied Combustion, Aircraft Propulsion, Thermal Turbo Machinery, Combustion Problems in Rocket Propulsion, Selected Topics in Turbo-Machines, High Speed Internal Flow Problems, Airbreathing Missile Propulsion, Transonic Aerodynamics, Aerospace Structural Analysis-I, Solid Mechanics, Rocket and Missile Structures, Advanced Aircraft Structural Analysis, Introduction to Finite Elements Methods, Aeroelasticity, Vibration Control, Theory of Vibrations, Non-Linear Oscillations, Reliability Analysis of Engineering System, Composite Materials, Analysis of Composite Structures, Random Vibrations, Aircraft Materials and Processes, Deterministic and Random Vibration, Helicopter Theory: Dynamics and Aeroelasticity, Aerospace Structural Analysis-II, Dynamics and Vibration, Introduction to the Theory of Smart Structures, High Temperature Gas Dynamics, Applied Mathematics for Engineers, Instrumentation, Measurement and Experiments in Fluids, Introduction to Virtual Instrumentation, Nonlinear Finite Element Method, Molecular Gas Dynamics, Fundamentals of Liquid Atomization, Principles of Acoustics, Theory of Combustion, Introduction to Scientific Computing, Computational Fluid Mechanics, Advanced Computational Fluid mechanics, Numerical Modelling of Chemically Reacting flow, Turbulent Combustion, Preliminary design of Helicopter, Rocket Engine Design.

FACILITIES

The department has several well established laboratories focusing on various research and academic activities. They are: High Speed and Low Speed Aerodynamics Lab, Propulsion Lab, Combustion Lab, Fire Lab, Structures Lab, Aeromodelling Lab, Unsteady Aerodynamics Lab, Autonomous Helicopter Lab, CFD Lab, High Performance Computing Lab, Structural Analysis Lab, Flight Lab and National Wind Tunnel Facility. The experimental facilities include several low speed wind tunnels, a high speed blow down tunnel, high speed jet facility, anechoic chamber for noise measurements, hot wire and laser Doppler anemometry; facility for static and dynamic tests of materials, cascade tunnel, continuous combustion unit and gas turbine test rig; Malvern Spraytech particle size analyzer, Gas Chromatograph. Flight laboratory, with four powered airplanes and several gliders and an operational aerodrome for flight research; NWTF (National Wind

Tunnel Facility) which is a unique facility, with latest technology and automated instrumentation and a very large test section of 3m x 2.25m, capable of testing (aerodynamics) a full-scale model of car.

BIOLOGICAL SCIENCES AND BIO ENGINEERING

The Department of Biological Sciences and Bioengineering (BSBE) was established in September, 2001. The department offers both undergraduate (B.Tech) and postgraduate programs (M.Tech and Ph.D) and the faculty conduct research in diverse areas of basic and applied biology. Ongoing research projects are spread in broadly three major domains that include (a) molecular, cellular and developmental biology, (b) structural and computational biology and (c) bioengineering. A major emphasis is on understanding the fundamental aspects of cell differentiation and growth, regenerative medicine, elucidating protein structure-function relationship, and engineering approaches to understand complex biological systems. The department has attracted funding from major national and international agencies including the Wellcome-DBT India Alliance, Indo-UK Science bridge program, UKERI, DBT, DST, CSIR, DAE, ICMR and DRDO to name a few. BSBE faculty and student members have received many awards and honors in recognition of their excellence in research.

The department currently has sixteen members in its faculty with expertise in diverse areas of research.

FACULTY

Amitabha Bandyopadhyay, Ph.D. (Albert Einstein College of Medicine, New York): skeletal development and differentiation; metabolomics.

Arun K. Shukla, PhD (Max Planck Institute of Biophysics, Frankfurt, Germany): Structural biology of membrane proteins, cellular signaling and combinatorial biology.

Ashok Kumar, Ph.D. (IIT Roorkee): Downstream processing, biomaterials, nanobiotechnology, affinity interactions and cell separation, bioprocessing, and tissue engineering.

Ashwani Kumar Thakur, Ph.D. (Inst. of Microbial Tech., Chandigarh) : Protein aggregation in diseases and therapeutic design; self assembly of proteins; and biopharmaceuticals.

Balaji Prakash, Ph.D. (IISc., Bangalore) (*currently on long leave*): Structural Biology, bioinformatics, structure-based drug design.

Bushra Ateeq, Ph.D. (AMU, Aligarh): Molecular oncology, Genetic alterations, Cancer pathogenesis, diagnosis and therapeutics

Dhirendra S. Katti, Ph.D. (Bombay Univ.): Tissue engineering, biomaterials, drug delivery systems and nanobiotechnology.

Ganesh S, Ph.D. (BHU, Varanasi): Neurobiology of disorders, stress biology, and human genetics.

Jayandharan G Rao, Ph.D (Christian Medical College, Vellore): Gene therapy; human molecular genetics;

Jonaki Sen, Ph.D. (Albert Einstein College of Medicine, New York): Morphogenesis and differentiation of the retina and various regions of the brain; vertebrate developmental neurobiology.

Mainak Das, Ph.D. (Univ. of Central Florida, Orlando): Bioelectronics, Green Energy, Physiology & Sensor

Nitin Gupta, Ph.D (University of California, San Diego): Neurophysiology; computational biology

Pradip Sinha, Ph.D. (BHU, Varanasi): Cancer genetics, growth control & pattern formation in fruit fly, Drosophila model.

Sankararamakrishnan R, Ph.D. (IISc, Bangalore): Bioinformatics, molecular modelling of membrane proteins and bimolecular simulation.

Saravanan M, Ph.D. (IISc, Bangalore): Dynamics of chromatin recognition and remodeling

Subramaniam K, Ph.D. (IISc, Bangalore) (*currently on long leave*): Developmental biology – germ cell development in C.elegans; Functional genomics using RNAi – plant-parasitic nematodes.

FACILITIES

BSBE offers its members with a wide variety of high-end equipments. Some of these include bioinformatics facility (servers, workstations, and software modules for high performance computing), material characterization facility (SEM, rheometer, and fabrication facilities), cell sorting and imaging facility (cell sorter, confocal microscope), genomic facility (DNA sequencer, microarray scanner and real-time PCR machines), centrifuge facility (ultra-speed, large volume and multipurpose centrifuges), protein purification and characterization facility (Chromatography, HPLC and FPLC systems), protein crystallization facility (X-ray data collection facility with cryo cooling features), tissue culture facility (culture rooms for cell, organ and virus cultures), histopathology facility (tissue processing unit, automated microtome, and cryostat), and a transgenic facility (transgenic facility for mouse, chicken, *Drosophila*, *C.elegans* and zebra fish).

M.Tech. in BSBE (4 Semesters)

Master of Technology (M.Tech) program in BSBE meets a variety of career objectives in research and industry. The program is also supported by the Department of Biotechnology (DBT), Govt. of India. The Program is for four semesters of which the last two semesters involve hands-on training and research. Midway through the program, students may apply for switchover to the Ph.D. program of BSBE. The program is designed for students from both biology and non-biology background.

WHO CAN APPLY?

Candidates who have a Master's degree in any area of science (mathematics, physics, chemistry or life sciences) or Bachelor's degree (**4 year program**) - Bachelor's degree in

Technology/Engineering, Medicine (MBBS), Pharmaceutical (B.Pharm), Agricultural or Veterinary Sciences are eligible to apply. Applicants should have secured a minimum CPI of 6.6 (or 60 percent marks) in their qualifying degree (and should be at least seven percent higher than the minimum pass marks/CPI) and should either have a valid GATE score or qualified in the national level tests conducted by the UGC, CSIR, DBT, ICAR or ICMR. The requirement of a GATE score is waived for M.B.B.S. degree holders and for engineering graduates from IITs with an overall CGPA of 6.5 and a CGPA of 8.0 during the last two semesters. Candidates appearing in the final examinations of the qualifying degree are also eligible to apply.

Ph.D in BSBE

Ph.D. Program in BSBE is intended for students interested in carrying out distinguished scholarly activities. Excellence in research apart, the program envisages comprehensive development of students for leadership in science and engineering in both industry and academia. Therefore, the Ph.D. Program involves intense course work covering diverse areas of biology and bioengineering for competence in both analytical and quantitative skills.

WHO CAN APPLY?

Candidates should meet one of the following 4 conditions. Candidates appearing in the final examinations of the qualifying degree are also eligible to apply.

(1) Should have a master's degree in engineering (ME/M.Tech.), or medicine (MD) or M.Sc. (Agri) or equivalent with minimum of 55 percent marks/ 5.5 CPI (on a 10 point scale) as long as it is not less than the minimum pass marks/CPI.

OR

(2) Should have a bachelor's degree in engineering (B.E/B.Tech) or pharmacy (B.Pharm) or Bachelor's degree (**4 year program**) with a minimum of 75 percent marks/7.5 CPI, and a valid GATE score or qualified in the JRF of UGC, CSIR, DBT, ICAR or ICMR.

 OR

(3) Master's degree in sciences or an allied area (M.Sc.), satisfying each of the following criteria may also be considered.

(a) a minimum of 65 percent marks/6.5 CPI in the master's degree.

(b) first division in bachelor's degree, and

(c) UGC, CSIR, DBT, ICAR or ICMR junior research fellowship (JRF) OR 95 percentile or higher in GATE.

OR

(4) MBBS degree holders with a minimum of 60% marks in the qualifying degree.

The Department of Chemical Engineering offers academic programme leading to B.Tech., M.Tech. and Ph.D. degrees in Chemical Engineering.

The Department imparts graduate education with emphasis on chemical engineering fundamentals and applications. It prepares students to a high level of competence in the conventional areas like process engineering, process simulation, optimization and control, separation processes, polymer engineering and transport phenomena, as well as in frontier areas of energy and environment, nanosciences, molecular simulations, biotechnology and biocomputations.

Most of the graduate courses have a strong engineering science and state-of- the-art technological orientation. They are primarily intended to prepare students for careers in computer oriented design, simulation and controls, teaching, research and development. Our students find employment in renowned industrial and academic organizations. The department has a young and dynamic faculty who are recognized both nationally and internationally, who have received numerous awards and honours for excellence in research (e.g. Infosys Prize, J. C. Bose Fellowship, Shanti Swarup Bhatnagar prize, Herdillia, Amar Dye-Chem and NOCIL awards of IIChE, of ISTE, Fellowships of Academies of Sciences and of Engineering, etc.). This research done by the M.Tech and PhD students and faculty in diverse areas of Chemical Engineering is published in prestigious international journals. The department faculty has also authored over 35 textbooks and research monographs through reputed publishers in India and abroad which reflects the faculty's commitment to teaching and research. A number of projects have been sponsored by various national funding agencies including DRDO, DST, AICTE, ARDB,CSIR, DBT and MEF, MHRD, Planning Commission, Centre for High Technology etc. The depar tment enjoys an excellent rapport and professional interaction with various industria organizations. A few faculty members engage in high level consultancy work in industry during summers, whereas some others undertake sponsored projects funded by industry (e.g. IPCL, GSFC, Duncans Industries, U.P. State Agro Industries, Engineers India Limited, IOC, CHT, Gas Authority of India Limited, Hindustan Lever, Bharat Petroleum Corporation Limited, etc.).

FACULTY
P Apte, Ph.D. (Ohio): Statistical Mechanics, Interfacial Ther modynamics, Nucleation.
P K Bhattacharya, Ph.D. (IIT/B): Membrane Separations, Pulp and Paper Technology, Environmental Engineering
R P Chhabra, Ph.D. (Monash): Non-Newtonian Fluid Particle Systems, Transport Properties of Liquid Metals and Molten Salts
Goutam Deo, Ph.D. (Lehigh): Heterogeneous Catalysis, Kinetics, Transport Phenomena
S Garg, Ph.D. (Connecticut): Bio-informatics;Computer Aided Molecular Design; Flexibility Analysis
A Ghatak, Ph.D. (Lehigh): Adhesion and friction on soft interfaces, Fracture of soft thin sheets, Bio-inspired approaches in design of engineering materials.
R K Gupta, PhD (NUS Singapore): Nanomaterials, self-assembly, nanostructures for energy applications.
Y M Joshi, Ph.D. (IIT/B): Rheology, Polymer Science & Engineering, Fluid Mechanics

Nitin Kaistha, Ph.D. (Tennessee): Process Monitoring & Control, Reactive Distillation

D Kunzru, Ph.D. (Pittsburgh): Catalyst Deactivation, Kinetics, Pyrolysis of Hydrocarbons, Petroleum Processing

Raj Ganesh Pala, Ph.D. (Utah): Sustainable energy, Heterogeneous catalysis, Photo chemical analysis, Quantum and classical simulation of condensed matter systems.

S Panda, Ph.D. (Houston): Chemical Sensors, Micro/ Nano Fabrication processing of electronic materials Microfluidics, Lab-on-a-chip.

I. S. Dalal, Ph. D. (Michigan, Ann Arbor), Modelling and simulation of the dynamics of polymer chains in flow, complex fluids, flow induced effects in biomolecules

V Shankar, Ph.D. (IISc B'lore): Stability of Fluid Flows, Dynamics and Rheology of complex fluids.

Ashutosh Sharma, Ph.D. (SUNY, Buffalo): Colloid and Interface Engineering, Nanotechnology, Thin Films.

Jayant Singh, Ph.D. (SUNY, Buffalo): Molecular Simulation, Statistical Thermodynamics, Structure, Dynamics and Phase Behaviour of Complex Fluid

Sri Sivakumar, Ph.D. (Victoria): Synthesis and characterization of nanomaterials, Layer by layer assembly polymer capsules, Thin films, Drug delivery and photonic crystals

Raghvendra Singh, Ph.D., (SUNY, Buffalo): Computational Biology, Gene Therapy, Embryonic and Adult Stem Cell, Tissue Engineering, Biomaterials.

Naveen Tiwari, Ph.D., (University of Massachusetts, USA): Transport Phenomena, Instabilities in micro-scale free surface flows, Flow through porous media.

Anurag Tripathi, Ph.D (IIT Bombay): Mechanics and rheology of granular flows and complex fluids.

Nishith Verma, Ph.D. (Arizona): Adsorption, Environmental Pollution Control, Mathematical Modelling & Simulation,

PROGRAMMES

The M.Tech. students are required to complete a minimum of 64 units of which at least 24 units (equivalent to 6 courses) must be in terms of advanced postgraduate courses and research work equivalent to minimum of 28 units. The students are required to take at least three compulsory courses, one each from the four areas : Applied Mathematics, Transport Phenomena, Thermodynamics and Chemical Reaction Engineering. Besides these, the students take additional courses from a wide range of electives. The electives reflect the broad spectrum of research interests of the faculty. The electives offered keep changing from time to time and they are the means through which both faculty and students keep abreast of the latest developments. The electives may be chosen either from the departmental or outside departmental courses.

Students holding B.Tech. degrees registered for Ph.D. are required to omplete a minimum of 96 units of which at least 40 units (equivalent to 10 courses) must be in terms of advanced post graduate courses. Students holding M.Tech. degree registered for Ph.D. are required to complete a minimum of 64 units of which at least 16 units (equivalent to 4 courses) must be in terms of advanced post graduate courses.

Research projects for M.Tech./Ph.D. thesis work are offered by the faculty in their fields of specialization.

ELECTIVE COURSES

New Separation Processes, Thermodynamics of Fluids and Mixtures, Principles of Hetrogeneous Catalysis, Applied Statistics for Chemical Engineers, Optimization, Hazard Analysis and Reliability, Plant Safety and Hazard Assessment, Petroleum, Mechanics of soft materials, Introduction to nanoscience and technology, Polymer science and technology.

Refinery Engineering, Reaction Engineering of Polymers, Principles of Polymer Processing, Molecular Theories of Polymeric Systems, Environmental Pollution and Control, Engineering Applns. of Rheology, Advanced Process Dynamics and Control, Computer Aided Processes Control, Two Phase Flow and Heat Transfer, Design of Fluid-Particle Systems, Colloid and Interface Science and

Engineering Modelling and Simulation in Chemical Engineering, Introduction to polymer physics and Rheology of Soft Matter, Introduction to Molecular Simulation, Analytical and material characterization techniques for engineers; Introduction to hydrodynamic stability.

Electrochemical energy conversion and storage, CFD of Multiphase Reactors, Nuclear Chemical Engineering, Structure and Rheology of Complex Fluids, Process Engineering Principles in Microelectronics Fabrication.

FACILITIES
Besides the central facilities, at the Institute level, the Chemical Engineering Department has its own workshop, library, SEM, XRD, FACS, BET, GLCS, GPC, AAS, catalyst characterization facilities, centrifuges, fermentor, incubator-shaker, cryostats, IBM compatible personal computers, Magnetic flow meters, Ultrafiltration, Reverse Osmosis, AFM, Electrodialysis, Goniometer, Haake & Physica Viscometers and Rheometer, Parr Reactors, Laser Printer, Density meter, Dedicated NO gas analyzer,Ion chromatography, on line IR Gas analyser, Softwares such as MATLAB, SPEEDUP, ASPEN+, Langmuir-Blodegett depositions, Ellipsometr, Spin-coater etc. For more details visit www.iitk.ac.in

Postgraduate education in the Department is aimed at attaining an understanding of the basic scientific principles underlying various disciplinesin Civil Engineering. In addition, the research component of the graduateprogrammesis meant to develop capabilities to confidently undertake an independent analysis of complex field situations. Our graduates have gone on to become leaders in their professions and have significantly contributed to research and development. Keeping in view the needs of the society and the challenging problems faced by the profession, we offer postgraduate programmesin several specializations of Civil Engineering.

FACULTY

Purnendu Bose, Ph.D. (Massachusetts, Amherst): Environmental Engg.—Physicochemical processes for water and wastewater treatment, Advanced oxidation processes for water and wastewater treatment, Abiotic remediationof groundwater resources.

Partha Chakroborty, Ph.D. (Delaware): Transportation Engg.—Traffic flow theory and traffic engineering, Optimal transit system design, Transport system evaluation and management.

Sekhar K Chakrabarti, Ph.D. (Arizona, Tucson): Structural Engg.—Behavior and Design of of Steel-Concrete Interface in Composite Construction, Structural Connections, Structures Health monitoring and Rehabilitation of Structures

Sarvesh Chandra, Ph.D. (IIT/K): Geotechnical Engg.—Soil structure interaction, Ground improvement technique, Rock mechanics, Computer aided design and railway geotechnology.

Animesh Das, Ph.D. (IIT/KGP):Transportation Engg.—Pavement design, Pavement materials, Pavement evaluation and maintenance.

Arghya Das, Ph.D. (University of Sydney): Geotechnical Engg.—Constitutive modeling of Geomaterials. Micromechanics of granular materials. Bifurcation & instability analysis in Geomaterials. Numerical & physical modeling in Geotechnical Engineering.

Onkar Dikshit, Ph.D. (Cambridge): Geoinformatics—DIP, GPS, GIS, Remote Sensing and Pattern recognition applications.

Priyanka Ghosh, Ph.D. (IISc): Geotechnical Engg.—Bearing capacity of foundations and Stability of slopes under both static and seismic cases, Method of characteristics, Upper bound limit analysis and Finite element analysis, Liquefaction analysis.

Anubha Goel, Ph.D. (Maryland): Environmental Engg.—Fate and transport of pollutants, Environmental modeling, climate change.

Saumyen Guha, Ph.D. (Princeton):Environmental Engg.—Fate and transport of pesticides, Uptake of nutrients and heavy metals by plants, pathogens in water, Industrial wastewater treatment.

Tarun Gupta, Sc.D. (Harvard): <u>Environmental Engg.</u>—Development of instruments for aerosol measurement, Engineering control of particles in ambient and indoor settings, Physico-chemical characterization of atmospheric pollutants, Personal exposure assessment and health effects of inhaled particles.

Vinay K Gupta, Ph.D. (Southern California): <u>Structural Engg.</u>—Random vibrations, Earthquake engineering.

Ashu Jain, Ph.D. (Kentucky): <u>Hydraulics & Water Resources Engg.</u>—Surface hydrology, Rainfall-runoff modeling & Soft Computing.

Sudhir K Jain, Ph.D. (Caltech): <u>Structural Engg.</u>—Earthquake engineering, Structural dynamics.

Bharat Lohani, Ph.D. (Reading): <u>Geoinformatics</u>—Terrestrial, Mobile and airborne laser scanning, Remote sensing, GIS, GPS, Electronic surveying, Algorithm development, Terrain modeling, Geodata visualization, and Applications.

Javed N Malik, Ph.D. (Baroda): Active tectonics, Paleoseismology, Paleo-tsunami deposits, Geomorphology and sedimentology.

Sudhir Misra, Ph.D. (Tokyo): <u>Structural Engg.</u>—Durability and deterioration of concrete structures, Non-destructive testing, Concrete materials.

Sudib K Mishra, Ph.D. (Arizona, Tucson): <u>Structural Engg.</u>—Multi-scale, Multi-physics in materials and Mechanics, Stochastic optimization, Reliability analysis of structures, structural damage assessment.

B. Nagarajan, Ph.D. (Ohio): <u>Geoinformatics</u> - Geodesy, Satellite altimetric and gravimetric studies, Earth rotation and polar motion, photogrammetry and remote sensing, Topographical surveying and mapping, Regional Geoidal models

Syam Nair, Ph.D. (Texas A&M): <u>Transportation Engg.</u>—Stabilization of pavement subgrade soils and base materials, Post-stabilization swelling in expansive soils, Characterization and performance prediction of cementitious materials, Use of recycled materials and by-products in pavementconstruction, Surface properties of aggregates and interactionwith binding materials.

Richa Ojha, Ph.D. (Purdue University): <u>Hydraulics & Water Resources Engg.</u>—Flow and transport through unsaturated porous media

Nihar R Patra, Ph.D. (IIT/KGP): <u>Geotechnical Engg.</u>—Pile foundations, Soil-structure interactions, Ground engineering, Soil arching, Liquefaction potential evaluation.

Durgesh C Rai, Ph.D. (Michigan, Ann Arbor): <u>Structural Engg.</u>—Experimental seismic behavior of structures, Seismic evaluation and strengthening, Energy dissipation devices, Masonry and Steel-RC composite members.

Samit Ray Chaudhuri, Ph.D.(California,Irvine):<u>Structural Engg.</u>—Structural dynamics, Earthquake Engg., Performance-based design, structural rehabilitation, seismic soil-structural interaction, structural health monitoring & structural testing.

Prishati Raychowdhury, Ph.D. (California,San Diego): <u>Geotechnical Engg.</u>—Soil dynamics, Geotectnical Earthquake Engineering, Seismic soil-structure interaction.

Rajesh Sathiyamoorthy, Ph.D. (IIT/B): <u>Geotechnical Engg.</u>—Numericaland Physical modeling, Geo-Environmental Engineering, Geosynthetics, Unsaturated soil mechanics, Railway Geotechnology.

Mukesh Sharma, Ph.D. (Waterloo): <u>Environmental Engg.</u>—Air quality modeling and management, Fate processes of organic pollutants and parameter estimation.

Abhas Singh, Ph.D. (Washington, Saint Louis):<u>Environmental Engg.</u>—Environmental geochemistry of heavy metals and inorganic contaminants, Inorganic contaminant fate and transport through surface complexation and flow-through reactor modeling, Contaminant remediation in natural as well as engineered environments.

Rajesh Srivastava, Ph.D. (Arizona, Tucson): <u>Hydraulics & Water Resources Engg.</u>—Flow and transport through variably saturated porous media.

Vinod Tare, Ph.D. (IIT/K): <u>Environmental Engg.</u>—Water and wastewater treatment, modelling and simulation of environmental systems.

SachchidaN Tripathi, Ph.D. (Reading): <u>Environmental Engg.</u>—Laboratory measurements of aerosol absorption and hygroscopic properties, Fog processing of aerosols, Aerosol climate impacts, Electrical properties of aerosols, Development of new techniques to measure carbonaceous aerosols.

Shivam Tripathi, Ph.D. (Purdue): <u>Hydraulics & Water Resources Engg.</u>—Statistical hydrology, Sediment transport, Eco-hydrology.

Vinod Vasudevan, Ph.D. (Nevada, Las Vegas): <u>Transportation Engg.</u>—Traffic safety, Pedestrian safety, Highway financing and policy analysis.

Harish K Venkatanarayanan, Ph.D. (Clemson): <u>Structural Engg.</u>—Microstructure of cement-based material, Material characterization techniques, Advanced cementitious materials, Sustainable construction materials, Repair and rehabilitation of concrete structures.

1. PROGRAMMES

Graduate programmes leading to the degrees of Master of Technology (M.Tech.) and Doctor of Philosophy (Ph.D.) are offered with specializations in Environmental Engineering, Geoinformatics, Geotechnical Engineering, Hydraulics & Water Resources Engineering, Structural Engineering and Transportation Engineering.

For M.Tech. programme in Environmental Engineering, see under Environmental Engineering and Management Programme.

Admissions to the M.Tech. programme in the above disciplines are offered in the first semester of each academic year. However, admissions to the Ph.D. programme are

offered in both semesters. Admissions to Ph.D. programme are also offered throughout the year on walk-in-interview basis.

2. ELIGIBILITY REQUIREMENTS

Following are the eligibility requirements for various programmes:

2.1 M.Tech. Programme

Geoinformatics: B.Tech./B.E. degree in Civil/Mining/Electrical/Computer Science/ Electronics Engineering/Information Technology/Geoinformatics, or M.Sc. degree in Earth Science streams or Geography/Physics/Mathematics/Environmental Sciences. Candidates with M.Sc. degree must have mathematics as one of the subjects at B.Sc. level.

Geotechnical Engineering: B.Tech./B.E. degree in Civil Engineering.

Hydraulics & Water Resources Engineering: B.Tech./B.E. degree in Civil/Agriculture Engineering. The candidates must have taken at least one mathematics course at the undergraduate level.

Structural Engineering: B.Tech./B.E. degree in Civil Engineering. Some candidates with Bachelor's degree in Architecture, Building Construction and allied subjects may also be considered.

Transportation Engineering: B.Tech./B.E. degree in Civil/Mechanical/Aerospace Engineering.

Notes:

1.   In addition to the above, a valid GATE score is also needed.

2.   The GATE requirement is waived for B.Tech. graduates from IITs with a minimum overall CGPA/CPI of 6.5 and a minimum CGPA/CPI of 8.0 in the last two semesters in B.Tech. However, such candidates are not entitled for Institute Assistantship if their overall CGPA/CPI isbelow 8.0.

3.   Candidates with AMIE certificates are not eligible to apply.

2.2 Ph.D. Programme

Environmental Engineering: M.Tech./M.E. degree in Civil/Environmental/Chemical/ Mechanical/Metallurgical Engineering or in related engineering branch[*].

Geoinformatics: M.Tech./M.E. degree in Civil/Mining/Electrical/Computer Science/ Electronics Engineering/Information Technology, or M.Tech./M.Sc. degree in Earth Science streams or Geography/Physics/Mathematics/Environmental Sciences[$].

Geotechnical Engineering: M.Tech./M.E. degree in Civil Engineering.

Hydraulics & Water Resources Engineering:M.Tech./M.E. degree in Civil/Aerospace/ Agriculture Engineering.

Structural Engineering: M.Tech./M.E. degree in Engineering. Some candidates with Master's degree in Architecture, Building Construction and allied subjects may also be considered.

Transportation Engineering: M.Tech./M.E. degree in Civil Engineering.

[*] Some bright and motivated candidates with M.Sc. degree may be considered under certain circumstances; however, they should provide documentary proof of having taken Mathematics at the 10+2 level.

[$] Candidates with M.Sc. degree must have taken Mathematics as one of the subjects at B.Sc. level.

Notes:

1.   Candidates with a bachelor's degree in engineering with marks not below 75% marks (or CGPA/CPI of 7.5 on a 10-point scale) may be considered for admission. However, a valid GATE score is needed (the waiver for IIT graduates as mentioned in the notes above for the M.Tech. programme applies).

2.   Candidates with M.Sc. degree must satisfy each of the following criteria: (a) a minimum of 65 percent marks/6.5 CGPA/CPI in the M.Sc. degree, (b) first division in B.Sc. degree, and (c) JRF/95 percentile or higher in GATE.

3. COURSES

For M.Tech. degree, a minimum of 32 credits should be earned through coursework, while maintaining a minimum CPI of 6.5, and a minimum of 32 credits through research. The minimum total credits requirement for a Ph.D. student with M.Tech./M.E. degree is 64. Out of this, a minimum of 16 credits should be earned through coursework (in a minimum of 4 courses), while maintaining a minimum CPI of 7.0,and a minimum of 32 credits through research. The minimum credits requirement for a Ph.D. student with B.Tech./B.E./M.Sc. degree is 96. Out of this, a minimum of 40 credits should be earned through coursework (in a minimum of 10 courses) and a minimum of 32 credits through research. The various courses offered from time to time in each area of specialization are listed below:

Geoinformatics: Introduction to Remote Sensing; Machine Processing of Remotely Sensed Data; Instrumentation, Laboratory and Field Practices in Geoinformatics; Global Positioning System; Geographical Information System; Precision Remote Sensing; Geospatial Data Processing, Geodesy

Geotechnical Engineering: Rock Mechanics; Advanced Geotechnical Engineering; Foundation Analysis and Design; Reinforced Earth Structures; Ground Improvement Techniques; Foundation Dynamics; Geotechnical Earthquake Engineering; Constitutive Modeling of Frictional Materials; Geotechnical Investigations for CE Projects.

Hydraulics & Water Resources Engineering: Advanced Hydrology, Engineering Hydraulics, Fluid Mechanics Laboratory, Computer Methods in Hydraulics and

Hydrology, Stochastic Hydrology, Introduction to AI Techniques, Sediment Transportation, Transients in Pipes, Unsteady Open Channel Flow, Ecohydrology..

Structural Engineering: Structural Dynamics; Engineering Mechanics; Stability of Structures; Experimental Methods in Structural Engineering; Advanced Structural Analysis; Masonry Structures; Advanced Design of Reinforced Concrete Structures; Advanced Design of Steel Structures; Durability of Concrete Structures; Earthquake Analysis and Design of Structures; Random Vibrations; Theory of Plates and Shells.

Transportation Engineering: Traffic Flow Modeling and Simulation; Analysis and Design of Pavement Systems; Analysis and Design of Transportation Infrastructure; Traffic Engineering; Urban Transportation System; Rail Transportation Systems Planning and Design; Airport Systems Planning and Design; Characterization of Pavement Materials and Analysis of Pavements; Laboratory Course in Transportation Engineering.

In addition, Advanced Mathematics for Civil Engineers is a compulsory course in the M.Tech. programme for all areas of specialization. Further, the Department offers the courses like Geological Hazards, Satellite Photogeology in Terrain Evaluation, Paleoseismology and Tectonic Geomorphology.

4. FACILITIES

In each of the areas of specialization, the Department is equipped with well-developed laboratory facilities. The state-of-the-art research facilities in the Department include the following:

- Exploration Seismograph, GPS, GPR Survey Instrument, Petrological Microscopes.
- Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Atomic Emission Spectrometry (ICP-OES), Microwave Plasma Atomic Emission Spectrometry (MP-AES), Ion Chromatograph (IC), High Performance Liquid Chromatograph, AAS, TOC, CHNOS Analyzer, GC-ECD-FID, Weather Monitoring Station, UV Visible Spectrometer, HDTLC, GC-MS, Optical Particle Counter, Scanning Mobility Particle Sizer, Aerosol Mass Spectrometer, Micro-Orifice Uniform Deposition Impactors, Aerodynamic Particle Sizer, Cloud Condensation Nuclear Counter, Particle Soot Absorption Photometer, Particle Absorption Soot Photometer, Cloud Combination Probe, Condensation Particle Counter, Fog Chamber, Optical Particle Sizer, Micro Pulse Lidar, Sun photometer, Gas Analyzers (Ozone, Sulfur Dioxide, Carbon Mono Oxide, Nitrogen Oxides), Scanning Mobility Particle Sizer, High Performance Computing Clusters
- Robotic and Motorized Total Stations, Digital and Auto Levels, Digital Theodolites, Single and Dual Frequency Geodetic Quality Differential GPS Receivers, Navigational GPS Receivers, Permanent GPS Reference Station for Engineering and Scientific Applications, Terrestrial Laser Scanner, Range Camera, Integrated GPS and INS system, Digital Photogrammetric Workstation, Software for Geospatial Applications: ERDAS lmagine, ERMapper, Arclnfo and ArcView, AutoDesk and Bentley Microstation Suites, Terrascan, Terramodeller, Polyworks, Leica Photogrammetry Suite.
- Advanced Cyclic Triaxial Testing Facility, In-situ Testing, SCPT Plate Load Test Facility, Spectrum Analyzer for Surface Waves, Seismic Down-Hole Testing Facility,

Geotechnical Digital System (GDS), Geosynthetics Testing Facility for Geogrids and Geonets.

- Complete Infrastructure for Physical Modelling of Rivers for Studying Scour Patterns and River Training Works, Facility for Hydraulic Testing of Pipes, Fluid Friction Apparatus, Momentum Measurement Apparatus, Apparatus to Calculate Sudden Losses in Expansion, Contraction and Bends, Hydrology System, Hydro-Metrological Observatory.
- Pseudo Static Cyclic Testing Facility, Shake Table Test Facility for Small Scale Models, Accelerometer-Based Wireless Measurement System, Fibre Optic-Based Strain and Temperature Measurement System, State-of-the-Art Teaching Laboratory for Structural Dynamics, Construction Materials Testing Facilities including NDT equipment, Equipments for Properties of Fresh and Hardened Concrete, Vibration Survey System (including eccentric mass shaker) for In-situ Measurement of Dynamic Properties of Existing Structures.
- Centrifuge Bitumen Extractor, Marshall Test, Fatigue Test for Bituminous Mixes, Profilograph, Rotational Viscometer, British Pendulum Tester, Driver Testing Equipment, Traffic Speed Measurement Radar, Stone Polishing Machine, Thin Film Oven Test, Asphalt Content Tester by Ignition Method, GPS Set-up, Vehicle Detection and Classification System.

The department offers academic programs leading to B.Tech., M.Tech., M.Tech. dual degree (B.Tech. and M.Tech) and Ph.D in Computer Science and Engineering. These programs are flexible and allow the students to choose courses from a number of elective courses offered by the department that cover a wide range of topics in Computer Science & Engineering.

RESEARCH

The department is actively involved in research in various fields of Computer Science. The domain of research ranges from abstract theory to problems of immediate interest to industry. The research in the department can be broadly classified into the following areas:

Algorithms: Parallel and distributed algorithms, graphs and combinatorics, computational geometry, randomized algorithms, computational number theory, computational biology, bioinformatics, algorithms for biometric based identification, algorithms for streaming data, algorithmic game theory, semi-definite programming.

Artificial intelligence and data science: Machine learning, pattern recognition, image processing, text processing, natural language processing, machine translation, computer vision, cognition and computation, data mining.

Computer architecture, operating systems and hardware design : Computer architecture, operating systems, embedded systems, parallel and distributed computation, VLSI design and testing, embedded computing design and security.

Information system and networks : Database systems, mobile computing, transaction management and processing, distributed systems, workflow systems, protocols, network performance and analysis, IPv6, internet technologies, wireless and mobile networks, low-cost networking, sensor networks.

Software engineering, compilers, programming languages: Metrics and models for software architecture, quantitative approaches to project and process management, design methodologies, formal specification and verification, programming environments, translators for declarative and functional languages, automatic generation of compilers, compilers for non-conventional architectures, parallel processing and applications, grid computing, code optimization.

Theoretical Computer Science: Complexity theory, logic in computer science, functional programming, algorithmic information theory, computational number theory, cryptography, computable real and complex analysis, computational algebraic-geometry, algebraic complexity theory, quantum computation & coding theory.

Computer Security: Network and OS security, cryptography, biometrics, cyber security of cyber physical systems.

FACULTY

Manindra Agrawal, Ph.D. (IIT, Kanpur): Computational complexity theory, randomized algorithms, cryptography, computational number theory.

Surender Baswana, Ph.D. (IIT, Delhi): Graph algorithms, dynamic algorithms and randomized algorithms.

Arnab Bhattacharya, Ph.D. (Univ. of California, Santa Barbara): Database systems, data mining, bioinformatics.

Somenath Biswas, Ph.D. (IIT, Kanpur): Computational complexity theory, logic, randomized algorithms, computational biology.

Mainak Chaudhuri, Ph.D. (Cornell Univ.): Computer architecture, cache coherence protocols.

Sumit Ganguly, Ph.D. (Univ. of Texas, Austin): Database systems, streaming algorithms.

R K Ghosh, Ph.D. (IIT, Kharagpur): Mobile computing, adhoc and cellular mobile networks, parallel and distributed computing, web services, mobile commerce.

Phalguni Gupta, Ph.D. (IIT, Kharagpur): Biometrics, image processing, sequential and parallel algorithms, parallelization of sequential programs.

Ajai Jain, Ph.D. (McGill Univ.): Machine translation, VLSI testing, computer architecture, parallel computing.

Amey Karkare, Ph.D. (IIT Bombay): Compilers, Program Analysis and Optimizations, Functional Programming, Intelligent Tutoring Systems.

Harish Karnick, Ph.D. (IIT, Kanpur): AI, machine learning, cognitive science, programming languages, computational biology.

Piyush P Kurur, Ph.D. (IMSc, Chennai): Complexity theory, computational algebra, quantum computing.

Shashank Mehta, Ph.D. (Univ. of Nebraska): Graph and Geometry Algorithms,Approximation Algorithms

Rajat Mittal Ph.D. (Rutgers University): Quantum computing, Complexity, Combinatorics.

Rajat Moona, Ph.D. (IISc, Bangalore): Computer architecture, embedded computing hardware, operating systems, VLSI design and CAD for VLSI.

Amitabh Mukherjee, Ph.D. (Univ. of Rochester): Visual surveillance, natural language processing, machine learning, cognitive science.

Satyadev Nandakumar, Ph.D. (Iowa State Univ.) : Algorithmic information theory, computable real and complex analysis.

Vinay P. Namboodri, Ph.D. (IIT Bombay): Computer Vision, Machine Learning, Image Processing, Computer Graphics

T V Prabhakar, Ph.D. (IIT Kanpur): Software architecture, Knowledge Engineering, Cloud Computing, Big Data Architectures..

Subhajit Roy, Ph.D. (IISc, Bangalore): Compilers, program analysis and optimization.

Dheeraj Sanghi, Ph.D. (Univ of Maryland): Computer networks, protocols at MAC/network/transport layers, Ipv6, wireless networks, internet applications, multimedia applications

Nitin Saxena, Ph.D. (IIT Kanpur): Computational Complexity Theory, Algebra, Number theory, Algebraic-Geometry.

Sanjeev Saxena, Ph.D. (IIT Delhi): Parallel processing, algorithms and data structures, heuristics, computational geometry, graph theory, VLSI and architecture.

Sandeep Shukla, PhD. (SUNY, Albany): Cyber security of cyber physical systems, formal methods, formal verification, software engineering, embedded systems.

Sunil Simon, Ph,D. (IMSc, Chennai): Algorithmic aspects of game theory, Logic, automata and games, theory of distributed systems.

Anil Seth, Ph.D. (TIFR, Mumbai): Logic in computer science.

Raghunath Tewari, Ph. D. (Univ. of Nebraska): Computational complexity theory, graph theory.

Programs

The department has a highly regarded undergraduate program. The course curriculum for the undergraduate program gives the flexibility to students to prepare for advanced specializations. The course structure provides a mix of compulsory and elective courses. The institute also has dual major (two BTech degrees) and dual degree (BTech-MTech) programs.

B.Tech. Program

Admission to the B.Tech programs of all departments of lITs and some other Institutes is made once a year through a Joint Entrance Examination (JEE-Advanced). Admissions are offered on the basis of a candidate's All India Rank in JEE-Advanced. More information about admission into B.Tech program is available from the institute's JEE office.

M.Tech. Program

The M.Tech program is oriented towards research and advanced training in Computer Science. It is designed for students who have a B.Tech./B.E. in computer science or

equivalent degrees. The student has to do two compulsory courses (can be waived depending on background) and five (six or seven if waiver is taken) electives for a total of seven or more courses depending on his/her interests. Thesis work forms a major component of the program and begins in the second semester. Admission to the M.Tech. program is open to candidates holding a B.Tech./B.E. in any discipline or MSc. degree in science and who have qualified GATE with CS stream. Applicants with GATE in EE, EC and MATHS streams are also considered provided they have adequate CS background. Sponsored/Q.I.P. candidates need not qualify GATE, but must possess a good CS background.

Eligible candidates may have to go through a test and/or interview conducted by the department for admission to MTech. Program.

Ph.D. program

The Ph.D. program is designed for students with strong motivation for doing research in computer science. Admission to Ph.D. is open to candidates holding M.Tech./M.E. degree or equivalent. Outstanding candidates with strong CS background and having B.Tech/B.E. or equivalent degree in any discipline and M.Sc in Maths, Statistics, Physics are also admitted to Ph.D. Normally a student with an M.Tech degree in CS has to complete four courses but a student with only B.Tech/BE/MSc must complete ten courses as a part of his/her Ph.D. program. The students choose these courses depending on their interest and on suggestions of their mentor. Each student must also pass a comprehensive examination which tests the breadth of his/her knowledge as well as the ability to do research.

All Ph. D. Students are provided with individual laptops, own office spaces and a shared telephone when they join. They also get office support for photocopying, laser printing, mailing, stationery, etc. Ph.D. students also get generous travel support to attend conferences inside the country and abroad. Ph.D. students get enhanced stipends depending on his/her performance. A number of industry supported fellowships are also available to Ph.D. Students.

Eligible candidates may have to go through a test and/or interview conducted by the department for admission to Ph.D. program.

LABORATORY

The department has its own well-equipped laboratories apart from a state-of-art Computer Centre that is a central facility. IIT Kanpur has one of the largest campus-wide networks in the educational sector in the nation with 3Gbps connectivity to the Internet. All students get e-mail, browsing and other internet facilities.

LIBRARY

The department library supplements the Central library by procuring proceedings of select conferences and some journals.

Indian Institute of Technology Kanpur has set up a new Department of Earth Sciences to promote interdisciplinary teaching and research programs of contemporary relevance in Earth Science with the goal of providing trained manpower for promoting sustainable development and resourcing India's future generations. The Department of Earth Sciences aims to focus on the study of the Earth, encompassing its evolution and internal dynamics, its surface processes, andnatural and human-induced transformations of the terrestrial environment vis-a-vis sustainable development. Apart from an interdisciplinary teaching programme, students will be trained for high quality research thorough issues related to the Earth Sciences, such as those concerned with natural resources (identification and exploration techniques) and their use to society, solid earth geology, Quaternary geology and the understanding and mitigation of natural hazards. This programmethus provides a sound, topical background in various aspects of Earth Sciences, which will form the foundation for further study and for a wide range of employment opportunities in the mineral, energy, water, environmental and space sectors.

FACULTY LIST AND THEIR RESEARCH INTERESTS

Sinha Rajiv, Ph.D (University of Cambridge), Professor. River science – river morphology and dynamics, flood hazards, morphology-ecology linkages, Remote Sensing and GIS Applications, Climate Change and paleoclimate reconstruction.

Paul Debajyoti, Ph.D (Cornell University), Associate Professor.Geochemistry, Mantle Dynamics, Paleoclimatereconstruction.

Sen, Indra Shekhar, PhD (Florida International University). Assistant Professor. Hydrocarbon exploration, anthro-biogeochemical cycles of environmental pollutants, river chemistry, aerosol source apportionment studies.

Misra, Santanu, PhD (Jadavpur University). Assistant Professor. Structural geology,high pressure-temperature experimental rock deformation and rock physics, Microstructure, Solid Earth Geophysics (Geodymanics).

Tandon S.K., Ph.D(University of Delhi). D.N. Wadia Chair Professor.River science – human transformations of river systems, fluvial sedimentology, Paleoclimate.

PROGRAMMES

M.Tech. Programme in Engineering Geosciences (4 Semesters):

The M.Tech. programme in Engineering Geosciences has a focus on applied earth sciences, specialized courses in earth surface processes, climate science, and natural hazards. The programme consists of 2 semester of course work and two semesters of research. TheM.Tech. students are expected to complete 8 courses in the first two semesters with a minimum CPI of 6.0 and then carry out research in one of the specialized

areas for the next two semesters. A written thesis has to be submitted and defended at the end of the programme.

The programmeaims to provide high quality manpower in Earth Sciences, where intellectual foundations and traditions are anchored in the (a) integration of quantitative data across various earth systems, and (b) application of geological, geophysical and other related analytical methods. Some of our major research areas include river science, natural hazards, environmental geology, hydrocarbons, water and soil chemistry, and climate change. The Department encourages however interdisciplinary research and innovative ideas in all possible areas of Earth Sciences.

Who Can Apply?

Students with M.Sc. degree in Earth Science streams or B.Tech./B.E. degree in Civil/GeosciencesEngineering are eligible to apply for the M.Tech. programme. Candidates having M.Sc. degree in other science streams may also be considered. In addition, a valid GATE score will be needed. The GATE requirement will be waived for the B.Tech graduates from IITs with a minimum overall CPI of 6.5 and a minimum CPI of 8.0 in the last two semesters in B.Tech. However, such students are not entitled to Institute Assistantship if overall CPI is below 8.0.

Ph.D. Programme in Earth Sciences

The PhD programmesin Earth Sciences aims to develop high quality research programs in areas of crust-mantle interaction, hydrology, soil formation, climate change, energy, natural hazards with an emphasis on interdisciplinary and quantitative approach.The PhD programme also consists of a combination of course work and independent research.

All PhD students are expected to complete a minimum number of courses (4 courses for students with M.Tech. degree) and 6 courses for students with MSc. or B.Tech. degree). After completing thecourse work, student must cleara comprehensive (written and oral) examinationbefore he/she is admittedto the candidacy of the Ph.D. programme. Subsequently, the candidate is required to deliver a "State of the ArtSeminar" on his/her area of research. All PhD students are expected to carry out independent research and are encouraged to present researchfindings in conferences and publications. Prior to completion, the candidate isrequired to deliver an "Open Seminar" following which he/she is allowed to submitthe thesis and appear for the thesis oral examination.

Who Can Apply?

Students with MSc / M.Tech degree or equivalent in Earth Science streamswith first division with CPI/marks not below 6.5 or 65% or Bachelor's degree in engineering with CPI/marks not below 7.5 or 75% are eligible to apply. ValidGATE/UGC/ CSIR score is required for financial assistance, except for graduatesfrom IITs with a minimum CGPA of 8.0.The candidates with DST INSPIRE fellowship for PhD are also eligible to apply.

COURSES

Earth System Processes,Geochemistry, Petroleum geology, Advanced Structural geology, Environmental Geology, Laboratory practices in geosciences, Igneous and Metamorphic Petrology,Sedimentology and basin evolution, Petroleum Geology, Satellite Remote Sensing and GIS for Geo-resource Evaluation, River Science, Isotope Geochemistry and Applications,Global Climate Change.

FACILITIES

Major Laboratory Facilities: Core Archival and Analysis Facility, Drill Core Scanner (DCS), Eutech Multi-probe water quality bench meter, Hydrobios Gravity Corer and Core Dredger, Leica Optical Microscopes with modal counting stage, Nikon Stereo zoom microscope, Resistivity Meter, Sedimentological Facilities, Rock cutter and Thin section preparation units, Total Station, RTK-enabled Kinematic GPS, Inflatable boats, Acoustic Doppler Current Profiler (ADCP), Atomic Absorption Spectrophotometer (AAS) with graphite furnace, X-ray Diffractometer, Water isotope analyzer, QuadrupoleICP-MS, Wet chemistry lab, UV spectrophotometer, Milli-Q system, Muffle furnaces, centrifuge, Unmanned Aerial System (UAS), Imaging Rover System,Bartington Magnetic Susceptibility Meter,

*Central Facilities:*Electron Microprobe, Stable isotope-ratio mass spectrometer (IRMS), Scanning Electron Microscope (SEM), Vibrating Sample Magnetometer (VSM), X-ray Diffractometer (XRD), wave-length dispersive X-ray Fluorescence (WD-XRF) etc.

RESEARCH ENVIRONMENT AND FUTURE DIRECTIONS

The Department is currently engaged in major research programmes in the areas of river science, groundwater, geochemistry and mantle dynamics, critical zone, cryosphere, climate change, hydrocarbon exploration and natural hazards. Significant opportunities for multidisciplinary research collaboration already exist with faculty from other programmes and disciplines interested in issues related to water resources, climate, atmospheric processes, environment, and natural hazards. Several major research projects funded by the Ministry of Earth Sciences, Indo-French Centre for Promotion of Advanced Research (IFCPAR), USAID-NSF, MoEF, and DST are currently running in the department. This multi-disciplinary environment has the potential to greatly enhance research, and benefit our graduate students at IIT Kanpur and society at large. The students are encouraged to work on these projects and also participate in conferences and workshops both at the national as well as international level. We aim to build a strong and the most modern graduate programme in Earth Science with an emphasis on global sustainability of the Earth's surface.

For further information about the department, please visit: www.iitk.ac.in/es

The department of Electrical Engineering offers M.Tech and Ph.Dprogrammes in almost all the sub-disciplines of Electrical Engineering. The areas include: Digital Communication Systems; Information and Coding Theory; Telecom Networks; Mobile and Wireless Communication Systems; Digital Signal and Image Processing; Computer Vision; Inverse Problems and Tomography ; Signals and Systems Theory; Control Systems and Robotics; Path Tracking and Electric Vehicle Control; Electronic and Virtual Instrumentation; Fuzzy Logic; Neural Networks and their applications; Power Systems; Smart Grid and Synchrophasors; Power Electronics; Electric Drives; Active Power Filters and Static VAR Systems; Renewable Energy Interfaces; Microelectronics; VLSI System Design; Analog and Digital Circuit Design;Semiconductor Device Modeling and Simulation; Solid State Devices; Nano-electronics and Nano-scale Devices;Spintronics;Organic Electronics; Photovoltaics; Electromagnetics; RF Engineering and Microwaves; Metamaterials, MMIC, RF and Microwave Sensors, RFID, Microwave Imaging, ElectromagneticTomographic Imaging, Quantum Dots, Optoelectronics, Optical Communications; Quantum Cryptography and Quantum Optics, Spin waves, Photonic Networks and Systems.

Programmes

Specialization in the M.TechProgrammesis available in any of the following broad areas:

Microelectronics and VLSI **(Code: 01)**

Power Engineering **(Code: 02)**

RF, Microwaves and Photonics **(Code: 03)**

Signal Processing, Communications and Networks **(Code: 04)**

Control and Automation **(Code: 05)**

Specialization in the Ph.DProgrammes is available in any of the following broad areas:

Microelectronics and VLSI **(Code: 01)**

Power Engineering**(Code: 02)**

RF, Microwaves and Photonics (**Code: 03)**

Signal Processing, Communications and Networks (**Code: 04)**

Control and Automation **(Code: 05)**

In the application form for M.Tech, the applicants must specify their choice of area(s) of specialization/code number mentioned above. Please note that the candidates have to use only those code numbers given above while filling up application form for Ph.Dprogramme. Eligibility for a specialization may depend on the candidate's choice of test paper in the GATE examination. For detailed information regarding eligibility and minimum qualifications, applicants should refer to the web-site of the Dean of Academic Affairs.

In the Master'sprogramme. a student credits eight courses, some of which may be from a compulsory package for the area of specialization chosen, the rest being electives to be chosen in consultation with programme advisors. The programme culminates in a thesis that has to be defended in an oral examination before a thesis board.

In the Ph.Dprogramme, a student has to complete minimum of four courses. The most important part of the doctoral programme is the research work leading to a thesis. The research should represent an original investigation and is expected to make a significant contribution to the knowledge in the subject. The thesis is examined by a board of examiners appointed by the institute and is also defended by the student in an oral examination before a thesis board.

OPPORTUNITIES IN SPONSORED RESEARCH

Sponsored research and development activities are pursued in the department. Work on currently relevant problems involving advanced technologies is carried out in many sponsored projects. Students are encouraged to choose problems that have relevance to these activities, thus enabling them to not only use some of the sophisticated facilities available, but also to work on state of art and practically meaningful topics.

In special cases it is possible for qualifying candidates to join projects as Research Associates and concurrently carry out both Research (which will usually be related to their thesis work) and course work. Such candidates are likely to get additional remuneration than the MHRD norms for PG scholarships.

FACULTY

Akhtar M J, Ph.D. (Magdeburg): Microwave imaging and nondestructive testing, Electromagnetic characterization, Electromagnetic scattering: direct and inverse problems, Microstrip Circuits, Computational electromagnetics.

Anand S, Ph.D. (IITB): Renewable sources based DC microgrid and power electronic converters for solar PV systems.

Banerjee A, Ph.D. (Notre Dame): Cognitive radio; Error control coding; Wireless Communications; Optical Communications.

Bansal R K, Ph.D. (Connecticut): Universal source coding algorithms and data compression; Ergodic theory and large deviation theory – applications; Robust detection; Sequential detection of a change in distribution.

Behera L, Ph.D. (IITD): Intelligent control; Soft computing; Quantum computing and Information; Applied nonlinear control

Biswas A, Ph.D. (IITD): Electromagnetics; Microwave and millimeter wave circuits and techniques; Optical guide structure and RFICs

Chakraborti S, Ph.D. (Newfoundland): Power system dynamics and stability; Power system state estimation; Synchrophasor applications in power systems; Power system reliability.

Chaturvedi A K, Ph.D. (IITK): Communication theory and systems; Mobile communications; Spread spectrum systems.

Chauhan Y S, Ph.D. (EPFL): Nanoelectronics; Compact modeling of semiconductor devices: Bulk/SOI/FINFET/Tunnel FET/Nanowire/Power devices; DC/CV and RF Characterization of MOSFET

Das S P, Ph.D. (IITKGP): Power electronics; Electric drives; Electrical machines; Microprocessor and microcontroller systems

Das Utpal, Ph.D. (Michigan): High speed photonic semiconductor devices and integrated optoelectronics.

Dutta Aloke, Ph.D. (LouisianaState): Semiconductor device modeling; IC fabrication tehnology, Analog/digital/mixed-signal VLSI circuits.

Gupta N, Ph.D. (IISC): High voltage engineering: Dielectrics and electric insulation; Gaseous and plasma discharge process; Numerical techniques in electric and magnetic field computation.

Gupta Shilpi, Ph.D. (UMCP): Nanophotonics; Nanoplasmonics; Quantum optics.

Gupta Sumana, Ph.D. (London): Digital signal processing; Image processing; Digital video signal processing.

Harish A R, Ph.D. (IITK): Antennas; RF Engineering; Electromagnetics.

Hegde R M, Ph.D. (IITM): Multimedia information processing; Speech signal processing; Array processing; Application of signal processing in wireless networks.

Iyer S S K, Ph.D (Berkeley): Organic solar cell; semiconductor devices.

Jagannatham A K, Ph.D. (UCSD): Wireless communication; Digital video processing; MIMO, OFDM and CDMA technologies; Wireless sensor networks.

Joshi A, Ph.D. (Toronto): Power electronics and drives; Electronic circuits; Digital systems; Microprocessor based systems.

Mazhari B, Ph.D. (Illinois): Semiconductor device modeling and fabrication; VLSI design; Transducers and sensors.

Mishra S K, Ph.D. (Florida): Multiphase DC/DC power conversion; Power management circuits; Modeling and control of power electronics systems.

Mohapatra A, Ph.D. (IITD): Power system security;Uncertainitymodelling;Stochastic analysis and optimization;Robust and efficient system operation and planning;Renewable integration in power systems;Deregulation.

NaikNaren, Ph.D. (IISC): Reconstruction and analysis approaches to tomographic problems; Numerical solutions for wave propagation; Sub-surface imaging.

Potluri R P, Ph.D. (Kentucky): Control system theory; Practical applications of control theory; Electric vehicles.

Pradeep Kumar K, Ph.D. (IITM): Quantum and non-linear optics; quantum cryptography and computation; Optical communications, Spin Waves.

Qureshi S, Ph.D. (Berkeley): Thin film transistors; Device physics and modeling; VLSI design; Nanoelectronics; Nuclear detectors and electronics.

Rajawat K, Ph.D. (Minnesota): Sensor networks; Cross-layer optimization; Distributed network control; Network monitoring; Network coding.

Rajshekhar G, Ph.D. (EPFL): Biomedical Optics; Light Microscopy; Optical Metrology; Digital Holography.

Sahoo S R, Ph.D. (IITB): Nonlinear Systems; Multi-agent systems and their coordinated control.

Sensarma P, Ph.D (IISC): Power electronic converters; Power quality; FACTS devices; Renewable energy delivery systems; Motor drives.

Sharma G, Ph.D. (USC): Signal processing; Communication Systems; Video signal processing; Medical image processing.

Singh S N, Ph.D. (IITK): Power system restructuring; FACTS technology; Optimal power dispatch and security analysis; Power system dynamics, operation and control; Power quality; Application of genetic algorithms and artificial neural networks in power systems; Wind power.

Singh Y N, Ph.D. (IITD): Telecommunication networks; Optical communications, networks and switching systems; Wireless networks; Wireless sensor networks; eLearning systems development.

Sircar P, Ph.D. (Syracuse): Signal processing and systems; Communication theory;

Computational methods.

Srivastava Kumar Vaibhav, Ph.D. (IITK): RF Engineering; Microwave; Electromagnetics.

Srivastava S C, Ph.D. (IITD): Power systems; Energy management systems; Stability and security analysis; Technical issues in electricity markets; Wide area monitoring and control; Distribution management systems.

Vasudevan K, Ph.D. (IITM): Communication systems; Signal processing for communications.

Venkatesh K S, Ph.D. (IITK): Signal/Systems theory, Image and video processing; Computer vision applications.

Verma N K, Ph.D. (IITD): Big Data; Internet of Things/Cyber physical systems; Intelligent Data Mining Algorithms and Applications; Diagnosis and Prognosis of Rotating Machines; Soft-Computing in Modelling and Control; Machine Learning Algorithms; Computer Vision; Bioinformatics; Smart Grid; Intelligent Agents and their Applications; Intelligent Informatics; Fuzzy Controllers; Image frame generation; Brain Computer/Machine Interface.

COURSES

The Department offers a rich set of PG courses from the following:

Digital Circuit Design; Architecture of Advanced Microprocessors & Microcomputers; Analog/digital VLSI Circuits; VLSI System Design; Measurements, Parameter Extraction and VLSI tools in Microelectronics; solid State devices I; Semiconductor Device Modeling; Fluctuation Phenomena in Microelectronics; Integrated Circuit Technology; High Frequency Semiconductor Devices and Circuits; Organic Electronics; Nanoelectronics.

Economic Operation & Control of Power Systems; HVDC and flexible AC Transmission Systems; Advanced Power System Stability; Simulation of Modern Power Systems; Electric Power System Operation and Management under Restructured Environment; Electrical Insulation in Power Apparatus and Systems.

Basics of Modern Control Systems; Control System Design; Optimal Control; Digital Control; Robust Control Systems; Nonlinear Systems; Linear Stochastic Dynamical Systems; Industrial Automation and Control; Neuro-Fuzzy Control.

Basics of Power Electronics Converters; Power Electronics Applications in Power Systems; Control Techniques in Power Electronics; Modeling and Simulation of Power Electronics Systems; Fundamentals of Electric Drives; Advanced Electric Drives; Special Topics in Power Electronics.

Advanced Engineering Electromagnetics; Computational Electromagnetics; Finite Element Method for Electric and Magnetic Fields; Antenna Analysis & Synthesis; Smart Antennas for Mobile Communication; Microwave measurement and Design; Microwave Circuits; Monolithic Microwave Integrated Circuits; Microwave Imaging, Characterization and Non-

destructive Testing; Computational Tomography; Fiber Optics Systems I and II; Optical Communication; Photonic Networks and Switching.

Mathematical Structures of Signals and Systems; mathematical Methods in Signal Processing; Statistical Signal Processing; Advanced Topics in Digital Filtering; Image Processing; Architecture and Applications of Digital Signal Processors; Wavelet Transforms for Signal and Image Processing; Introduction to Signal Analysis; Digital Video Signal Processing; Computer Vision and Document Processing; Speech Signal Processing.

Representation & Analysis of Random Signals; Communication Theory; Detection and Estimation Theory; Information and Coding Theory; Satellite Communications; Topics in Stochastic Processes; Topics in Cryptography and Coding; Digital Switching; Wireless Communications; Queuing Systems; Digital Communication Networks; Sensor Networks; Application of CDMA to Cellular Communication.

Knowledge Based Man-machine Systems; Computational Bio-instrumentation & Neural Networks; Fuzzy Set, Logic & Systems and Applications; Neural Systems and Networks; Virtual Instrumentation.

FACILITIES:

The department has excellent research laboratories and support facilities in several areas.

Micro fabrication lab with basic semiconductor processing capability for silicon as well as organic material based devices (OLED, organic solar cells, OTFT, etc.); Solar cell characterization lab; photo mask making facility; Semiconductor device lab with capability to synthesize organic materials for organic LEDs and solar cells; Integrated circuits simulation and VLSI design laboratory with all the modern EDA tools, (e.g. Cadence, Synopsis, Mentor Graphics, Xilinx based gate array design & programming tools, etc.) and adequate hardware in the form of servers and good number of workstations for research and course work with provision to fabricate chips at different technology nodes.

Three teaching/training labs have been developed to train students in areas related to organic electronics. These are the organic electronics processing lab, the organic electronics characterization lab and the organic electronics simulation lab.

Robotics lab equipped with 7 DoF manipulators, mobile robots, and visual systems for autonomous navigation of mobile robots, multi-robot formation and control. Control system lab with facilities for multi-motor coordination, control networks and intelligent vehicle control.

Modern high voltage laboratory with AC, DC and impulse test facilities, partial discharge monitoring, electrometer for polarization and loss factor tests, outdoor insulation test bay; Power electronics and solid state drives laboratory; Power systems simulation laboratory; NAMPET laboratory with complete fabrication and testing facilities for research in power electronics including frequency response analyzer, solar photovoltaic panels. Power management lab with solar simulator, frequency response analyzer, electronic loads and fabrication facility

RF and Microwaves lab having network analyzer up to 67 GHz, spectrum analyzers, signal generators, power meters, noise figure meter, shielded anechoic chamber for antenna and RCS measurements, microwave imaging and material testing facility over a wide frequency range, dielectric probe kit, rectangular waveguide and coax calibration kits for various frequency bands.

Fiber optics laboratory equipped with optical spectrum analyzer and interface development facility for fiber optic links, clean room for semiconductor optoelectronic device fabrication and photonic measurement laboratory.

In addition, Advanced Fiber optics laboratory has WDM optical components, single-mode standard and nonlinear fibers, Optical and Sampling oscilloscope to enable experiments on 40G optical links.

Networks laboratory with scalable and configurable test-bed for simulating complex network topologies, 802.11 WiFi links, software radio, multiservice network and QoS, etc.

Speech processing and multi-modal information processing lab equipped with the state of art multi-channel audio visual data acquisition test bed along with dedicated data and voice server connected on E1 digital telephony line enabling research on multi-channel and multi-modal information processing and content delivery; Digital signal processing laboratory with multiple PCs and DSP hardware based on Texas instrument's DSPs; Computer vision lab equipped with chroma keying, controlled illumination, structured light sources, various kinds of camera and associated computational resources.

Electronic equipment maintenance and calibration facility; Multilayer (up to six layers) PTH printed circuits fabrication facility, including CAD facility for printed circuits design and verification; Department library with a good collection of specialized books, research reports and data catalogues; An extensive campus wide LAN with a high speed internet connectivity.

The wide-ranging research facilities and various sponsored research activities ensure that the students are thoroughly exposed to modern trends in Electrical Engineering. The informal atmosphere and free discussions between the students and the teachers are a source of inspiration to both the sides and maintain the standards of academic progress.

INDUSTRIAL AND MANAGEMENT ENGINEERING

The Department of Industrial and Management Engineering at IIT Kanpur was established with the aim of synergizing technology with management. This synergy, which commenced with the M.Tech and PhD programmes offered by the department, was consummated with the introduction of MBA programme in the year 2001.

We focus on developing techniques and skills relevant to students with diverse backgrounds who may wish to subsequently pursue a career in academics or in different managerial positions. The department covers all areas of management that include Services Management, Management of Technology, Social Media and Business Analytics, Innovation and Entrepreneurship, Marketing Management, Manufacturing, Operations and Supply Chain, Quantitative Methods & Decision Making, Organizational Behaviour, Human Resource Management, Business Economics, Infrastructure and Public Systems, Corporate Governance, Finance and Control Systems, Financial Markets and Models, Enterprise Information and Knowledge Systems, Management of Technology, Innovation, Intellectual Property Management, Entrepreneurship, Leadership, Ethics, Strategic Management, Business Policy, etc.

Ph.D. Programme

Students in the Ph.D. program are required to take eight courses. A student may be required to take additional courses depending on his/her background and research interests. At the end of the course work, the student appears for the Ph.D. comprehensive examination, which includes both written and oral parts. On successfully completing the comprehensive examination, he/she will continue research towards completion of the doctoral thesis. Students are encouraged to carry out discussions and consultations with the department faculty members about the field of research and are expected to identify their thesis supervisor by the time of their comprehensive examination.

M.Tech. Programme

M.Tech. students are required to take 3 core courses and 6 elective courses. Students in the M.Tech Programme take a minimum of four courses per semester during the first two semesters and one course in the third semester. The last two semesters are dedicated mostly to a thesis. A student can select courses based on his/her area of interest. Courses lay foundation for thesis work. Thesis can be done in any of the areas of management that include Services Management, Management of Technology, Innovation and Entrepreneurship, Marketing Management, Manufacturing, Operations and Supply Chain, Quantitative Methods & Decision Making, Organizational Behaviour, Human Resource Management, Business Economics, Infrastructure and Public Systems, Energy and Environment Policy modelling, Corporate Governance, Finance and Control Systems, Social Media and Business Analytics, Financial Markets and Models, Enterprise Information and Knowledge Systems, Leadership, Ethics, Strategic Management, Business Policy, etc.

MBA Programme

Students in the MBA program are required to take a set of 12 compulsory courses in the first two semesters. Along with that they are also supposed to do the requisite number of specialization and elective courses in the next semesters. In the III and IV semesters the students are supposed to do two special studies courses with an aim to give them an in-depth understanding in any area of management which is in line with the student's interests.

Facilities

The Department has state-of-the art facilities for computational business modelling and simulation, design prototyping, SAP, Primavera, PFI (Project Finance International), Real Options SLS, Risk Simulator, DEA-Solver-Pro 8.0, SHAZAM Professional Edition 11, Product Lifecycle Management (PLM) software, graphics software like NX 7.5, also known as NX Unigraphics, Simulation and Automation Software like Arena 13, Stella 9.1 and DTS (Data Transformation Services), Statistical Software like SPSS 18 (Statistical Package for the Social Sciences), SAS 10 (Statistical Analysis System), MATLAB, MINITAB and UML diagramming applications like ArgoUML digital innovation & investigating and all spheres of business systems in an integrated smart building. Apart from that the department also has PROWESS database, Primavira which is a Project Management software, etc. The various laboratories provide computational support both for academic teaching and for research. Different academic databases are also available for research as well as teaching purposes. Furthermore the department also has the state of the art class rooms, lecture rooms, video-conferencing facilities, etc.

Faculty

1. Veena Bansal, Ph.D. (IIT Kanpur): Information Technology and Management, ERP systems, E-Commerce.
2. Devlina Chatterjee, Ph.D. (IISc Bangalore): Business Economics, Applied Economics, Empirical Finance, Rural Economics.
3. Jayanta Chatterjee, Ph.D. (IIT Delhi): Marketing, Entrepreneurship, Services Management, Management of Technology & Innovation, Management of Design and Media.
4. Faiz Hamid, Fellow in Management (IIM Lucknow): Combinatorial Optimization, Network Optimization, Fuzzy Logic, Data Mining, Recommender Systems.
5. Avijit Khanra (IIM Ahmedabad): Stochastic Modelling, System Analysis and Optimization, Inventory Management.
6. Shashi Shekhar Mishra, Fellow in Management (IIM Lucknow): Marketing Strategy, New Product Development, Marketing Research.
7. Subhas Chandra Misra, Ph.D. (Carleton University, Canada): Business Process Management, Project Management, Supply Chain Management, Quality Management, Enterprise Resource Planning (ERP), Business Analytics/Data Analysis, E-Governance, and Information Systems.
8. B. V. Phani, Fellow in Management (IIM Calcutta): Entrepreneurship, Accounting & Finance, Financial Governance.
9. Deepu Philip, Ph.D. (MSU Bozeman, USA): Operations Management, Decision Sciences, Business Games, System Simulation, Digital Innovation.
10. Puneet Prakash, Ph.D. (GSU, Atlanta, USA): Financial Risk Management, Finance, Insurance, Quantitative Finance.

11. Shankar Prawesh, Ph. D. (University of South Florida, USA): Social Media, Recommender Systems, Data Mining, Evolutionary Computation and Agent Based Modelling.
12. Uday S. Racherla, Ph.D. (Purdue University, USA): Strategy, Innovation, Intellectual Property Management, Sustainability and Technology Management.
13. R. N. Sengupta, Fellow in Management (IIM Calcutta): Statistical Analysis, Risk Management, Quantitative Decision Techniques, Financial Optimization.
14. Kripa Shanker, Ph.D. (Cornell University, USA): Production/Operations Management, FMS/CIMS; Quantitative Decision Modelling.
15. R. R. K. Sharma, Fellow in Management (IIM Ahmedabad): Quantitative Methods for Management, Manufacturing Policy, Strategic Management.
16. Anoop Singh, Ph.D. (IGIDR, Mumbai): Power Sector Regulation and Policy, Infrastructure Project Financing, Energy & Environment, Managerial Economics, Energy Economics & Policy Modelling.
17. S. V. Vanamalla, Ph.D. (IISc Bangalore): Applied Operations Research, Optimization and Game Theory.
18. Rahul Varman, Fellow in Management (IIM Ahmedabad): Personnel Management and Industrial Relations, Organizational Theory and Social, Political, Legal issues in Business.

Courses

Financial Engineering; Accounting For Management; Financial Management; Project Financing And Management; Management Of Risk In Financial System; Probability And Statistics; Introduction To Computing; Operations Research For Management; Computer Aided Decision Systems; Introduction to Stochastic Processes And Their Applications; Management Decision Analysis; Introduction To Game Theory; Design Of Production Systems; Operations Management; Managing Software Projects; Data Mining & Knowledge Discovery; Simulation & Scheduling Of Manufacturing; Advanced Statistical Methods For Business Analytics; Industrial Project; Research Methodology; Economic Analysis For Management; Investment Valuation And Real Options; Organization Structure And Design; Human Resources Management; Social Political And Legal Environment Of Business; Globalization State & Corporations; Managerial Communication; Manufacturing Strategy; Strategic Management; Corporate Innovation & Entrepreneurship; Management Of Technology; International Business Management; Management In A Global Economy : An Indian Perspective; Economics Of Business Policy; Marketing Management; E-Marketing; Marketing Research; Consumer Behaviour; Marketing of Service; Business To Business Marketing; Strategic Marketing - Contemporary Issues; Intellectual Property Management; Value Creation And Value Capture; Computing For Management; Simulation Of Business Systems; Knowledge Strategies & Knowledge Systems; Management Information Systems; Enterprise Integration With Information Technology; Business Process Management; Software Quality Management; E-Commerce; Quantitative Methods For Decision Making; Statistical Modelling For Business Analytics; Innovation For Sustainable Business Advantage; Production And Operations Management; Total Quality Management; Supply Chain Management; Manufacturing Planning And Control; Project Management; Managing Service Operations; Infrastructure Regulation; Policy And Finance; Security Analysis; Derivatives And Portfolio Management; Energy & Carbon Markets: Economics Policy & Regulations; Social Media Analytics, etc.

Detailed information of the department and related information can be accessed at Department: http://www.iitk.ac.in/ime

Faculty: http://www.iitk.ac.in/ime/faculty.html

Research: http://www.iitk.ac.in/ime/research.html

Ph.D. scholar: http://www.iitk.ac.in/ime/research.html

MATERIALS SCIENCE AND ENGINEERING

The department of Materials Science and Engineering at IIT Kanpur is world renowned for its exceptional quality of faculty and facilities. It excels in both research and teaching (undergraduate and postgraduate). It hosts a wide variety of state-of-the-art research facilities. In addition, the Advanced Center for Materials Sciences houses several advanced processing and characterization facilities. The department is involved in cutting edge computational as well as experimental research in both traditional as well as modern areas of materials science and engineering. The research activities of the department encompass a wide selection of materials including metals and alloys, semiconductors, ceramics, polymers, biomaterials and composites. The departmental research is directly relevant to various technologies such as Health, Renewable Energy, Transport and Automotive, Defense, Aerospace and Consumer Electronics.

Major Research Areas

- Extractive, Process and Powder Metallurgy
- Physical Metallurgy
- Mechanical Behaviour of Materials
- Electrochemistry and Corrosion Science
- Computational Materials Science and Process Modelling
- Biomaterials
- Functional materials (e.g. Optical, Magnetic, Optoelectronic and Multiferroic) and Devices such as Memories, Displays and LEDs
- Energy and Environment Related Materials for Solar Cells, Fuel cells and Hydrogen Storage

Career Opportunities

The postgraduate alumni of the department have an excellent placement record. Students of our department have become faculty members at premier institutions such as IISc, IITs, NITs and universities elsewhere in the world and scientists in several research labs such as ISRO, BARC, IGCAR, NML, DRDO, to name a few. Postgraduate alumni are also employed with leading industries like Tata Steel, Tata Motors, Ashok Leyland, Mahindra, GE, GM, SAIL, Moserbaer, BHEL,JSW steel etc. Our students also find opportunities in the IT and Finance sector.

Academic Environment

In addition to pursuing research and education, our students are also actively involved in the activities of various professional bodies, such as Materials Advantage and Indian Institute of Metals. Institute provides ample opportunities and financial support to the PG students to present their research work at various conferences, in India and abroad. Students are also exposed to various teaching opportunities in the form of teaching assistantships and tutorships. Students are encouraged and rewarded for publications in peer-reviewed journals. The institute offers ample opportunities for participation in a wide range of extracurricular activities for overall personality development.

PG Admissions

For admission into the PhD program, students with M.Tech./M.E./B.Tech./B.E. degree in Metallurgical Engineering / Ceramic Engineering / Materials Science and Engineering / Mechanical Engineering and other appropriate engineering disciplines are eligible. Exceptionally bright students with M.Sc. degree in Materials Science / Physics / Chemistry / Biology (with Mathematics at B.Sc. level) are also eligible to apply for the PhD programme.

The minimum qualification for admission into the M.Tech. programme is B.E./B.Tech./B.S. degree in Metallurgical Engineering / Ceramic Engineering / Materials Science and Engineering/ Mechanical Engineering and other appropriate engineering disciplines or M.Sc. degree in Materials Science / Physics / Chemistry. Candidates should also have qualified GATE with a valid score.

Further details can be found at http://www.iitk.ac.in/mse/test/ → Academics

Research Facilities

Synthesis and processing facilities include manufacturing units and facilities to fabricate materials in bulk and thin film form. Some of these facilities are specialty melting units and furnaces, physical and chemical thin film processing methods, mammalian and bacterial cell culture facilities, advanced sintering techniques such as spark plasma sintering, and conventional mechanical processing units such as rolling, swagging, and hot press. The department also has class 100 and 10000 clean rooms for the fabrication of devices.

Characterization facilities of the department include microscopy facilities consisting of optical and electron microscopes (SEM/ TEM/ FEG-SEM), atomic force microscope (AFM), powder and thin film X-ray diffractometer and thermogravimetric analysis instruments. Department also houses state-of-the-art testing facilities for measurement of complete array of mechanical, electrical, optical, magnetic and functional properties.

Post Graduate Courses

PG students are free to choose from a number of fundamental and advanced postgraduate courses covering various aspects of material science and engineering. In addition to thesis requirements, PG students are required to complete minimum course requirement, depending upon their last degree and the background. A detailed list of courses, course requirement details and research interests of the faculty members are available on the department website (http://www.iitk.ac.in/mse/test/).

Faculty Profiles

Kantesh Balani *Ph.D.* (Florida Intl. University)	Biomaterials, Nanomechanics; Ultra High Temperature Ceramics, Tribology, Ab-Initio Molecular Modeling, Carbon Nanotube (CNT) Reinforced Composites
Somnath Bhowmick *Ph.D.* (IISc Bangalore)	Computational Materials Science, Size Dependent Properties Of Nanomaterials, Electronic Structure Calculations, Multiscale Modeling
Krishanu Biswas *Ph.D.* (IISc Bangalore)	Nanomaterials, Solidification, Electron Microscopy, Phase Transformations, Graphene, Sintering
Ashish Garg *Ph.D.* (Cambridge University)	Structure-Property Correlations In Multifunctional Materials, Ferroic And Multiferroic Thin Films And Devices, Organic Solar Cells
Anshu Gaur *Ph.D.* (UI Urbana-Champaign)	Materials For Electronic Devices, Carbon Based Nanostructures, Device Physics And Simulation, Computational Materials Science
Deepak Gupta *Ph.D.* (UC Berkeley)	Organic Electronics (Oleds, Displays, Tfts), Oxide And Transparent Semiconductors, Defects In Semiconductors
Gouthama *Ph.D.* (IISc Bangalore)	Electron Microscopy, Surfaces And Interfaces, SPD Processing, Structure Property Correlations In Materials, Shape Memory Alloys
Nilesh Gurao *Ph.D.* (IISc Bangalore)	Crystallographic Texture, Thermo-Mechanical Processing And Mechanical Behaviour Of Materials
Sarang Ingole *Ph. D.* (Arizona State University)	Inorganic Semiconductors For Photovoltaics, Fabrication & Applications Of Nano Materials
Monica Katiyar *Ph.D.* (UI Urbana-Champaign)	Organic Electronics, Solid State Lighting, Printable Electronics, Thin Films, Electronic Materials And Devices: Characterization And Processing
Kaustubh Kulkarni *Ph.D.* (Purdue University)	Light-Weight Alloys For Automotive And Aerospace Applications, Multicomponent Diffusion, Integrated Computational Materials Engineering
Tanmoy Maiti *Ph.D.* (Penn State University)	Plasmonics, Oxide electronics, Thermolelectrics, Energy Harvesting and Energy Storage
Indranil Manna *Ph.D.* (IIT Kharagpur)	Structure-Property Correlations In Materials, Synthesis And Application Of Nano-Materials, Surface Engineering, Phase Transitions And Fuel Cells
Dipak Mazumdar *Ph.D.* (McGill University)	Steelmaking, Process Modeling, Heat, Mass And Momentum Transfer In Materials Processing
Kallol Mondal *Ph.D.* (IIT Kharagpur)	Phase Transformations, Corrosion, Oxidation, Non-Equilibrium Processing, Metallic Glasses, Nanocrystalline Alloys
Rajdip Mukherjee *Ph.D.* (IISc Bangalore)	Phase-field Modelling, Multiscale Modelling, Phase Transformations
Shobit Omar *Ph. D.* (University of Florida)	Ionic Conductor, Mixed Ionic-Electronic Conductor, Ceramic Processing, Solid Oxide Fuel Cells, Thermal

	Barrier Coatings
Sandeep Sangal *Ph.D.* (Manitoba University)	Mechanical Properties Of Materials, Stereology, Computational Materials Science
Rajiv Shekhar *Ph.D.* (UC Berkeley)	Electrochemical Processing, Molten Salt Electrolysis, Aluminium Electrolysis, Electrodeposition, Electrochemical Remediation Of Soil
Shashank Shekhar *Ph. D.* (Purdue University)	Grain Boundaries And Triple Junctions, Severe Plastic Deformation, Machining And Manufacturing, Structural Nanomaterials
Anandh Subramaniam *Ph.D.* (IISc Bangalore)	Nanomaterials, Amorphous And Metastable Materials, Epitaxial Systems, Defects And Interfaces, TEM, Finite Element Modelling, Hydrogen Storage.
Anish Upadhyaya *Ph.D.* (Penn State University)	Materials Processing, Liquid Phase Sintering, Structure-Property Correlations, Alloy Design, Metal Matrix Composites, Nanocrystalline Alloys
Vivek Verma *Ph. D.* (Penn State University)	Protein Micropatterning, Biomaterials, Fiber Reinforced Composites, Bioplastics
B Basu (Adjunct Faculty) *Ph.D* (Katholieke Universiteit Leuven (KUL), Belgium)	Biomaterials for hard tissue replacement and nerve regeneration, Nanoceramics and Nanoceramic Bio-composites, Influence of external fields (electric/magnetic) on Eukaryotic/ Prokaryotic Cell-Material interaction

MECHANICAL ENGINEERING

The Department of Mechanical Engineering is engaged in UG and PG teaching, research, developmental work and industrial consultancy. The PG program for M.Tech. and Ph.D. degree has four broad streams: Solid Mechanics and Design; Fluid Mechanics and Thermal Sciences; Manufacturing Science; and Robotics and Mechatronics (Ph.D only).

In the M.Tech. program, the emphasis is on the development of a broad background in a particular stream followed by a deeper study of a problem in the stream. Every student is required to take a minimum of 8 courses of which 3 or 4 (depending on the stream) are compulsory to be taken mostly in the first semester. In the second semester, the student takes mostly the elective courses and the remaining compulsory courses, if any. The elective courses are chosen in consultation with the thesis supervisor to match the student's interest as well as his thesis requirements. The third and fourth semesters are dedicated for the thesis work.

The minimum qualification for admission to the M.Tech. program is a Bachelor's degree in Mechanical Engineering*. Candidates with a Bachelor's degree in Production Engineering* are eligible for admission to the Manufacturing Science stream. At the time of admission, the candidates are ranked according to the merit depending on their previous educational background, GATE score and their performance in the interview/written test. The stream is allotted according to the rank and the preference of the candidate.

The Ph.D. program is designed to equip the student with general proficiency in a stream through the course work. The student then proceeds to do fundamental creative investigation of a topic in the stream. In general, a Ph.D. student is required to take a minimum of 4-6 courses. After completion of the course work and before proceeding to the thesis work, he/she is required to pass the comprehensive examination. This examination is in both the written and the oral form and is designed to judge the overall comprehension of the student in his major field (the field of the thesis topic) and two minor fields (fields related to the thesis topics).

The minimum qualification for admission to the Ph.D. program is a Master's degree in Mechanical Engineering*. In exceptional cases, candidates with B.Tech in Mechanical Engineering*, Master's degree in other branches of Engineering* and Sciences* will be considered. Interview/written test will be conducted by the department and the admissions would be made as per the procedure detailed at http://www.iitk.ac.in/mech/.

To be considered for admission to the Ph.D programme of the Mechanical Engineering Department, candidates must provide ALL of the following documents:
1. Completed Application Form
2. At least two Reference Forms from referees who are well acquainted with your work.
3. SC-ST, OBC-NCL, PD certificates, if applicable

4. A 'Statement of Research' in about 1000 words
5. An abstract (in about 500 words) of the work done as part of your MTech thesis (Btech project, in case you are applying after Btech)
6. Copies of papers that you may have published already in conferences and/or journals.

Note that the requirements 4-6 are specific to the ME Department and are mandatory. They should reach us before the interview date, alongwith the completed application form. Your chances of getting admitted will be significantly affected if you do not send all the documents. Please visit the page http://www.iitk.ac.in/me/admission/phd2013.htm to know more about the PhD selection process.

*with minimum percentage/CPI specified by the Institute

FACULTY

Agarwal A.K, Ph.D. (IIT Delhi): IC Engines, Alternate Fuels, Emissions, Laser Diagnostic Techniques, Micro-sensor Development, Lubricating Oil Tribology, Nano-particulates.

Basu Sumit, Ph.D. (IISc Bangalore): Computational Micromechanics, Fracture Mechanics, Modeling of Materials across Length Scales, Finite Deformation Theories and Non-linear FEM.

Bhattacharya B, Ph.D. (IISc Bangalore): Smart Structures, Active and Passive Vibration Control, Flexible Manipulators and Smart Compliant Joints, Active Shape Control and Adaptive Structures.

Bhattacharya S, Ph.D. (University of Missouri, Columbia): Bio MEMS, Lab on Chip, Nano Technology, Microsystems Fabrication, Micro-Fluidics, Lithography processes, Nano-energetics.

Biswas G, Ph.D. (IIT/Kh, on deputation): Computational Fluid Mechanics and Heat Transfer, Turbulence.

Chatterjee Anindya, Ph.D. (Cornell University): Dynamics and Vibrations.

Choudhury S.K, Ph.D. (PLPF Moscow): Vibration Control of Machine Tools, Adaptive Control System, Metal Cutting, Hydraulic Control, Unconventional Machining.

Dasgupta Bhaskar, Ph.D. (IISc Bangalore): Robotics, CAD, Mechanisms, Machine Dynamics, Engineering Computation.

Das M.K, Ph.D. (Penn State): Electrochemical Energy Conversion, Chemically Reacting Systems.

Das S.L, Ph.D. (Cornell): Mechanics of Biological Membranes, Continuum Mechanics, Granular Mechanics.

Dixit P.M, Ph.D. (Minnesota): Metal Forming, Ductile Fracture, Elasto-plastic Impact/Contact Problems, Finite Element Method.

Dutta Ashish, Ph.D. (Akita, Japan): Robotics, Intelligent Control systems, Microsensors and actuators, Bio-robotics.

Ghoshdastidar P.S, Ph.D. (South Carolina): Computational Heat Transfer, Rotary Kiln modelling, Non-Newtonian Flow and Heat Transfer, Simulation of Boiling Heat Transfer. Modelling of Microscale and nanofluids heat transfer, food drying and chilling.

Gupta A, Ph.D. (Berkeley): Dynamics of Defects in Solids, Waves in Solids, Mechanics of Thin films.

Gupta S.S, Ph.D. (Virginia Tech.): Linear/Nonlinear Structural Mechanics, Mechanics of Nanomaterials and their Characterization using Molecular Simulations.

Hatwal H, Ph.D. (IIT/K): Vibrations, Dynamics of Ground Vehicles, Robotics.

Jain V.K, Ph.D. (Roorkee): Advanced Machining Processes, Accelerated Cutting, CAM Machining of Advanced Engineering Materials.

Kumar Arvind, Ph.D (IISc Bangalore): Manufacturing (casting, joining, welding, electron/laser beam melting/welding, layered and micro manufacturing, photovoltaic silicon growth); Heat transfer, Computational fluid dynamics (CFD); Multiscale and multiphysics modelling − coupling of heat transfer with electric/magnetic fields, thermal stress etc; Solid-Liquid phase change (Melting/solidification); Laser/plasma assisted surface coating technologies; Phase change energy technologies; Flow interaction with cells and tissues.

Kalra M.S, Sc D (MIT): Nonlinear Dynamics and Control; Kinetic Simulation of Fusion Plasmas; Boundary Element Techniques.

Kar K.K, Ph.D. (IIT/Kh): Polymer, Polymer Blends, Alloys, & Composites, Polymer Processing & Rheology.

Khandekar S, Ph.D. (Univ. Stuttgart, Germany): Thermal Management, Passive heat Transfer, Heat Pipes, Energy systems.

Kishore N.N, Ph.D. (IIT/K): Composite Materials, FEM, Non-Destructive Testing.

Munshi P, Ph.D. (IIT/K): Computer Tomography, Two-phase Flow, Nondestructive Testing.

Muralidhar K, Ph.D. (Delaware): Optical Techniques, Flow control, hierarchical transport phenomena, biological flows.

Panigrahi P.K, (LSU): Laser Based Instrumentation, Flow Control, CAD of Thermal Systems, Turbulence, Micro-fluidics and Heat Transfer.

Ramkumar J, Ph.D. (IIT/M): Micro/Nano-Fabrication & finishing, Nano Composites & Tribology.

Saha A.K, Ph.D. (IIT/K): Turbulance, Chaos & Bifurcation, Vortex Dynamics, Hotwire Anemometry, Gas Hydrates, Experimental Fluid Dynamics and Heat Transfer, Computational Fluid Dynamics and Heat Transfer.

Sarkar S (IIT/M): Turbomachinery, Fluid Mechanics, Computational Fluid Flows, Turbulence, LES/DNS and Heat Transfer.

Saxena Anupam Ph.D. (U Penn): Compliant Mechanisms, Topology design, CAD, Robotics, MEMs, Optimization, Large Deformation Systems.

Sharma B.L, Ph.D. (Cornell): Continuum Mechanics and Thermodynamics, Lattice Dynamics, Dislocations and Solid-Solid Phase transformation.

Sinha Sujeet K., Ph.D (Imperial College, London UK): Nanotribology of microsystems, Tribological coatings, Lubrication, Polymer tribology, Bio-inspired surfaces for Tribology.

Sinha Neeraj, Ph.D (U Waterloo, Canada): Nanotechnology, Bioengineering, Manufacturing system

Sharma Ishan, Ph.D. (Cornell): Fluid/Solid mechanics; Contact mechanics; Granular media; Planetary/Space science; Waves and instabilities in continua; Fluid-structure interaction.

Tiwari Nachiketa, Ph.D. (Virginia Tech): Acoustics and Noise Control, Solid Mechanics, Composite Structures, Vibrations, Product Design, Automotive Systems, MEMS.

Venkitanarayanan P, Ph.D. (U Rhode Island): Experimental Solid Mechanics, Dynamic Fracture Mechanics, Functionally graded Composites.

Vyas Nalinaksh S, Ph.D. (IIT/D): Micro-Electro-Mechanical System (MEMS), Vibrations and Control, Rotor Dynamics, Instrumentation, Condition Monitoring

Wahi P, Ph.D. (IISc Bangalore): Nonlinear Dynamics, Vibrations.

COURSES

The compulsory courses for M.Tech. Programs are as follows

Solid Mechanics and Design: Mathematics for Engineers, Introduction to Solid Mechanics, Applied Dynamics and Vibration

Fluid Mechanics and Thermal Sciences: Mathematics for Engineers, Viscous Flow Theory, Conduction and Radiation, Convective Heat and Mass Transfer

Manufacturing Science: Mathematics for Engineers, Metal Cutting, Non-traditional Machining Processes, Metal Forming

Elective courses for M.Tech. and Ph.D. students are listed at http://www.iitk.ac.in/mech/

FACILITIES

The Department maintains the following laboratories for instruction and research: Experimental Stress Analysis, Vibration and Control, Material Testing, Machines and Mechanisms, Fluid Mechanics, Energy Conversion, Heat Transfer, Refrigeration and Air Conditioning and Manufacturing Science. There are many specialized research laboratories and facilities and their details can be seen on http://www.iitk.ac.in/mech/

NUCLEAR ENGINEERING AND TECHNOLOGY
(Interdisciplinary Program)

Nuclear Engineering and Technology is an interdisciplinary postgraduate program offering M.Tech. and Ph.D. degrees. The interdisciplinary nature of the program is reflected in the eligibility of students for admission to M.Tech. Program: graduates in engineering, primarily Mechanical, Electrical, Electronics, Instrumentation, Chemical, and M.Sc. in Physics. M.Tech. in Nuclear Engineering (or a related area) is required for admission to Ph.D. programme. Selection of M.Tech. students is done through interview and scores in GATE and qualifying examination. Selection of Ph.D. students is done through interview and scores in qualifying examination.

FACULTY

Prabhat Munshi, Ph.D. (IIT/K): Radiation Imaging and Tomography, Safety Analysis.

S Qureshi, Ph.D. (Berkeley): Radiation Detectors, VLSI.

Shikha Prasad, Ph.D. (Univ. of Michigan): Radiation Measurements, Shielding, Reactor Physics.

ASSOCIATED FACULTY

P Wahi, Ph.D. (IISc Bangalore): Nonlinear Dynamics

EMERITUS FELLOWS

M S Kalra, Sc.D. (MIT): Nonlinear Dynamics, Fusion Plasmas, Boundary Element & Meshless Boundary Methods.

A Khanna, Ph.D. (IITK): Nuclear Chemical Engineering.

VISITNG FACULTY

Om Pal Singh, Ph.D. (IIT Delhi): Reactor Physics, Risk Analysis

COMPULSORY COURSES

Mathematics for Engineers, Nuclear and Reactor Physics, Nuclear Power Engg I, Nuclear Power Engineering II, Nuclear Measurements Laboratory,

ELECTIVE COURSES

Nondestructive Evaluation, Computerized Tomography, Nuclear Fusion, Nuclear Chemical Engg, Nuclear Fuel Cycles, Nuclear Materials, Fast Reactor Technology, Nuclear Power Engineering III, Advanced Reactor Physics, Neutron Transport Theory, Radioisotope Applications in Engineering, Interaction of Radiation with Matter

FACILITIES

The nuclear engineering laboratory is well equipped with radiation detectors (semi-conductor, scintillation, gas), radioisotope gauges, PC-based multi-channel analyzer, signal correlator, neutron sources, 1.7 MeV Tandetron accelerator, a nine-detector gamma-ray CT system using Cs-137 source and a Micro-focal X-ray CT scanner (7 microns).

RESEARCH AREAS

Radiation Imaging and Tomography, Thermal Safety Analysis, Probabilistic Safety Analysis, Non-linear Dynamics (fusion and fission), nuclear chemical simulations, Severe Accident Analysis, Radiation Measurements, Shielding, Reactor Physics.

PHOTONICS SCIENCE AND ENGINEERING

(Inter-disciplinary Programme)

Since their invention in 1960s, lasers have transformed most fields of science and technology. Laser activity started at IIT Kanpur in 1964 and by late 1960s, IIT Kanpur distinguished itself in the fabrication of lasers of various kinds. The Laser Technology Programme (LTP) at IIT Kanpur started in July 1988 with the aim and objective of training young Engineering and Science graduates for providing skilled manpower in the specialised field of lasers and photonics. The name of the programme was changed to Photonics Science and Engineering in the year 2012. It is hard to imagine our lives without laser-based optical communications and networks; compact disc payers; laser printers, laser surgery; lasers-based materials processing; and applications of laser spectroscopy in medicine and nano-materials. Today, IIT Kanpur has excellent facilities for research in the field of lasers and various laser applications. The curriculum has been designed to provide the necessary theoretical and experimental background in lasers, quantum optics, and various laser applications such as optical communications/networks & switching, holography, material processing, materials and biomedical spectroscopy, flow/temperature & stress analysis, optical signal processing & computing and optoelectronic integration. Compulsory laboratory courses constitute an integral part of the curriculum. Each student is required to take up a two-semester long research project with any one of the faculty members associated with the laser technology programme. It is a unique interdisciplinary programme, which draws faculty from the departments of Aerospace Engineering, Chemistry, Electrical Engineering, Mechanical Engineering, Civil Engineering and Physics to teach various core courses and guide/supervise M.Tech. thesis. The students make use of the facilities of the Centre for Lasers and Photonics, which consolidates the research and developmental activities in this field. In addition to the usual classroom teaching, emphasis is given to hands-on experience on lasers. The compulsory course on Photonics Science & Engineering Laboratory Techniques facilitates the process.

Candidates having relevant background from Bachelor's degree in all branches of engineering or Master's degree in Physics, Applied Physics, Applied Optics or Chemistry are eligible to apply for admission to the M.Tech. programme in Photonics Science and Engineering.

Candidates having relevant background and exceptional performance in Bachelor's degree in Engineering or a first-class in Master's degree in Engineering, Physics, Applied Physics, Applied Optics or Chemistry are eligible to apply for Ph.D programme in Photonics Science and Engineering. Seats are limited and subject to availability of vacancy in the sub-area preferred by the candidate. A Statement of Purpose should be attached with the application for Ph.D programme indicating the area of interest and the reasons for its choice.

FACULTY

Ramesh C Budhani, Ph.D. (IIT/D): Experimental Condensed Matter Physics.

Utpal Das, Ph.D. (Michigan): Quantum structures, Semiconductor Optoelectronic Integration.

Debabrata Goswami, Ph.D. (Princeton): Ultrafast Pulses, Non-linear Spectroscopy, Quantum Computing, Coherent Control

Sudhir Kamle, Ph.D. (Purdue): Holography, Stress Analysis, Smart Materials

Pradeep K. Kumar Ph.D. (IIT, Chennai): Quantum cryptography, Quantum optics, Non-linear Fiber optics, optical fiber communication.

B. Lohani, Ph.D. (ESSC,UK): Laser ranging, Flash scanning Laser applications, Laser imaging and cross section.

D.P. Mishra, Ph.D. (IISc. Bangalore): CFD of Chemically Reacting Flows.

K. Muralidhar, Ph.D. (Delaware): Fluid Mechanics, Heat Transfer

Naren Naik, Ph.D. (IISc. Bangalore): Reconstruction and analysis approaches to tomographic problems; Numerical solutions for wave propagation; Sub-surface imaging.

Pradipta K Panigrahi, Ph.D (Louisiana State): Holography, Laser Schlieren, Particle image velocimetry.

Asima Pradhan, Ph.D. (CUNY, N Y): Biophotonics, Laser Spectroscopy and Imaging

G. Rajshekhar, Ph.D (EPFL Switzerland): Optical Metrology, Digital Holography, Biomedical Imaging, Applied Signal Processing
Raj K Thareja, Ph.D. (Delhi): Laser Physics, Laser Plasma Interaction

R. Vijaya, Ph.D. (IIT Madras): Fibre optics, non linear optics, photonic band gap structures.

Harshawardhan Wanare, Ph.D. (Hyderabad): Non-linear Optics, Quantum Optics, Light Interaction in Biological Tissues.

Compulsory Courses:

Introduction to Photonics, Principles of Lasers and Detectors, Photonic Systems and Applications, Photonics Laboratory Techniques, Research in Photonics and Lasers, M.Tech. Thesis.

Electives:

Numerical methods in Optics, Laser Spectroscopy, Fiber Optic Systems I & II, Semiconductor Lasers, Optical Communication Systems, Optical Computing, and Optical networks & Switching, Quantum Optics.

Facilities:

Besides the central facilities at the Institute level, the Centre for Lasers and Photonics (CELP) has its own precision machine shop and library, which support the Photonic Science and Engineering Programme. Various state-of-the-art facilities i.e. Femto-second laser, Ti-sapphire laser, CCD- spectrograph system, micro-Raman facility, spectrofluorimeter, Polarimetry system, PIV, Interferometry, Holography, Schlieren, CO_2 laser, confocal microscopy, Tunable laser, optical wave guiding setup, pulsed laser sources, diode lasers, MCT detectors, laser scanners, Photon counters and Lock-in amplifier are available. The programme also shares a semiconductor optoelectronic device fabrication facility with other departments.

**(An Interdisciplinary Courses-of-Study for the award of Master and PhD in Design
Design as a stand-alone discipline of study)**

Design as a field began and evolved into a discipline during the period of post industrial revolution in the west, in response to the recognition that customer's preferences and requirements must be included as a crucial element in the creation of mass-produced end products. After innumerable flight mishaps thereafter during WWII came the recognition that social science perspectives along with engineering must be included in the design of objects, to account for inherent human capabilities and limitations. People centricity evolved thereafter in the field of Design, integrating both of the above, and ethodologies that keep users at the center of the process of creation of end products are currently in practice today.

Benefits realized have not just been in meeting the comforts, convenience, desirability and affordability factors of the user but also in creating differentiated products, reduced risks of rework and rejects, customer loyalty and increased stock value for the manufacturer. In the education and practice of Design, we build all these criteria mentioned above into the product life cycle, that is, accounting for comfort, convenience, desirability and affordability. This results in a more robust design with greater predictability in its outcome and minimized costs of unmet needs and undiscovered requirements post release. Further, the notion of standalone products today as well has been undergoing a sea change and is getting replaced by the notion of an overall experience and an ecosystem created by products and services that form a part of it.

And embedded products are proliferating today, where intelligence is built into more and more products.

In teaching design students therefore, to think of wider possibilities, of user orientation and of greater eventualities, designers get trained to think out of the box, think of ease of use and manufacture and of the business and market angles to an end product. It is these lateral, broad and strategic thinking skills that are being recognized and valued in

organizations today. Design education serves to provide graduates who can create and manage the design of not just a customer focused product but an overall experience a product creates in the life of its consumers, beyond the design of the standalone product alone.

Design as a discipline is a confluence of many disciplines and its strength lies in its breadth and in this integration, particularly in today's global, fast to market and fiercely competitive information age. Design takes from applied engineering its scientific, structured and methodological principles, from applied cognitive science its principles of human characteristics and behaviors, from applied computer science its logical approaches and prototyping methods of information products, from applied ethnography its principles to understand deeper user needs, sense of human values and a broader sensitivity of society and culture, from industrial engineering its application of productivity and efficiency,

from applied experimental psychology its evaluative approaches with users, from applied art its principles of visual and sensory attributes of products and experiences, from library and information science its application of architecting of large information sets and from management and economics its financial and business constructs, entrepreneurship and

returns on investments made in objects designed.

Thus Design as practiced and taught around the world as a standalone discipline is a left and right brain combination execution of a methodology, that not only integrates principles and approaches from a wide set of disciplines but must necessarily be unified by a common philosophy, process, method and delivery.

Design Programme: Aims and Objectives

The Design Programme envisions itself as an interdisciplinary space for co-creation of design education, research and people-centric application. We believe in developing a collaborative environment between students, researchers, academicians and business practitioners. We aim at creating a working environment enabling knowledge sharing and

experience exchange. Pedagogically, we believe in 'learning by doing', experimentation, collaboration and innovation.

We aim at creating the next generation of designers, design thinkers and design leaders who will conceptualize and develop design solutions for the challenges faced by industry and society. To do so, we foster a passion based and student centric learning culture. We constantly explore creative ways of working and enhancing interaction to support

world-class development in education, research and practical application context. We strive to build on designers' ability to research, discover, invent, innovate, ideate, make decisions, evaluate and lead for the purpose of improving quality of life.

Our curriculum is based upon an interdisciplinary synthesis of design, technology, social sciences and management, while also adhering to the principles of sustainability. The programme inculcates the spirit of creativity, celebrates innovation, develops an appreciation for human values, fosters craftsmanship, and encourages personal xpression leading to evolution of products and services for the betterment of society and people.

Our Students

Design at IIT Kanpur is a unique program in terms of its multidisciplinary approach and flexibility. This requires a certain maturity to be able to navigate, exploit it to its fullest and derive maximum benefit from it. Students comfortable with ambiguity & flexibility fit well and have a better head start in the unique environs for Design education at IIT Kanpur.

Students more comfortable with rigid structure and predictability may not be the best fit in to the programme and therefore the initial foundation courses and the essential unlearning process becomes an important component of the design curriculum to help engage all such students better.

Good academic record, strong in emotional and social intelligence and multi-faceted along with versatility, flexibility, ability to think on their feet, interest in people, strong convictions, confident communication and above all hard working are few of the key traits that may result in a graduate with the profile we seek at Design IITK

Our Graduates

Placements have had a strong track record since inception in 2002. Our graduates have been joining the IT industry, organizations with a focus on media, product design and visual graphics, automobile industry and several have launched out as entrepreneurs. A select few have also pursued research in Design towards a PhD and eventually opted an academic career.

Admissions

M.Des:

Masters programme in Design aims at attracting students from diverse backgrounds who exhibit high levels of creativity, intellectual ability and maturity. To ensure such a student profile, we admit those best suited to our programme through a rigorous selection process.

Admissions are made once a year, in July. The minimum academic qualification is that candidates should hold a Bachelor's degree in Engineering, Design or Architecture from a recognized University with not less than 55% marks or equivalent (no marks restriction for SC/ST/PD candidates) as well as a valid CEED/GATE score. Candidates holding degrees in Fine Arts or Interior Design are not eligible to apply for this programme. Students in the final year of the qualifying degree may also apply, but the admission would stand cancelled if the final examination is not over at the time of admission, or if the proof of minimum qualification is not submitted by September 30 in the year of admission. There is no restriction on the age of the candidate or the number of attempts for CEED/GATE. Successful candidates are called for an Interview and a written test conducted by the Programme and admission is granted based on the results.

Ph.D. in Design:

The applicant must have a master's degree in Engineering/ Technology/ Design with marks/CPI not below the specified minimum. Applicants with a bachelor's degree in Engineering/ Technology/ Design (four years programme) with a minimum of 75 percent marks / 7.5 CPI or Master's Degree in Science or an allied area satisfying each of the following criteria may also be considered.

(a) A minimum of 65 percent marks/6.5 CPI in the Master's Degree

(b) First division in Bachelor's Degree, and

(c) Valid GATE/CEED score

Streams of study

In the first two semesters of the masters programme we offer students a holistic training in Design through the core courses and departmental electives in various different disciplines of Design. Students are also encouraged to take courses outside their own discipline. Students take up thesis project in the third and fourth semester of their masters

programme in some of the following streams of study: Product Design, Mobility Design, Visual Communication, Engineering Design, User Experience Design, Interaction Design, Film Making, Systems Design etc

Faculty

We have a multidisciplinary group of faculty drawn from many different departments, streams and discipline of study from across the institute who contribute in teaching as well as research in the Design Programme. Additionally we have several adjunct and visiting faculty members from the industry and academia.

Humanities and Social Sciences

- Koumudi P Patil PhD (IDC, IITB)

- Shatarupa Roy PhD (DOD, IIT Guwahati)

- Satyaki Roy Ph.D (Visva Bharati University)

- Braj Bhusan Ph.D (BRAB University)

- Munmun Jha Ph.D (Glasgow University)

- Vimal Kumar Ph.D (University of California, Irvine)

Mechanical Engineering

- Bishakh Bhattacharya Ph.D (IISc, Bangalore)

- Nachiketa Tiwari Ph.D (Virginia Tech)

- J Ramkumar Ph.D (IIT Madras)

- Shantanu Bhattacharya Ph.D (University of Missouri, Columbia)

- Ishan Sharma Ph.D (Cornell University)

- Niraj Sinha Ph.D (University of Waterloo)

Bio Sciences and Bio Engineering

- Mainak Das PhD (University of Central Florida)

Industrial Management & Engineering

- Deepu Philip Ph.D, (MSU Bozeman)

- Jayanta Chatterjee Ph.D (IIT Delhi)

Computer Sciences

- Manindra Agarwal Ph.D (IIT Kanpur)

Aerospace Engineering

- D.P.Mishra Ph.D (IISc Bangalore)

Adjunct Faculty

- Jhumkee Sengupta Iyengar, User Experience Design

- Bidyabijay Bhaumik, Mobility Design

- Udaya Kr. Dharmalingam, Typography

HUMANITIES AND SOCIAL SCIENCES

The Department consists of six major disciplines Economics, English Literature and Linguistics, Fine Arts, Philosophy, Psychology and Sociology. Each of these disciplines except Fine Arts has a Ph.D. programme. Shortly, Fine Arts is expected to start a Ph.D. programme. The Ph.D. programme of the department is committed to producing research work of high quality in theoretical and applied fields and in interdisciplinary areas. Several doctoral dissertations produced in the Department have received encomiums in India and abroad. The Department also has an under graduate programme in Economics.

FACULTY

Bagad, Prashant (Southampton): Aesthetics, Philosophy of Literature, Plato, Existentialism.

Bhushan, Braj (BRAB): Cognitive Neuropsychology, Cognitive Factors in Design, Trauma Psychology.

Bhowmik, Ritwij (National Chiao Tung): Far-Eastern Art History, Modern Indian Art, Visual Culture and Cinema studies.

Chakrabarti, Anindita (Delhi): Sociology of Religion, Social Movements, Urban Sociology.

Chakraborty, Tanika (Washington, St Louis): Development Economics, Labor, Applied Micro-economics, Decision-making.

Chandran, Mini (Kerala): Modern British Literature, European Literature, Indian Literature & Aesthetics, Translation Studies.

Chattopadhyay, Sayan Ph.D. (Cambridge): Indian Writings in English, Postcolonial Studies, Life Writings, Literature of Colonial Bengal.

Dixit, Shikha (Agra): Cognitive Psychology, Social Cognition, Application of Psychology to Armed Forces and Health Psychology.

Dutta, Joydeep (IIT Kharagpur): Optimization Theory.

Gohain, S. (Emory): Culture and Politics, Borders, Spatial Theories, Anthropology of Mobilities.

Jha, Munmun (Glasgow): Indian Society, Human Rights, Social Movements, Design Anthropology.

Koshy, Philose (Hyderabad): Philosophy of Science, Epistemology, Logic.

Kulshreshtha, Praveen (Cornell): Microeconomics, Industrial & Financial Economics, Econometrics, Governance and Business Ethics.

Kumar, Vimal (UC Irvine): Game Theory, Growth & Technology, Political Economics.
Mathur, Somesh K (JNU): Efficiency and Productivity Analysis, New Trade and Growth Theories, Firm level trade, WTO issues, like TRIPS and IT Policy, Evaluating Economic

Agreements, Convergence Issues, Panel Data Analysis and Procedures and Gravity analysis.

Mathur, Suchitra (Wayne State): Indian Writing in English, Postcolonial Theory and Literature, Women's Studies, Cultural Studies.

Mukherjee, Deep (Connecticut): Agricultural Economics, Environmental and Resource Economics, Public Policy.

Neelakantan, G (IIT Kanpur): Twentieth-Century American Literature, Modernism and Post-Modernism, American Jewish Literature, Literary Theory.

Pakrashi, Debayan (Queensland): Behavioral Economics, Experimental Economics, Health Economics, and Economic Development.

Patil, Koumudi (IIT Bombay): Art history, Installation Art, Participatory/ Community Arts.

Pattnaik, B. K. (Pune): Social Studies in Science and Technology, Sociology of Development, Sociology of Voluntary Sector and Social Movements.

Prasad, P.M. (Hyderabad): Law and Economics, Microeconomic Theory, Environmental Economics, Intellectual Property Rights.

Priya, Kumar Ravi (Delhi): Disaster Psychology and Disaster Management, Cultural Psychology, Health Psychology and Alternative Paradigms of Psychology.

Puttaswamy, Chaithra (SOAS London): Language Documentation and Description, Historical Linguistics, Language Typology, Language contact, Dravidian Linguistics.

Rahman, Mohammad Arshad (UC Irvine): Bayesian Econometrics, Quantile Regression, Markov chain Monte Carlo Techniques, Simulation based Inference, Latent Variable Models, Computation and Data Analysis, Program and Policy Evaluation.

Raina, Achla M. (IIT Kanpur): Cognitive Linguistics, Lexical Semantics, Sign Linguistics, Indo-Aryan Linguistics.

Ravichandran, T (Pondicherry): Postmodern American Literature, Literary Theory, Cyberpunk Literature, Indian Writing in English, English Language Teaching.

Roy, Satyaki (Visva Bharati): Art History, Visual Communication, Graphics, Media Studies.

Saha, Sarani (UC Santa Barbara): Environmental Economics, Public Economics, Political Economy, Applied Microeconomics.

Sarma, A. V. Ravishankar (IIT Bombay): Formal and Philosophical Logic, General Philosophy of Science, Formal Epistemology.

Saxena, K. K. (Udaipur): Input-Output Analysis, Regional Economics, Macroeconomic Analysis.

Sharma, A. K. (IIT Bombay): Social Demography, Rural Development, Sociology of Health and Illness, HIV Studies.

Sinha, Arvind K. (Patna): Organizational Behavior and Social Psychology.

Sinha, Surajit (McMaster): Macro-Money.

Sahu, Sohini (SUNY Albany): Macroeconomics, Econometrics.

Sahu, Vineet (Hyderabad): Philosophy of Mind, Ethics in the Western Tradition.

Shatarupa, Thakurta Roy (IIT Guwahati): History of Art, Graphics, Design Theory.

Sudharshana, N. P. (EFL Hyderabad): Second Language Acquisition, ELT, Language Testing, Dravidian Linguistics.

Ph.D. PROGRAMME
The Ph.D. programme includes both course work and dissertation. The two-semester course work consists of a minimum of six advanced level courses. The courses are designed to enhance the students' knowledge of their own disciplines and to expose them to new areas. After successful completion of the course work, but not later than the fifth semester, a student has to pass the Comprehensive Examination which is a necessary requirement for submission of the Ph.D. dissertation. The entire programme is expected to extend over eight to nine semesters. The following are among the important areas of specialization offered by the department.

ECONOMICS
Industrial Economics, Input-output Economics, Development Economics, Environmental Economics, Macroeconomic analysis, Econometrics, Microeconomic Theory, Monetary Economics, Law and Economics, Environmental Impact Assessment, Game Theory, Political Economics, International Economics, Behavioral Economics, Experimental Economics.

ENGLISH (Qualifying degree: Masters in English Literature/Linguistics)
British and American Literature, Postcolonial Literature, Indian Literature, Feminist Theory and Literature, Postmodern Theory and Literature, Indian Writing in English, Critical Theory, Linguistic Theory, Cognitive Linguistics, Communication, English Language Teaching (ELT), Computational Linguistics, Sociolinguistics, Language Documentation and description, Language Typology, Lexical Semantics, Sign Linguistics.

PHILOSOPHY
Ethics, Social & Political Philosophy, Philosophy of Mind, Metaphysics, Philosophical Aesthetics, Existentialism & Phenomenology, Hermeneutics, Philosophy of Social Sciences, Philosophy of Language, Philosophy of Cognitive Science, Philosophy of Science, formal and Philosophical Logic.

PSYCHOLOGY
Cognitive Psychology, Engineering Psychology, Organizational Behavior, Personality and Developmental Psychology, Social Psychology, Consumer Psychology, Social Cognition, Organizational Cognition, Health Psychology, Neuropsychology, Disaster Psychology and Disaster Management, (Cross) Cultural Psychology, Alternative Paradigms of Psychology, Applications of Psychology to Armed Forces.

SOCIOLOGY
Sociology of Health and Illness, Social Demography, Sociology of Religion, Sociology of Work, Urban Sociology, Sociology of Science and Technology, Sociology of Development, Social Movements, Design Culture, Human Rights.

FACILITIES
The Department has full access to the Computer Centre of the Institute. In the Department there are four academic laboratories. The Language Laboratory is a sophisticated one containing 32 booths. The Economics Laboratory has the latest databases and software. The Psychology Laboratory is well equipped for demonstration of various experiments and also has a good collection of psychological tests. The Fine Arts Studio provides facilities to the students to develop their artistic creativity. It has adequate equipment and studio space for this purpose. The Studio has built an infrastructure in the area of design development and design and aesthetics. Continuous modernization of these laboratories ensures that these are provided with latest equipment and facilities. See Facilities at http://www.iitk.ac.in/hss/

Eligibility Requirements for Ph.D.
Ph.D. in HSS: A Master's degree in the relevant subject or in sciences or a Bachelor's degree in Engineering with marks/CPI not below the prescribed minimum and a valid JRF/NET/GATE/UGC/CSIR score.

CHEMISTRY

The Department of Chemistry has a PhD program designed to train candidates to pursue research of both fundamental and applied nature, and also to interact with other programmes of this Institute in a meaningful manner. The Department believes that the training of the students to a high level of professional competence for academic and industrial careers can be done best only in an environment where active research of high quality is being carried out. Accordingly, research forms one of the major activities of the Department.

The department consists of thirty four faculty members, about two hundred and twenty doctoral students, several post-doctoral and project research associates. In addition, the department has about 80 masters and 120 undergraduate students.

FACULTY LIST AND THEIR RESEARCH INTERESTS:

G. Anantharaman, Ph.D. (Goettingen Univ.):

Organometallic Chemistry,Coordination Chemistry, Main group chemistry.

R. Angamuthu, Ph. D. (Univ. of Leiden):

Inorganic synthesis, biomimetics, activation of H_2, CO_2 and SO_2, and electrocatalysis

J. K. Bera, Ph.D. (IISc Bangalore):

Organometallic Chemistry, Catalysis.

P. K. Bharadwaj, Ph.D. (IIT, Kharagpur):

Supramolecular Chemistry, X-ray Crystallography.

A. Chandra, Ph.D. (IISc Bangalore):

Statistical Mechanics, Computer Simulations.

M. Chandra, Ph. D. (Indian Institute of Science, Bangalore):

Optical properties of metal nanostructures, Single particle-level spectroscopy and imaging, Nonlinear optics.

V. Chandrasekhar, Ph.D. (IISc Bangalore):

Polymers, Main Group Inorganic Chemistry.

D. H. Dethe, Ph. D. (IISC Bangalore):

Total Synthesis of bioactive natural synthesis new synthetic methods.

S. R. Gadre, Ph. D. (IIT Kanpur):

Theoretical and computational quantum chemisty.

N. S. Gajbhiye, Ph.D. (IISc Bangalore):

Chemistry of Nanomaterials, Solid State Chemistry.

M. K. Ghorai, Ph.D. (Univ. Poona):

Organic Asymmetric Synthesis, Bio-Organic Chemistry.

T. G. Gopakumar, Ph. D (Technical University of Chemnitz, Germany)

Molecular Ultra-Thin Films, Functional Molecules and their Chemistry at Surfaces, Scanning Probe Microscopy.

D. Goswami, Ph.D. (Princeton Univ.):

Femto second pulse shaping, nonlinear spectroscopy, coherent control, multiphoton imaging, Quantum Computing.

R. Gurunath, Ph.D. (IISc Bangalore):

Bio-chemistry, Environmental biodegradation, fluorescence probes in biology.

S. K. Kundu, Ph. D. (Rutgers University):

Organometallic Chemistry and Catalysis; Renewable Energy and Green Chemistry.

S. Manogaran, Ph.D. (IISc, Bangalore):

Molecular Conformations, Electronic Structure and Spectroscopy calculations using Computational Methods.

J. N. Moorthy, Ph.D. (IISc Bangalore):

Organic Photochemistry, Mechanistic Organic Chemistry, Organic Synthesis and Supramolecular Chemistry.

R. N. Mukherjee, Ph.D. (Calcutta Univ.):

Biomimetic Inorganic Chemistry: Synthesis, Structure and Reactivity.

N. N. Nair (Univ. of Hannover, Germany):

Computational chemistry, computational catalysis, ab initio molecular dynamics simulations of condensed matter systems.

A. K. Patra Ph. D. (IISc Bangalore):

Medicinal Inorganic Chemistry, Chemical Biology, bioconjugate chemistry, drug delivery.

D.L.V.K. Prasad, Ph.D. (University of Hyderabad):

Computational Materials

R. Ramapanicker, Ph. D. (IISc Bangalore):

Synthetic organic Chemistry, Bioorganic Chemistry, Bioconjugation Chemistry.

M. Ranganathan, Ph.D. (Stanford Univ.):

Statistical Mechanics of Crystal Growth, Biochemistry and Bioinformatics.

M. L. N. Rao, Ph.D. (Univ. Hyderabad):

Organometallic Method for Organic Synthesis, Green chemistry, Combinatorial Chemistry, Organic Synthesis, Heteroatom chemistry.

S. **P**. **Rath**, (IACS, Calcutta):

Bioinorganic Chemistry, Metalloporphyrins in Biology, Election and Energy Transfer, Supramolecular Chirality, NMR spectroscopy of Paramagnetic molecule.

N. Sathyamurthy, Ph.D. (Oklahoma State Univ.):

Theoretical Molecular Reaction Dynamics.

P. Sen, Ph.D. (IACS Kolkata):

Ultrafast Laser Spectroscopy, Fluorescence Spectroscopy, Interface selective non-linear Spectroscopy, Single molecule spectroscopy.

A. Singh, Ph.D. (Vanderbilt University):

Synthetic Organic Chemistry, Medicinal Chemistry, Enantioselective Catalysis.

V. K. Singh, Ph.D. (M.S. Univ., Baroda):

Synthetic Organic Chemistry with Particular Emphasis on Enantio-selective Reactions, Synthesis of Biologically Active Molecules.

K. Srihari, Ph.D. (Univ. Calif., Berkeley):

Semi classical Methods in Chemistry (Theory).

B. Sundararaju Ph. D. (Université de Rennes1, France):

Organometallic chemistry and Catalysis with particular emphasis on sustainability.

Y. D. Vankar, Ph.D. (BHU):

Synthetic Carbohydrate Chemistry of Biological relevance and Development of new synthetic methods.

S. Verma, Ph.D. (Univ. Illinois, Chicago):

Bioinspired Molecular Scaffolds for Nucleic Acid and Protein Clevage, Modeling of Prebiotic Catalysis and Drug design.

V. K. Yadav, Ph.D. (M.S. Univ., Baroda):

Synthetic Organic Chemistry with Particular Emphasis on (a) the Synthesis of Structurally and Biologically interesting Molecules (b) the Development of New Synthetic Protocols (c) Free Radical Cyclization and (d) the Use of Metals as Templates for Organic Reactions.

Ph.D. PROGRAMME

The Ph.D. programme includes an integrated sequence of course work and research. Like most other Ph.D. programmes, a significant portion of the first year is spent taking courses (of minimum four) in consultation with thesis supervisor(s), some compulsory and some electives. A student is admitted to the candidacy of the Ph.D. programme only after successful completion the comprehensive (written and oral) examinations, typically in the second year of the programme. Subsequently, the candidate is required to deliver a "State of the Art Seminar" on his/her area of research. Typically, a candidate completes Ph. D. between 4-6 years and the candidate is expected to carry out a significant amount of independent research. The candidate is also encouraged to present research findings in conferences and publications. Prior to completion, the candidate is required to deliver an "Open Seminar" following which he/she is allowed to submit the thesis and appear for the thesis oral examination.

COURSES OFFERED

Scientific Instrumentation, Principles of X-ray Crystallography, Advanced Organic Chemistry I & II, Chemical Binding, Chemical Thermo-dynamics, Physical Organic Chemistry, Electronics for Chemists, Advanced Inorganic Chemistry I & II, Basic Biological Chemistry, Mathematics for Chemistry, Chemistry of Natural Products, Organic Reaction Mechanisms, Stereochemistry, Organic Photochemistry, Electrocyclic Reactions, Orbital Interactions in Chemistry, Advanced Main group Chemistry, Lasers in Chemistry and Biology, Methods of Electronic Structure calculations, Chemistry of Organometallic Compounds, Frontiers in Molecular Biology, Molecular Reaction Dynamics, Chemical Kinetics, Valence Bond and Molecular Orbital Theories, Chemistry of Ionized Gases, Solid State Chemistry, Quantum Chemistry I & II, Ligand Field Theory, Enzyme Reaction Mechanisms and Enzyme Kinetics, Symmetry and Molecular Structure, Physical Photo-chemistry, Physical Inorganic Chemistry, Bio-inorganic Chemistry, Statistical Mechanics and its Application to Chemistry, Molecular Modelling in Chemistry, Computer Programming in Chemistry, Lasers in Chemistry and Biology, Chemistry of Drug Design and Metabolism, Supramolecular Chemistry, Special Topics of Current Interest in Organic, Physical and Inorganic Chemistry.

FACILITIES

The Department is equipped with *state of art* instrumental facilities normally required for research and training. These include infrared, ultra-violet/visible and near infrared spectrophotometer, various solid-state dye lasers, supersonic jet fluorecence spectrometer, magnetic resonance equipment (nuclear, electron-spin), and single crystal X-ray diffractometer with liquid nitrogen facility, various types of chromatographs, polarographs, light scattering photometer, cyclic voltammetric equipment, steady-state spectrofluorimeter, circular dichroism, time-correlated single photon counting spectrofluorimeter, stopped flow-spectrometer, high speed centrifuge, ultracentrifuge, electrophoretic equipment facilities for doing protein and model chemistry and photochemistry reactors. The department has acquired a state-of-the-art 400 and 500 MHz multinuclear NMR spectrometers, EI and ESI Mass spectrometers, Gas chromatography, Resonance Raman spectrophotometer, Bruker EPR spectrometer, Quantachrome Gas adsorption, FT-IR spectrometer, CHNSO analyser, Atomic force Microscopy (AFM) and single crystal X-ray diffractometers to augment research activities. The department has also recently acquired thin film deposition chamber for Nanostructured devices and CEM microwave reactor for organic scale-up processes. A Molecular Modelling Laboratory and PC clusters are also now available in the department. Some equipment like the powder X-ray diffractometer, DTA & TGA etc. are also available.

The department also has access to the Institute's low-temperature laboratory, glass blowing and machine shops and various other analytical facilities in the institute. The department has very good high performance computational (HPC) facility and the department also has access to institute's excellent HPC facility (listed in world's best top 200 supercomputers)

SEMINARS AND CONFERENCES:

In order to keep abreast of the latest developments in chemistry and allied subjects, and also to provide a forum for discussions about research in progress, the department holds weekly lectures/seminars, where active researchers are invited to deliver lectures on topics of current interest. In addition, various national and international symposia are periodically organized by the department.

The Department, which started as the Department of Mathematics in 1960, got its new name as the Department of Mathematics and Statistics in 2004. It has always shared the vision of the Institute in striving for excellence in research and teaching and has succeeded in this endeavor to a large extent. Over the years, the department has evolved as one of the premier departments in the country providing excellent teaching and research in Mathematical Sciences and Statistics. The vibrant academic environment is nurtured by strongly motivated faculty and provides an opportunity to pursue research in frontline areas of basic as well as interdisciplinary areas of science and technology.

The Department currently has 39 faculty members who are engaged in research and teaching in various areas of Pure Mathematics, Applied Mathematics and Statistics. The faculty members of the Department aim to achieve high quality research and teaching standards in various disciplines of Mathematics and Statistics with a flavor of unified approach towards both pure and applied aspects and are ever responsive towards the growing demands of new and emerging areas of research and teaching. As Mathematics and Statistics have penetrated into many areas of human endeavors, an updating of the curricula is regularly undertaken to keep abreast with the latest developments and to bring innovations. The contributions by the faculty members of the Department in research and teaching have won recognition by the scientific community in the form of various prestigious awards and distinctions. A number of sponsored research projects funded by national and international agencies are also undertaken by them.

FACILITIES

The Computer Centre of the Institute provides E-mail, Web, DNS, FTP, Internet access, high performance computing and other services for 24 hours and 365 days a year. Computer Centre has a number of state of the art servers, high end Linux and Windows labs and application software. The state of the art parallel and multi-processor computer servers cater to the computational needs of the academic community. In addition, the Department also has its own high-end Linux Lab with 48 desktop computers and Windows Lab with 34 desktop computers that provide computing and remote access facilities exclusively to the departmental students. All PCs have advanced configurations (Core i7 and Core 2 Quad processors) and some latest and advanced software. Apart from this, the Department has one Parallel Computing Laboratory and an Advanced Digital Imaging Solution (ADIS) Laboratory.

IIT Kanpur has a large Central Library named after late Professor P.K. Kelkar, the founding director of the Institute. This library is one of the best libraries of its kind in India with an excellent collection of books and periodicals. There is a generous allocation from the Institute towards library funding for Mathematics and Statistics. The library is fully automated and provides CD-Rom computer aided referral services. In addition, the Central Library has the special status of being an NBHM (National Board of Higher Mathematics) Regional Library, thereby looking after the needs of mathematicians in the geographic region. Towards this, NBHM has been providing us with a sizeable annual grant. The Department maintains its own library with a good collection of text books and reference books. It is run by the Ph.D. students of the Department. The

Department provides B/W Laser printing facility to all PhD students for their research use and to all UG and other PG students on request basis. The departmental seminar room is well-equipped with Top-mounted, Handnote and OHP projectors, cordless Microphone and other Audio-Visual support. The Department has three separate labs only for our research scholars. Every research scholar has his own cabin with advanced core i7 computer.

Ph.D. PROGRAMME

In addition to a five-year integrated M. Sc. Program in Mathematics & Scientific Computing (from the academic session 2011-12, the five-year M.Sc. (Integrated) programme in Mathematics and Scientific Computing has been replaced by a more flexible four-year BS programme in Mathematics and Scientific Computing) and two parallel two-year M.Sc. programs in Mathematics and in Statistics, the Department also offers two parallel Ph.D. programs in Mathematics and in Statistics. Admission to these Ph.D. programs require a valid GATE score in MA paper or a valid UGC/CSIR JRF rank in Mathematical Sciences or a qualifying certificate of NBHM / INSPIRE fellowship. The admissions are done through a written test and interview. The programs attract good students from all over India. Research work leading to the Ph.D. degree in Mathematics / Statistics is carried out in various areas indicated under faculty specialization. In the first two semesters, every Ph.D. student is required to do at least six courses. These courses are intended to familiarize the students with the modern aspects of Mathematics / Statistics and initiate the students to the chosen area of research. Apart from training related to the fundamental principles of Mathematics and Statistics, the scope of these comprehensive and flexible programs include interaction with allied areas from other departments of the Institute. Such an interaction, while maintaining the identity of the Department, is unique to the curricula. The doctoral programs aim to prepare motivated researchers in frontline areas. The department has so far produced over 300 Ph.D. students who are now associated with reputed educational institutes and R&D organizations across the globe. Many of our Ph.D. students are also doing extremely well in private sector industries. Currently the department has about 60 research scholars working in state of the art research areas. Regular seminars keep everyone charged and updated. Ph.D. students are required to actively participate in the tutoring of U.G. students (from B. Tech, B. Tech - M. Tech Dual, M. Sc. Integrated, four-year BS and two-year M. Sc. programs) in core and professional courses. They also conduct voluntary helping sessions for the benefit of the U.G. students. This helps them in tuning their communication and teaching skills.

FACULTY AND THEIR AREA OF RESEARCH SPECIALIZATION

Akash Anand, Ph.D. (Univ. of Minnesota, Twin Cities): Numerical analysis, Scientific computing, Partial differential and integral equations.

Kaushik Bal, Ph.D. (Universite de Pau et des Pays de l'Adour, France): Elliptic and Parabolic Partial Differential Equations

D. Bahuguna, Ph.D. (IIT/K): Differential Equations, Non-linear Analysis, Theory of Semi-groups.

Malay Banerjee, Ph.D. (Calcutta Univ): Mathematical Ecology and Eco-Epidemiology, Stochastic Stability Analysis and Chaos in Related Areas, Nonlinear Dynamics.

Mohua Banerjee, Ph.D. (Calcutta Univ): Mathematical Logic and Rough Set Theory.

Peeyush Chandra, Ph.D. (IIT/K): Mathematical Modeling, Fluid Mechanics, lubrication, Biomechanics.

Sameer Chavan, Ph.D. (Pune Univ): Operator Theory, Subnormals and Operators Close to Isometrics.

Aparna Dar, Ph.D. (SUNY Stonybrook): Differential Geometry, Algebraic Topology, Knot Theory.

Subhra Sankar Dhar, Ph.D. (ISI Kolkata): Non-parametric and robust statistical methods, Cluster analysis and likelihood based inference

I. D. Dhariyal, Ph.D. (Ohio State): Estimation, Ranking and Selection Procedures

Pravir K. Dutt, Ph.D. (UC Los Angeles): Numerical Analysis, Fluid Mechanics

Subhajit Dutta, Ph.D. (ISI Kolkata): Discriminant Analysis, Inference based on Data Depth, Characterization of Multivariate Distributions, Classification of Sequence Data

Sudipta Dutta, Ph.D. (ISI Kolkata): Functional Analysis.

S. Ghorai, Ph.D. (Univ. of Leeds): Mathematical Biology, Scientific Computing.

Manjul Gupta, Ph.D. (IIT/K): Functional Analysis, Operator Theory.

M. K. Kadalbajoo, Ph.D. (IIT/B): Numerical Analysis.

G. P. Kapoor, Ph.D. (IIT/K): Complex Analytic Dynamics and Fractals, Computational Complex Analysis.

B. V. Rathish Kumar, Ph.D. (Sri Sathya Sai Instt.): Computational Fluid Dynamics, Finite Element Analysis, Parallel Numerical Algorithms.

Debasis Kundu, Ph.D. (Penn State Univ): Statistical Signal Processing, Non-linear Regression, Survival Analysis, Statistical Computing.

Arbind Kumar Lal, Ph.D. (ISI Delhi): Algebraic Graph Theory

Shobha Madan, Ph.D. (IIT/K): Harmonic Analysis, Hp-Spaces, Wavelets.

Alok Kumar Maloo, Ph.D. (Bombay Univ./TIFR): Commutative Algebra.

Ashis Mandal, Ph.D. (ISI Kolkata) : Algebraic Topology; Deformation of Algebraic Structures, Higher Structures and Related Fields.

Neeraj Misra Ph.D. (IIT/K): Statistical Inference, Reliability Theory, Ranking & Selection Problems, Nonparametric Entropy Estimation.

Amit Mitra, Ph.D. (IIT/K): Statistical Signal Processing, Robust Model Selection & Parameter Estimation, Data Mining in Finance

Sharmishtha Mitra, Ph.D. (IIT/K): Order Statistics, Reliability Models, Robust Estimation in Non-linear Models, Econometrics

Parasar Mohanty, Ph.D. (IIT/K): Harmonic Analysis.

T. Muthukumar, Ph. D. (IMSc, Chennai) : Homogenization and variational methods for PDE's, Elliptic PDE's, Optimal Controls.

Nandini Nilakantan, Ph.D. (IISc B'lore): Combinatorial Theory, Computational Geometry.

Abhijit Pal, Ph.D. (ISI Kolkata): Geometric Group Theory, Relatively Hyperbolic Groups, Mapping Class Groups.

Sasmita Patnaik, Ph.D. (Univ. of Cincinnati): Operator Theory

S. K. Pattanayak, Ph.D. (CMI): Algebraic Groups and Invariant Theory, Lie Algebras and Representation Theory.

Sanjoy Pusti, Ph.D. (ISI Kolkata): Harmonic Analysis on Lie Groups.

R. K. S. Rathore, Ph.D. (IIT/D; D Sc (Delft)) : Approximation Theory, Numerical Analysis, Computer Aided Tomography.

Rama Rawat, Ph.D. (ISI B'lore): Harmonic Analysis.

G. Santhanam, Ph.D. (IITB/TIFR): Differential Geometry.

Debashis Sen, Ph.D. (ISI Kolkata): Homotopy theory, Group actions.

Shalabh, Ph.D. (Lucknow Univ): Econometrics, Regression Modelling, Statistical Inference, Sample Surveys.

P. Shunmugaraj, Ph.D. (IIT/B): Functional Analysis

Prawal Sinha, Ph.D. (IIT/B): Lubrication Theory, Biomechanics, Environmental Pollution, Epidemiology.

The Department of Physics at IIT Kanpur is reputed for its high quality academic programme and research in front-line areas of both fundamental and applied importance. The Department has at present 38 members in the Faculty and is assisted by a team of DST-Inspire Faculty Fellows and Postdoctoral Fellows as part of the academic staff. There are around 120 research scholars engaged in doctoral research.

The Department participates in the undergraduate Core Courses in the B.Tech. Programme, and has started a new BS (4 yr) + MS (1 yr) Programme in Physics (making effective use of the flexibility in the new credit-based undergraduate Programme, with options for minor and double major in different disciplines) which includes basic and engineering sciences, workshop practices, courses on computation as well as courses on humanities and social sciences. The Department has a M.Sc. (2 yr) Programme as well as a Ph.D. Programme with specialization in many major areas of Physics. The Physics Department also offers a unique time-saving M.Sc. - Ph.D. (Dual Degree) Programme for those seeking to take advantage of our M.Sc. training to accelerate their progress in doctoral work. Further, there is a large variety of courses offered by the Physics Faculty that are of interest to a number of Inter-Disciplinary Programmes of the Institute. The Physics Department also participates in the Laser Technology and the Materials Science Programmes of the Institute.

The Department actively participates in front-line research in several major areas of Physics. The largest group is working in the Physics of Condensed Matter Systems in all its aspects, with interests more or less evenly divided between theoretical and experimental work, with strong cross-pollination of ideas between theory and experiment.

Other moderate-size groups include High Energy Physics and Optics. The Ion-Beam Nuclear Solid State and Plasma Physics Group is involved in applying Nuclear Physics Techniques to the study of materials and applications of Ion Beans in Science and Engineering. Other groups include Biological and Statistical Physics, and Nonlinear Dynamics.

PH.D. PROGRAMME

The Department of Physics offers many subdisciplines in the Ph.D. programme. The requirements in the various programmes are prescribed to ensure that the scholars acquire enough professional maturity to enable them to deal with a wide range of research problems in their respective fields of specialization.

The research interests of the department include topics in Atomic and Molecular Physics, Biological and Statistical Physics, Condensed Matter Physics, Computatoinal Physics, Dynamical Systems, Turbulence and Non-linear Physics, Particle Physics, QCD, and Lattice Gauge Theories, Quantum Field Theory, Astrophysics, Cosmology, String Theory and Quantum Gravity - AdS/CFT - Hydrodynamics, Biophotonics, Light-Matter Interaction, Photonics of Micro and Nano Structured Materials, Non-linear Optics, Fiber Optics, Plasma Physics and Laser Plasma Interaction, Quantum Optics, Laser Cooling

and Trapping, Ion Beams and Nuclear Physics Techniques, with a substantial degree of Inter-Disciplinary activity.

Students with good academic record and strong motivation for a career in Physics can apply for admission to the Ph.D. Programme after earning Master's degree (or the new BS 4-yr degree). The programme combines course work, guided research, independent study and teaching assignments, all designed with a view to making the scholar a professional physicist. The compulsory courses consist of review of mathematical physics, classical mechanics, quantum mechanics, classical electrodynamics, while the elective courses cover the ongoing research areas in the department.

ELECTIVE COURSES

Advanced Quantum Mechanics, Group Theory and Application to Quantum Mechanics, Advanced Statistical Mechanics, Non-equilibrium Statistical Mechanics, Physics of Soft and Bio-materials, Condensed Matter II, Magnetism in Materials, Computational Methods in Physical Sciences, Electronic Structure of Materials, Topics in Semiconductor Physics and Technology of Thin Films, Disordered Systems, Physics of Semiconductor Nanostructures, Low Temperature Physics, Nuclear Techniques in Solid State Studies, Quantum Electronics, Coherence Optics, General Relativity and Cosmology, Special Topics in Field Theory and Particle Physics, String Theory, Special Topics in Physics, Measurement Techniques, Digital Electronics for Scientists, Mean Field Theories in Random Alloys, High Energy Physics II, Spintronics, Non-linear Systems and Dynamics, Concepts of Plasma Physics, Physics of Turbulence, Electromagnetic Metamaterials and Plasmonics, Transport in Mesoscopic Systems, Soft Matter Physics, Introduction to Biophotonics, Physics of Natural Nanomachines, Physics of Semiconductor Nanostructures, Condensed Matter Phenomena in Low Dimensional Systems, The Standard Model of Fundamental Physics, and large number of Special Topics Courses.

FACILITIES

Condensed Matter Physics: Nitrogen and Helium Liquefiers, Superconducting magnets (up to 14 Tesla), Closed cycle Helium Refrigerators (down to 1.3 K), Experimental Setup for Resistivity, Hall Effect and Magnetic Susceptibility, Magnetoresistance, Specific Heat, Thermoelectric Power, Tunneling Conductance, Magnetostriction, Ultra high vacuum scanning probe microscope, superconducting quantum interference device (SQUID) based Magnetic Properties Measurement System (MPMS) with 10^{-6} emu resolution and 1.7K - 350K temperature range and magnetic field up to 5 Tesla. We also have a Physical Properties Measurements System (PPMS) with a 14 tesla superconducting magnet and helium–3 fridge with 300 mK base temperature. Scanning electron microscope (SEM) with electron beam lithography facilities for nano-scale patterning have been installed recently.

Some homemade facilities like variable temperature (8K - 300K) scanning tunneling microscope (STM) with atomic resolution and conductance imaging, magneto-optic Kerr effect (MOKE) imaging of magnetic surfaces, Pulsed Excimer Laser ablation facility for synthesis of magnetic, superconducting and dielectric superlattices, high frequency measurements of vortex dynamics in superconductors, Raman and micro-Raman Spectroscopy set-up for correlated systems.

Well equipped facilities have been setup for opto-electronic characterization of semiconductor materials and devices. State of the art research facilities for organic semiconductors are available. The Department participates in major projects on Organic Electronics through Samtel Centre for display Technologies. For micro-fluidics, we have contact angle Goniometer, fluorescent microscope and high speed (10,000 fps) camera.

Optics Laboratories: ND:YAG lasers, Excimer Laser, Double Monochromators, Photon Counters, Spectrofluorimeter, Box Car Averagers, Vibration free tables. Facilities exist for High Resolution Spectroscopy, Micro-Raman Spectroscopy, Laser based pump-probe measurements, Laser-Plasma Studies and Nonlinear Optics, Diode Lasers, spectrograph-CCD system, Optical Spectrum Analyzers and Fibre Optics System, Optical Lithography Set-up, Atomic Force Microscopy Facility (Park XE 70 machine with a 100micron X 100 micron scanner head and a liquid cell). Two new Labs - Quantum and Nano-Optics, Quantum Optics and Entanglement Lab. are being set up.

lon Beam and Nuclear Techniques Laboratory: Mossbauer Spectrometer, Tandem particle accelerator, focused ion beam (FIB) with SEM column (Nova Lab 600) for Nano Microfabrication down to nm scales, modern 1.7 MeV Tandetron accelerator with capabilities of producing ion beams of almost all elemental species. The facility is equipped with a nuclear microprobe station for science and engineering applications such as proton and heavy ion beam writing, RBS, PIXE and ion Channeling E-beam deposition, Positron Annihilation, Mossbauer Studies at Low Temperatures.

Computational Facilities: Physics cluster (Newton): 396 cores, 1.5 TB memory, Infiband switch. Chaos I: 256 cores, ½ TB RAM, Gigabit switch. Chaos II: 128 cores, ½ TB RAM, Two K10 GPU cards, Infiband switch. Many workstations including 3D capable visualisation stations. Dirac cluster for electronic structure calculations, 96 cores, 768 GB RAM. In addition, there are the following Institute facilities : hpc Cluster 1: 2994 cores, 100 TB storage, Peak rating 34.5 Tflops (Ranked 369 in June 2010 Top500 ranking). hpc Cluster II: 15,360 cores, 98TB RAM, Peak rating 316 Tflops (Ranked 130 in Nov 2013 Top500 ranking).

The Department organizes a yearly "Jagadishwar Mahanty Distinguished Lecture" (since the year 2005) by an eminent scientist which provides unique opportunity of interaction with faculty and students, and has initiated a "Research Scholars Day" series from this year involving short talks and poster presentations by research scholars in the department.

Faculty Members

1   Amit Agarwal   *Ph.D. Indian Institute of Science, Bangalore, 2009*
2   Satyajit Banerjee   *Ph.D. Tata Institute of Fundamental Research, 2000*
3   Sudeep Bhattacharjee   *Ph.D. RIKEN, Japan,* 1999
4   Kaushik Bhattacharya   *Ph.D. Saha Institute of Nuclear Physics, 2005*
5   Sayantani Bhattacharyya   *Ph.D. Tata Institute of Fundamental Research, 2010*
6   R C Budhani   *Ph.D. I I T Delhi, 1983*
7   Dipankar Chakrabarti   *Ph.D. Saha Institute of Nuclear Physics, 2004*
8   Sagar Chakraborty   *Ph.D. S N Bose National Centre for Basic Sciences, 2008*
9   Debashish Chowdhury   *Ph.D. I I T Kanpur, 1984*
10   Amit Dutta   *Ph.D. Saha Institute of Nuclear Physics, 2000*
11   Saikat Ghosh   *Ph.D. Cornell University, 2008*
12   Tarun Kanti Ghosh   *Ph.D. Institute of Mathematical Sciences, 2003*
13   Anjan Kumar Gupta   *Ph.D. University of Kentucky, 2001*
14   Rajeev Gupta   *Ph.D. Indian Institute of Science, 2001*
15   Manoj Harbola   *Ph.D. City University of New York, 1989*
16   Zakir Hossain   *Ph.D. Tata Institute of Fundamental Research, 1997*
17   Pankaj Jain   *Ph.D. Syracuse University, 1988*
18   Anand Kumar Jha   *Ph.D. University of Rochester, 2009*
19   Krishnacharya   *Ph.D. Max Planck Institute, 2007*
20   Y N Mohapatra   *Ph.D. Indian Institute of Science, Bangalore, 1989*
21   Sutapa Mukherjee (on leave)   *Ph.D. Institute of Physics, Bhubaneswar, 1996*
22   Soumik Mukhpadhyay   *Ph.D. Saha Institute of Nuclear Physics, 2009*
23   Asima Pradhan   *Ph.D. City University of New York, 1991*
24   Rajendra Prasad   *Ph.D. University of Roorkee, 1976*
25   K P Rajeev   *Ph.D. Indian Institute of Science, Bangalore, 1992*
26   S A Ramakrishna   *Ph.D. Raman Research Institute, 2001*
27   V Ravishankar   *Ph.D. University of Mysore, 1987*
28   Deshdeep Sahdev (on leave) *Ph.D. Case Western Reserve University, 1979*
29   Tapobrata Sarkar   *Ph.D. Institute of Mathematical Sciences, 2001*
30   Gautam Sengupta   *Ph.D. Institute of Physics, Bhubaneswar, 1992*
31   Avinash Singh   (HoD)   *Ph.D. University of Illinois at Urbana-Champaign, 1987*
32   V Subrahmanyam   *Ph.D. Tata Institute of Fundamental Research, 1991*
33   Harish C Verma   *Ph.D. I I T Kanpur, 1980*
34   Mahendra K Verma   *Ph.D. University of Maryland, 1994*
35   R Vijaya   *Ph.D. I I T Madras, 1991*
36   Harshwardhan Wanare   *Ph.D. University of Hyderabad, 1998*
37   Aditya Kelkar   *Ph.D. Tata Institute of Fundamental Research, 2009*
38   Joydeep Chakrabortty *Ph.D. Harish Chandra Research Institute, 2011*
39   S M Tripathi *Ph.D. IIT Delhi, 2007*
40   S Nandi Ph.D. *Iowa State University, 2009*

Emeritus Faculty
41   R K Thareja   *Ph.D. Delhi University,*

Major Research Facilities

Condensed Matter Physics:

Central Cryogenic Facility - Nitrogen and Helium Liquifiers

SQUID based Magnetic and Physical Properties Measurement System

Scanning Electron Microscope with Electron Beam Lithography

Scanning Tunneling Microscope with Atomic Resolution and Conductance Imaging

Pulsed Excimer Laser Ablation Facility

Facilities for Opto-Electronic Characterization of Semiconductor Materials and Devices

Atomic Force Microscopy Facility (Park XE 70 machine with a

100micron X 100 micron scanner head and a liquid cell)

Photonics and Quantum Optics:

Spectrofluorimeter
Nd:YAG Lasers, Excimer Laser, Double Monochromators, Photon Counters
High Resolution Spectroscopy, Micro-Raman Spectroscopy,

Laser based Pump-Probe Measurements, Laser-Plasma Studies and Nonlinear Optics, Diode Lasers, spectrograph-CCD System, Optical Spectrum Analyzers and Fibre Optics System, Optical Lithography set-up.

lon Beam and Nuclear Techniques Laboratory:

Focused Ion Beam, 1.7 MeV Tandetron Accelerator

Proton and Heavy Ion Beam Writing, RBS, PIXE and ion Channeling

E-beam Deposition, Positron Annihilation, Mossbauer Studies.

Mossbauer Spectrometer

Computational Facilities:

Physics cluster (Newton): 396 cores, 1.5 TB memory, Infiband switch
Dirac cluster for electronic structure calculations, 96 cores, 768 GB RAM.
Chaos I: 256 cores, ½ TB RAM, Gigabit switch
Chaos II: 128 cores, ½ TB RAM, Two K10 GPU cards, Infiband switch
Many workstations including 3D capable visualisation stations.

The major research groups and active research areas are listed below:
Condensed Matter Experiments

- *Magneto-Optical Imaging*
- *Nanostructures of Superconducting and Magnetic Materials*
- *Intense Laser-Matter Interaction*
- *Non-Equilibrium Transitions in Driven Vortex States of Superconductors*
- *Interplay between Magnetism and Superconductivity*
- *Magnetic and Transport behaviour of Heavy Fermion Compounds*
- *Electronic, Magnetic, Optical Properties of Surfaces using Scanning Probe Microscopy*
- *Electronic and Magnetic Properties of Transition Metal Oxides*
- *Charge Ordered State of Transition Metal Oxide Thin Films*
- *Spintronics, Spin-Polarized Tunneling in Transition Metal Oxides*
- *Strongly Correlated Electron Systems in Low Dimensions*
- *Photonic and Electronic Materials*
- *Printable Electronics, Organic LED and Lighting*
- *Defects and Disorder in Semiconductors*
- *Effects of Localized States on Electrical and Optical Properties*
- *Hybrid Inorganic/Organic Devices*
- *Amorphous and Porous Silicon*
- *Electronic Properties of Crystalline Semiconductors*

Condensed Matter Theory

- *Electronic Structure of Disordered Systems*
- *Molecular Dynamics Simulations and Genetic Algorithms*
- *Topological Insulators*
- *Applications of Density Functional Theory*
- *Electronic Structure of Atoms, Molecules, and Solids*
- *Correlated Electrons and Quantum Magnetism*
- *Spin, Charge, Orbital Correlations in Transition Metal Oxides*
- *Antiferromagnetism, Superconductivity, BE Condensation and Disordered Systems*
- *Low Dimensional Electronic Systems, Graphene, Spintronics*
- *Quantum Many Body Effects in Low Dimensional Systems*
- *Transport Properties of Hybrid Structures*
- *One-Dimensional and Quasi-One Dimensional Spin and Electron Systems*
- *Classical and Quantum Phase Transitions in Random Systems*
- *Non-Equilibrium Dynamics of Magnetic and Non-Magnetic Systems*
- *Statistical and Theoretical Biophysics*
- *Natural Nano Machines, Complex Adaptive Biological networks*
- *Driven-Dissipative Systems, Self-Assembled Soft and Bio-Materials*
- *Phase Transitions in Driven Diffusive Systems*
- *Non-equilibrium Dynamics of Spin Systems*
- *Physics of Biopolymers and Molecular Motors*
- *Nonlinear Dynamics, Fluid Dynamics, Turbulence*
- *Magnetohydrodynamics, Turbulence, and Dynamo*
- *Structured Photonic Materials and Negative Refractive Materials*
- *Plasmonic Properties of Metallic Structures*

- *Quantum Entanglement and Quantum Computation*

Photonics and Quantum Optics

- *Laser Raman Spectroscopy*
- *Laser-Plasma Studies*
- *Bio-Medical Applications*
- *Nonlinear Optics, Fiber Optics*
- *Photonic Band Gap Structures*
- *Imaging in Complex Media & Biological Tissues*
- *Photonics and Waves in Random Media*
- *Coherent Control of Light-Matter Interaction*
- *Non-Linear Optics, Quantum Optics*
- *Quantum Optics, Quantum Information, Precision Spectroscopy*
- *Cold-Atom Systems, Foundations of Quantum Mechanics*
- *Using Cold-Atom Systems to Probe Nano-Materials and Molecules.*

High-Energy Physics

- *Quantum Field Theory*
- *Astrophysics, Cosmology, Particle Physics.*
- *Quark-Gluon Plasma*
- *Classical and Quantum Gravity*
- *String Theory, AdS-CFT and AdS-Condensed Matter correspondence.*
- *Black Holes Thermodynamics.*
- *Hydrodynamics from charged black branes, fluid dynamics and gravity*

Ion-Beam, Plasma, and Nuclear Solid State Physics

- *Ion-Beam Complex for Science, Engineering and Technology*
- *Wave Interaction with Anisotropic Plasmas Confined in Multi-Cusp Magnetic Fields*
- *Application of Nuclear Physics Techniques to Condensed Matter Physics*