

M. Tech., M. Des. and Ph.D. Programmes

Information Brochure



2009

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
KANPUR - 208 016

(website : www.iitk.ac.in/doaa/admissions.html)

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INTRODUCTION

The goals of the post graduate programmes at the Indian Institute of Technology Kanpur are:

The development of high quality scientific and engineering manpower with a broad grasp of the fundamental principles of sciences and the scientific methods, deep understanding of their areas of specialization, innovative ability to solve new problems, and the capacity to learn continually and interact with multi-disciplinary groups. Above all, the students should develop the capacity for free and objective enquiry, courage and integrity, awareness and sensitivity to the needs and aspirations of the society. The programmes are designed to impart knowledge, strengthen concepts and intellectual skills through course work, seminars and project/thesis work and thus cater to the needs of Industry, R & D organizations and educational institutions.

These programmes are intended to prepare students to enter their professions with a perspective and breadth of knowledge related to the principal divisions of their respective fields of specialization through courses and research experience. A post-graduate student will typically be enrolled for three or four courses each semester until he/she has fulfilled all the course requirements. The thesis work is aimed at providing the research experience in the relevant field of specialisations.

This brochure provides general information sought by those seeking admission at IIT Kanpur in any of the following approved postgraduate programmes. For rules pertaining to any particular issue, decisions of the competent authority would be applicable.

M.TECH.: MASTER OF TECHNOLOGY (4 Semester Programme)

Aerospace Engineering
Biological Sciences and Bio-engineering
Chemical Engineering
Civil Engineering
Computer Science & Engineering
Electrical Engineering
Environmental Engineering & Management
Industrial & Management Engineering
Laser Technology
Materials and Metallurgical Engineering
Mechanical Engineering
Materials Science
Nuclear Engineering & Technology

M.DES.: MASTER OF DESIGN (4 Semester Programme)

Design Programme (Interdisciplinary)

Ph.D.: DOCTOR OF PHILOSOPHY (Engineering)

Aerospace Engineering
Biological Sciences and Bio-Engineering
Chemical Engineering
Civil Engineering
Computer Science & Engineering
Electrical Engineering

Mechanical Engineering
Materials & Metallurgical Engineering
Industrial & Management Engineering
Materials Science
Nuclear Engineering & Technology

Sciences

Chemistry
Mathematics
Physics
Statistics

Social Science

English/Linguistics
Economics
Philosophy
Psychology
Sociology

ELIGIBILITY REQUIREMENTS

The eligibility conditions given below are the absolute minimum. Departments may prescribe any requirements over and above these.

The 'specified minimum' marks/CPI (Cumulative Performance Index), referred to in subsequent sections, implies a minimum of 55 percent marks /5.5 (on a 10 point scale) as long as it is not less than the minimum pass marks/CPI; otherwise, the 'specified minimum' marks/CPI implies the minimum pass marks/CPI.

M.Tech.: A Bachelor's degree in engineering or Master's degree in science with marks/CPI not below the prescribed minimum. For M.Tech in Biological Sciences and Bioengineering, candidates with MBBS, or B.Pharm. Degree may also be considered. Valid GATE score is required for financial assistance. Graduate from IITs with a minimum CGPA of 8.0 are exempted from this requirement

M.Des.(Master of Design): A Bachelor's degree in Engineering, Design or Architecture (only) with marks/CPI not below the prescribed minimum. Students with Bachelor's degree in a Fine Art are not eligible. Valid GATE/CEED score is required for financial assistance.

Ph.D. in Engineering: A Master's Degree in Engineering with marks/CPI not below the prescribed minimum. As a special case, Bachelor's degree in engineering with a minimum of 75 percent marks/7.5 CPI or Master's Degree in Sciences or in allied area, with exceptional academic records may also be considered. However, valid GATE/UGC/CSIR score is required for financial assistance, in such cases, except for graduates from IITs with a minimum CGPA of 8.0

Ph.D. in Sciences: A Master's degree in the relevant subject or a Bachelor's degree in engineering with marks/CPI not below the prescribed minimum. Valid GATE/UGC/CSIR score is required for financial assistance, in such cases, except for graduates from IITs with a minimum CGPA of 8.0

Ph.D. in HSS: A Master's degree in the relevant subject or a Bachelor's degree in Engineering or a Master's degree in sciences or in an allied field of HSS with marks/CPI not below the prescribed minimum. Valid GATE/UGC/CSIR score is

required for financial assistance, in such cases, except for graduates from IITs with a minimum CGPA of 8.0

Ph.D. in Management: A Master's degree in Management/Arts/Commerce/Science/Industrial Engineering/Production engineering/Operations research, or other relevant disciplines in Engineering/Technology, or a Bachelor's degree in Engineering/Technology with CPI not below the specified minimum. Valid GATE/UGC/CSIR score is required for financial assistance, in such cases, except for graduates from IITs with a minimum CGPA of 8.0

FINANCIAL ASSISTANCE

Financial aid (Assistantship/Scholarship) is available to the M.Tech., Ph.D. and M.Sc.-Ph.D. (Dual degree) Programmes.

Student is expected to carry out the assigned duties for teaching and Research Assistantship. The M.Tech. student currently carries a monthly stipend of Rs.8,000/- for 8 hours of work per week. For Ph.D. students the corresponding financial assistance is Rs.14,000/- (for engineering) and Rs.12,000/- (for Sciences/Social Sciences) for the first two years and there after its is raised to 15,000/- and 14,000/- respectively for another two years. A 50% tuition fee waiver for M.Sc.-Ph.D. (Dual degree) students is also available after the first semester.

In addition to this several attractive fellowships from Industries/DAE are also available

SELECTION CRITERIA

For both M.Tech. and Ph.D. programmes, some departments/programmes may call a selected number of candidates for test and/or interview in May/June for admission in first semester and in November for admission in second semester. Other departments/programmes may process the applications only on the basis of earlier academic records and/or GATE/UGC/CSIR scores where the same be required and offer admissions directly. All students who are offered admission will be informed normally by the first week of June (for admission in first semester) or first week of December (for admission in second semester). There also exists a provision of walk-in interview for admission to the Ph.D. programmes round the year.

CONCESSIONS TO SC/ST/OBC CANDIDATES

In each discipline, 15% seats are reserved for SC candidates, 7.5% seats for ST candidates and 18% seats are reserved for OBC (for non creamy layer). SC/ST/OBC candidates must also satisfy the eligibility requirement for admission. However, while considering their cases, only suitability for the programme is ensured and the SC/ST/OBC candidates are not compared with those belonging to other categories.

CONCESSIONS TO CANDIDATES WITH PHYSICAL DISABILITY (PD)

In total, 3% reservation shall apply for candidates with physical disability as per Govt. of India norms (minimum 40% disability; an appropriate certificate must be furnished). Such candidates must satisfy the eligibility requirements for admission. However, while considering these cases, only suitability for the

programme is ensured and the candidates are not compared with those belonging to other categories.

ADMISSION TO PART-TIME STUDIES

The Institute also offers part-time postgraduate programmes leading to the M.Tech/M.Des./Ph.D. degrees for local professionally employed personnel such as working engineers, scientists and teachers who can, while employed, attend regular classes as per schedule of the Institute.

The applicant must be an employee of a recognized organization with at least two years of service at the time of admission and be engaged in professional work in the area to which admission is sought. An application for the part-time studies should be forwarded by the employer.

ADMISSION TO EXTERNAL REGISTRATION PROGRAMME FOR Ph.D.

A candidate working in an R & D establishment which is equipped with the necessary research and library facilities may be considered for admission only to the Ph.D. programmes in engineering. Such a candidate must be sponsored by his/her employer and must have been in employment with the sponsoring organization for at least 2 years at the time of admission. The employer must expressly undertake to pay full salary to the candidate and relieve him/her to stay on the campus to enable the candidate to complete his/her residence requirement.

A candidate applying for admission to the external registration programme must provide detailed information about the research facilities available at his/her organization and a certificate that these would be available to him/her for carrying out research. He/she should also provide the biodata of the prospective supervisor who would supervise the candidate's work at his/her organization.

An application for admission from a candidate working in the approved organization will be considered only if he/she wishes to work in the specified area.

ADMISSION OF SPONSORED CANDIDATES

A candidate who is sponsored by his/her employer and who meets the additional conditions specified below may be admitted through a separate selection committee appointed specifically for the purpose.

A sponsored candidate must have been in service of the sponsoring organization for at least two years at the time of admission. The sponsoring organization must specifically undertake to provide full salary to the candidate and to relieve him/her to pursue the programme for its full duration.

Fulfillment of GATE eligibility requirement may be waived for such candidates. However, the sponsored candidates seeking admission to the M.Tech./M.Des./Ph.D. programme who have not taken GATE/CEED will be called for interview and may in addition be asked to take a written test.

GENERAL INFORMATION

Each postgraduate student is required to register in every semester till he/she completes the requirements of his/her programme. These requirements are

counted in terms of credits which roughly reflect the number of contact hours. Normal load in a semester is 16 credits. The minimum residence requirement for students registered in M.Tech. Programme is four semesters. They are required to complete a minimum of 64 credits of which at least 24 credits should be through course work and at least 28 credits would be through research work.

The minimum residence requirement for students holding M.Tech. degree registered for Ph.D. Programmes in engineering is four semesters. They are required to complete a minimum of 64 credits of which at least 16 credits must be in terms of postgraduate courses and at least 32 credits in terms of research work.

The minimum residence requirements for students holding B.Tech. degree registered for Ph.D. programmes in Engineering is six semesters. They are required to complete a minimum of 96 credits of which at least 40 credits must be through P.G. courses and at least 32 credits through research.

The minimum residence requirement for students holding M.Sc., MA., M.B.A. or M.Phil. degree registered for Ph.D. programmes in Sciences/HSS/Management is five semesters. They are required to complete a minimum of 80 credits of which at least 24 credits must be in terms of postgraduate courses and at least 32 credits in terms of research work.

In order to graduate, students must obtain a minimum CPI of 6.50 at the Master's level and 7.00 at the Ph.D. level.

The institute, being residential, requires that all registered students must reside in the campus. The Institute has eight hostels for boys and two hostels for girls with capacities of 3500 and 450, respectively. Seventy Two (72) Single Bed Room Apartments (SBRA) have been earmarked for allotment to married students. The students are, however, advised to bring their family only after allotment of a SBRA.

FEE CONCESSIONS

Partial waiver of tuition fee may be extended to sponsor full time Ph.D. students facing severe financial difficulties on case-to-case basis. All part-time PG students shall be given 50% tuition fee waiver.

Correspondence

All correspondence concerning admissions should be addressed to the concerned Department/Programme as follows:

The Convener DPGC

Department/Programme (Please write the name of Department/)

Indian Institute of Technology Kanpur

Kanpur 208 016

AEROSPACE ENGINEERING

The Department of Aerospace Engineering offers a comprehensive program of teaching and research at undergraduate and postgraduate levels leading to B.Tech., M.Tech. dual degree in B. Tech & M. Tech and Ph.D. degrees. Specializations are available in the areas of: i) Aerodynamics: including CFD, Gas Dynamics, Industrial Aerodynamics and Wind Energy. ii) Flight Mechanics: including Space Dynamics & Controls, iii) Propulsion: turbo machines Supersonic combustion, Flame, Micro combustor, Atomization microgravity combustion, active and passive flow control iv) Aerospace Structures: including computational mechanics, composites, random vibration, Helicopter dynamics, aeroelasticity, controls, smart structures & optimization.

Various consultancy and sponsored research and development 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 Propulsion of Advanced Research (IFCPAR),, TERI, PCRA, DRDO, etc. have been undertaken by the Department. Foreign collaboration including IFCPAR, ICTP (Italy), TUW, 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 CFD industrial and wind energy aerodynamics, CFD including subsonic, transonic, supersonic and hypersonic flow computations, supersonic/hypersonic similitude, unsteady aerodynamic modeling and parametric estimation techniques; satellite dynamics; (analysis and development of software in the areas of thermal problems in rocket propulsion) and flow through turbomachines, random vibration analysis, design and optimization of fibre reinforced composite structures for static, dynamic and random loading; Response of composites under different environmental conditions; Adaptive finite element analysis; Smart structures; damage in composite structures; behavior of adhesive joints; Helicopter dynamics, Aeroservoelasticity; modeling of advanced materials, MAV)/ Insect Flight).

FACULTY

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

Ashish Tewari, Ph.D. (Missouri - Rolla): Flight Mechanics, Aeroservoelasticity, Space Dynamics and Control.

B Eshpunijani, Ph.D. (Purdue): Transition & Turbulence, CFD, Supersonic & Hypersonic Flows, Biofluid mechanics.

C S Upadhyay, Ph.D. (Texas A&M): Computational mechanics, Damage Mechanics

C Venkatesan, Ph.D. (IISc Bangalore): Aeroelasticity, Helicopter Dynamics, Smart Structures

D. Das, Ph.D. (IISc. Bangalore): Low and High speed Aerodynamics, Transition and Turbulence, Aeroacoustics.

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

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

Kunal Ghosh, Ph.D. (Southampton): Unsteady High Speed Aerodynamics, Wind Energy

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

R K Sullerey, Ph.D. (IIT/K): Propulsion, Turbomachinery, Flow Controls

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

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

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

Hari B Hablani, Ph.D.(IISc, Bangalore): Spacecraft Guidance, Navigation and Control, (Visiting Faculty)

P.M. Mohite, Ph.D.(IIT/K): Damage mechanics of composites, composites, contact mechanics, FEM(Visiting Faculty)

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 with 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. 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 32 units (two semester load) of research leading to a thesis. A Ph.D. student is required to complete a minimum of 4 courses and 32 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 Engg. Aerodynamics I and II, Mathematics for Aerospace Engineers, Viscous Flows, Aerodynamics of Wings & Bodies, Boundary Layer Stability and Transition, Finite Element Methods for Fluid Dynamics, Introduction to Environmental Fluid Mechanics, Wind Engineering, Turbulence, Computational Fluid Dynamics, Turbulent Flows, Perturbation Methods in Turbulent Shear Flows, Continuum Hypersonic Aerodynamics, High Temperature Gas Dynamics, Applied Mathematics for Engineers, Instrumentation, Measurements and Experiments in fluids, Molecular Gas Dynamics, Advances in Wind Energy Conversion, Acoustics and Noise Control, Flight Dynamics, Flight Stability and Control, Advanced Dynamics Stability, Space Dynamics-I, Space

Dynamics-II, Rotary Wing Aerodynamics, Control Theory, Introduction to Hypersonic & Trans-atmospheric Flight, Navigation and Avionics Systems, Aircraft Propulsion, Aerospace Propulsion, Thermal Turbomachinery, Combustion Problems in Rocket Propulsion, Selected Topics in Turbomachines, Applied Combustion, Airbreathing, missile propulsion, Flow Control, High Speed Internal Flow Problems, Transonic Aerodynamics, Aerospace Structural Analysis I & II, Dynamics and Vibration, Introduction to Finite Element Methods, Solid Mechanics, Rocket and Missile Structures, Advanced Aircraft Structural Analysis, Aeroelasticity, Vibration Control, Theory of Vibrations, Nonlinear Oscillations, Reliability Analysis of Engineering System, Composite Materials, Analysis of Composite Structures, Random Vibrations, Aircraft Materials and Processes, Deterministic and Random Vibrations, Helicopter Theory-Dynamics and Aeroelasticity, Virtual Instrumentation, theory of smart structures, Astrodynamics, Theory of Combustion, Principles of Acoustics, Fundamentals of Liquid Atomization.

FACILITIES

The experimental facilities of the department include several low speed wind tunnels, a high speed blowdown tunnel, High Speed Jet facility, half anechoic chamber for noise measurements. and hot wire and laser Doppler anemometry; facility for static and dynamic tests and composite materials behavior; a cascade tunnel, a continuous combustion unit and a 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 BIOENGINEERING

The Department of Biological Sciences and Bioengineering (BSBE), founded on 14th of September, 2001, is the newest department at IIT Kanpur. Following the tradition of the Institute, the new department aspires to integrate teaching and research in the areas of modern biology in a multidisciplinary fashion.

In the first phase of its activities, the focus of this new department is set around the areas of genomics, human molecular genetics, developmental biology, bioinformatics, computational biology, structural biology, protein chemistry and drug design. The department has recently diversified in the areas of biomaterials, molecular biomechanics, tissue engineering, biochemical engineering, computational neuroscience and nanobiotechnology.

The department currently has ten members in its faculty with expertise in diverse areas of research and two Senior Research Scientists to strengthen the research component. The department provides a truly interdisciplinary environment where active research of high quality is being pursued.

FACULTY

Ashok Kumar, Ph.D. (IIT Roorkee): Downstream Processing, Biomaterials, Nanobiotechnology, Affinity interactions and Cell separations, Bioprocessing

P Sinha, Ph.D. (BHU, Varanasi): Cancer Genetics, Growth Control & Pattern formation in fruit fly, Drosophila model

R Sankararamkrishnan, Ph.D. (IISc, B'lore): Bioinformatics, Molecular modelling of membrane proteins, Biomolecular simulations

K Subramaniam, Ph.D. (IISc, B'lore): Developmental Biology – germ cell development in C.elegans, Functional Genomics Using RNAi – Plant-parasitic nematodes.

S Ganesh, Ph.D. (BHU, Varanasi): Human Molecular Genetics, Genomics, and mouse model for human genetic disorders.

Dhirendra S Katti, Ph.D. (Bombay Univ.): Tissue Engineering, Biomaterials, Drug Delivery Systems and Nanobiotechnology

B Prakash, Ph.D. (IISc, B'lore): Structural Biology, Bioinformatics, Structure Based drug Design.

Anupam Pal, Ph. D. (Pennsylvania State University (USA): Biomechanics; high performance computing; biomedical image processing and geometric modeling.

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

Jonaki Sen, Ph.D. (Albert Einstein College of Medicine New York): Retinal development and differentiation

FACILITIES

Computational Facility: SGI Fuel graphics workstation; Compaq ES45 Alpha machine with 4 processors; molecular modelling and graphics packages; bioinformatic tools.

Imaging Facility: Microscopic setup for confocal/fluorescence imaging, photodocumentation and image analysis software, Environmental Scanning Electron Microscope (ESEM).

Molecular Biology lab: Centrifuges, Gel-documentation system, PCR Machine, hybridization oven, transfer apparatus for nucleic acids and protein, automated DNA sequencer, and culture setup for bacterial and mammalian cells.

Facility for Protein Chemistry: peptide synthesizer, FPKC, CD spectropolarimeter and UV-VIS spectrophotometer

PROGRAMMES

M.Tech.

The M.Tech program is designed for students from all branches of biology including medicine and pharmacy to give training in the frontier areas of biological sciences and bioengineering. Candidates with engineering, maths, physics and chemistry background are especially encouraged to apply for this inter-disciplinary program. This program offers unique opportunity to pursue careers in academics as well as in industry. Introductory level courses in biology will be offered to non-biology students and a basic training in mathematics will be given for biology students. More advanced level topics in specialized areas will be covered in several courses followed by research leading to a thesis.

Minimum qualification for admission into the 2 Yr. M.Tech. programme would be B.E/B.Tech. in engineering, B.Pharm. or M.Sc. degree in any branch of science or MBBS with a minimum CPI of 6.0 (or 60 percent marks). In all cases a valid GATE score will be a prerequisite and the final selection would be based on an interview for the short-listed candidates. The requirement of GATE score is waived for MBBS Degree holders.

Doctor of Philosophy (Ph. D.)

The research programs of BSBE faculty offer an excellent opportunity for pursuing research in cutting-edge areas of biology. Intense training, which includes one-year course work, will be given in frontier areas of biology so that the Ph. D. students will be able to pursue their careers as independent researchers in academia or industry. Applicants must have a master's degree in engineering, or any area of science with a minimum of 60 percent marks/6.0 CPI. Applicants with a bachelor's degree in engineering with a minimum of 75 percent marks/7.5 CPI may also be considered. Candidates with Master's degree in science, B.E., B.Tech, MBBS or B.Pharm must have a valid GATE score or qualified in the junior research fellowship (JRF) examination conducted by the CSIR/UGC. The requirement of GATE score is waived for MBBS Degree holders. Final selection will be based on written tests and interview of the short listed candidates.

CHEMICAL ENGINEERING

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 prepares students for a high level of competence in the use of modern engineering methods, CAD and microprocessors based instrumentation, etc. Most of the graduate courses have a strong engineering science and state-of-the-Art 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. Bhatnagar, Herdillia, Amar Dye-Chem and NOCIL awards of IChE, of ISTE, Fellowships of Academies of Sciences and of Engineering, etc.). This research in diverse areas of Chemical Engineering is published in prestigious international journals. The department faculty has also authored over 30 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 department enjoys an excellent rapport and professional interaction with various industrial 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, GSF, 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 Thermodynamics, 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

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.

Goutam Deo, Ph.D. (Lehigh): Heterogeneous Catalysis, Kinetics, Transport Phenomena

J P Gupta, Ph.D. (Pennsylvania): Transport Phenomena, Heat Exchanger Design, Plant Safety and Hazard Analysis, Hazardous Waste Management.

S K Gupta, Ph.D. (Pennsylvania): Simulation and control of Polymerization Reaction, Momentum Transfer Operations

Y M Joshi, Ph.D. (IIT/B): Rheology, Polymer Science & Engineering, Fluid Mechanics

Ashok Khanna, Ph.D. (IIT/K): Process Control, Polymer Engineering, Two Phase Flow

Anil Kumar, Ph.D. (Carnegie-Mellon): Simulation and Control of Polymer System Process Design

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): Micro/ Nano Fabrication processing of electronic materials Microfluidics , Lab-on-a-chip sensors

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

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

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 complete 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 Heterogeneous 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, Nuclear chemical engg., 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.

FACILITIES

Besides the central facilities, at the Institute level, the Chemical Engineering Department has its own workshop, library, GLCS, GPC, catalyst characterization facilities, centrifuges, fermentor, incubator-shaker, cryostats, IBM compatible personal computers, Magnetic flow meters, Ultrafiltration, Reverse Osmosis, AFM, Electrodeialysis, Goniometer, Haake & Physica Viscometers and Rheometers, Parr Reactors, Laser Printer, Density meter, Dedicated NO gas analyzer, Ion chromatography on line IR Gas analyser, Softwares such as MATLAB, SPEEDUP, ASPEN+, Langmuir-Biodegett depositions, Ellipsometer, Spin-coater etc.

For more details visit www.iitk.ac.in

CIVIL ENGINEERING

Postgraduate education in the Department is aimed at attaining an understanding of the basic scientific principles underlying various disciplines in Civil Engineering. In addition, the research component of the graduate programmes is meant to develop capabilities to undertake confidently independent analysis of complex field situations. Our graduates have gone on to become leaders in their profession and have significant contributions to the research and development. Keeping in view the needs of the society and the challenging problems faced by the profession, the postgraduate programmes have been developed in several fields of specialisation.

FACULTY

P K Basudhar, Ph.D. (IIT/K): Geotechnical Engg.: Soil-structure interaction, Optimal design and analysis of foundation systems, Slope stability analysis

Purnendu Bose, Ph.D. (Univ. of Massachusetts, Amherst): Environmental Engg.: Physico-chemical processes for water and wastewater treatment, Advanced oxidation processes for water and wastewater treatment, Abiotic remediation of groundwater resources

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

S K Chakrabarti, Ph.D. (Arizona): Structural Engg.: Interfaces and interactions in structural connections, 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/Kh): Transportation Engg.: Pavement design, Pavement materials, Pavement maintenance management

Bithin Datta, Ph.D. (Purdue): Hydraulics and Water Resources Engg.: Ground and surface water resources systems management, Groundwater pollution source detection, Optimal groundwater pollution monitoring network design, Contaminant remediation

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.

Saumyen Guha, Ph.D. (Princeton): Environmental Engg.: Anaerobic wastewater treatment, Bioremediation, Microbial ecology, Fate and transport of heavy metals in the subsurface, Nutrient uptake in plants

Tarun Gupta, Sc.D. (Harvard): Environmental Engg.: 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. (S California): Structural Engg.: Random vibrations, Earthquake engineering

Ashu Jain, Ph.D. (Kentucky): Hydraulics and Water Resources Engg.: Rainfall-runoff modelling, Surface hydrology, Stochastic hydrology, Neural networks and genetic algorithms

Sudhir K Jain, Ph.D. (Caltech): Structural Engg.: Earthquake engineering, Structural dynamics

Ashwini Kumar, Ph.D. (Waterloo): Structural Engg.: Nonlinear mechanics, Stability of structures, Mechanics of composite laminates

Bharat Lohani, Ph.D. (Reading): Geoinformatics: Terrestrial and airborne laser scanning, Remote sensing, GIS, GPS, Electronic surveying, Terrain modeling, Geodata visualization, and Applications.

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

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

P K Mohapatra, Ph.D. (IIT/K): Hydraulics and Water Resources Engg.: Computational hydraulics, Experimental hydraulics, Surface water hydrology, Frequency response in pipe

C V R Murty, Ph.D. (Caltech), on leave: Structural Engg.: Nonlinear seismic behaviour of buildings and bridges

Nihar R Patra, Ph.D. (IIT/Kh): Geotechnical Engg.: Pile foundations, Soil structure interactions and ground engineering, Soil arching, Liquefaction potential evaluation

Debajyoti Paul, Ph.D. (Cornell): Engineering Geosciences, Geochemistry, Petrology, Environmental geology, Daleoclimate

Amit Prashant, Ph.D. (Tennessee): Geotechnical Engg.: Engineering properties of soils and other frictional materials, Numerical and constitutive modeling for granular materials, Soil dynamics and earthquake geotechnical engineering

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

Mukesh Sharma, Ph.D. (Waterloo): Environmental Engg.: Air quality modelling and management, Fate processes of organic pollutants and parameter estimation

Rajiv Sinha, Ph.D. (Cambridge): Engineering Geosciences: Geomorphology, Sedimentology, Tectonic geomorphology, Remote sensing applications, Climate change

Rajesh Srivastava, Ph.D. (Arizona): Hydraulics and Water Resources Engg.: Flow and transport through variably saturated porous media

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

S N Tripathi, Ph.D. (Reading): Environmental Engg.: Aerosol optical properties, Aerosol microphysical properties, Cloud microphysical properties and cloud electrical properties, Fog vision, Electrical properties of Mars atmosphere

1. PROGRAMMES

Graduate programmes leading to the degrees of Master of Technology and Doctor of Philosophy are offered with specialisation in Engineering Geosciences, Environmental Engineering, Geoinformatics, Geotechnical Engineering, Hydraulics and Water Resources Engineering, Structural Engineering and Transportation Engineering.

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

Admission to the M.Tech. programme in the above disciplines are offered generally in the first semester of each academic year. However, admission to Ph.D. programme is offered in both semesters. Admission to Ph.D. programme is also offered throughout the year on walk-in interview basis.

2. ELIGIBILITY REQUIREMENTS

The following are the eligibility requirements for various programmes:

2.1 M. Tech. Programme

Engineering Geosciences: B.Tech./B.E. degree in Civil Engineering, or M.Sc. degree in Earth Science streams. Some candidates having M.Sc. degree in other science streams may also be considered. Candidates with M.Sc. degree must have mathematics as one of the subjects at B.Sc. level.

Geoinformatics: B.Tech./B.E. degree in Civil/Mining/Electrical/Computer Science/Electronics Engineering/Information Technology, or M.Sc. degree in Earth Science streams/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 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 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 students are not entitled for Institute Assistantship if overall CGPA/CPI is below 8.0.
3. Candidates with AMIE certificate are not eligible to apply.

2.2 Ph.D. Programme

Engineering Geosciences: M.Tech./M.E. degree in Civil Engineering/M. Tech. or M.Sc. degree in Earth Science streams.¹

Environmental Engineering: Master's degree in Civil/Environmental/Chemical/Mechanical/ Metallurgical Engineering or in related engineering branch.²

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/Geography/Physics/Mathematics/Environmental Sciences.³

Geotechnical Engineering: B.Tech./B.E. and 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.

In addition to above, candidates with B.Tech./B.E. degree in Engineering with a minimum overall 75-percent marks/7.5 CPI and a valid GATE score or Master's degree in science or an allied area with exceptional academic records may also be considered for admission directly into the Ph.D. programme.

Foot Notes:

1. Candidates with M.Sc. degree must have mathematics as one of the subjects at 10+2 level.
2. 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 10+2 level and should have qualified GATE or CSIR-NET for JRF.

3. COURSES

For M.Tech., the minimum total credits requirement is 64, out of which a minimum of 28 credits should be 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 through coursework and a minimum of 32 credits through research. The minimum total 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 through coursework and a minimum of 32 credits through research. The various courses offered from time to time in each area of specialization are listed below:

Engineering Geosciences: Earth System Processes; Environmental Geology; Geological Hazards; Resource Exploration Techniques; Satellite Remote Sensing and GIS for Geo-resource Evaluation; Photogeology in Terrain Evaluation; Global Climate Change; Paleoseismology and Tectonic Geomorphology; Laboratory Practices in Geoscience.

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.

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 and Water Resources Engineering: Hydraulic Structures; Engineering Hydraulics; Fluid Mechanics Laboratory; Sediment Transportation; Hydrologic Analysis and Design; Groundwater Systems Analysis; Water Resources Engineering; Introduction to AI Techniques; Transients in Pipes; Unsteady Open Channel Flow; Stochastic Hydrology; Water Resources Systems Engineering and Management; Management and Modelling of Environmental Systems; Groundwater Hydrology and Pollutant Transport.

Structural Engineering: Structural Dynamics; Engineering Mechanics; Stability of Structures; Experimental Methods in Structural Engineering; Advanced

Structural Analysis; Masonary 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 Modelling 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 for M. Tech. programme in all the disciplines.

4. FACILITIES

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

- 1 Servo-hydraulic actuators and shake tables, eccentric mass shakers, pseudo-dynamic testing facility
- 1 Advanced triaxial system including dynamic loading, bender elements, ring shear apparatus, SASW, pressure meter, dilatometer
- 1 Integrated GPS-GIS receivers, Geodetic Quality RTK enabled DGPS, Motorized and robotic total station, Digital level and theodolite, Terrestrial laser scanner, Terrascan, Polyworks, LPS photogrammetric work station, ERDAS, Envi, ERMapper, ArcInfo, ArcView.
- 1 Portable Seismic refraction unit, GPR, Drill Core Scanner, microscopes, Digital Flame Photometer, AAS, HPLC, Carbon analyzer, Scanning Mobility Particle Sizer
- 1 PV-11 Bed profiler, Water Level Follower, Nortek Vectrino 3-D ADV
- 1 Rotational viscometer, Profilograph, British pendulum tester, Radar based speed data collection device, Store polishing machine, Fatigue testing of bituminous mix, Video data recording and processing unit, This film oven tester, GPS enabled instrumented vehicle.

COMPUTER SCIENCE & ENGINEERING

The department offers academic programmes leading to B.Tech., M. Tech., M. Tech. dual degree (B.Tech. and M.Tech) and Ph.D in Computer Science and Engineering. These programmes 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 ACTIVITIES

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 the industry. The areas in which research is being pursued in the department may broadly be classified into 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.

Artificial Intelligence: Natural language processing, Machine Translation, Computer Vision, Cognition and Computation, Machine Learning, Optical Character Recognition, Pattern Recognition and Text Processing.

Computer Graphics and CAD: Design and Display of Random Shapes, Dynamically Symmetric Pattern Algorithm for Shadows of Objects, Design of Curves, Surfaces and Solids, Engineering Applications of CAD.

Computer Architecture and Operating Systems: Computer Architecture, General Purpose Operating Systems, An Operating systems for Embedded controllers, Distributed Computer Architectures, Client-Server computation, Parallel and Distributed Computation,

Hardware Design: VLSI Design and Testing, Embedded Computing Design and Security.

Information System: Database Systems, Object-Oriented Database Systems, Mobile Computing, Transaction Management and Processing, Query Languages, Distributed Systems, Workflow Systems, Software Fault Tolerance, and Hypermedia.

Networks: Protocols, Network performance and analysis, IPv6, Internet Technologies, Wireless and Mobile Networks, Low-cost Networking, Sensor Networks.

Software Engineering and Programming Languages: Software Development Models; Software quality, Process Improvement, Metrics and Models Software Architecture, Quantitative approaches to project-and process management,

Design Methodologies, Formal Specification, Programming Environments, Translators for Declarative and Functional Languages, Automatic Generation of Compilers, Compilers for Non conventional Architectures, Parallel Processing and Applications grid Computing.

Theoretical Computer Science: Complexity Theory, Logic in Computer Science, Nonmonotonic Reasoning, Functional Programming.

Computer Security: Network and OS Security, Cryptography, Biometrics

FACULTY

Sanjeev K Aggarwal, Ph.D. (IIT/K): Compiler Design, Compilers for Advanced Computer Architectures, Parallelizing Compilers, Tools for Compiler Generation, Semantics of Programming Languages, Grid Computing.

Manindra Agrawal, Ph.D. (IIT/K): Computational Complexity Theory, Randomized Algorithms, Cryptography, Computational Number Theory

Somenath Biswas, Ph.D. (IIT/K): Computational Complexity Theory, Logic, Randomized Algorithms, Computational Biology

Surendra Baswana, Ph.D. (IIT Delhi): Graph algorithms, Dynamic algorithms and Randomized algorithms.

M Chaudhuri, Ph.D. (Cornell): Computer Architecture

Sanjay G Dhande, Ph.D. (IIT/K): Computer Graphics, Computer Animation, Computer Aided Design, Robotics and Kinematics of Mechanisms

Sumit Ganguly, Ph.D. (UT Austin): Databases.

R K Ghosh, Ph.D. (IIT/Kh): Mobile Computing, Adhoc and Cellular Mobile Networks, Parallel and Distributed Computing, Web Services, Mobile Commerce

Arnab Bhattacharya, Ph.D. (Uni. of California): Database, Data Mixing, Sensor Networks, Bioinformatics.

Phalguni Gupta, Ph.D. (IIT/Kh): Sequential and Parallel Algorithms, Parallelization of Sequential Programs, Image Processing, Biometrics.

Ajai Jain, Ph.D. (McGill): VLSI Testing, Fault Tolerance, Computer Architecture, Parallel Processing, Operating Systems, Machine Translation.

Piyush P Kurur, Ph.D. (IMSc Chennai): Complexity Theory,computational Algebra,Quantum Computing.

Harish Karnick, Ph.D. (IIT/K): Commonsense Reasoning especially Non Monotonic Approaches, Automated Reasoning, Theorem Proving, Functional Programming and Semantics of Programming Languages, Pattern Recognition and Vision, Philosophical Aspects of Artificial Intelligence and its relation to Human Cognition.

Shashank Mehta, Ph.D. (Nebraska): Computational Geometry, Graph Algorithms, VLSI Testing.

Rajat Moona, Ph.D. (IISc B'lore): Computer Architecture, Embedded Computing Hardware, Operating System, VLSI Design and CAD for VLSI.

Amitabh Mukherjee, Ph.D. (Rochester): Visual Surveillance, Natural Language Processing, Machine Learning, Cognitive Science.

T V Prabbakar, Ph.D. (IIT/K): Software Architecture, Database Management Systems, Internet Technologies

Dheeraj Sanghi, Ph.D. (Univ of Maryland): Computer Networks, Protocols at MAC/Network/ Transport layers, Ipv6, Wireless Networks, Internet Applications, Multimedia Applications

Sanjeev Saxena, Ph.D. (IIT/D): Parallel Processing, Algorithms and Data Structures, Heuristics, Computational Geometry, Graph Theory, VLSI and Architectures

Anil Seth, Ph.D. (TIFR/Mumbai): Logic in Computer Science

R M K Sinha, Ph.D. (IIT/K): Artificial Intelligence, Natural Language Processing, Pattern Recognition, Computer Architecture.

PROGRAMME

The department has one of the best undergraduate programs in the country. The course curriculum for the undergraduate program gives the flexibility to the students to prepare for advanced specializations. The course structure provides a mix of compulsory and elective courses.

Admission to the B. Tech programs of all departments of IITs and some other Institutes is made once a year through a Joint Entrance Examination (JEE). The minimum academic qualification for appearing in the JEE is graduation from (10+2) school system or its equivalent with Chemistry, Mathematics, and Physics. The admissions are offered on the basis of a candidate's All India Rank in JEE. More information about admission into B. Tech programme is available from the institute's JEE office.

The M. Tech programme is oriented towards research and advanced training in Computer Science. It is designed for students who have B. Tech./B.E. in computer science or equivalent degrees. The student may choose six or more elective depending on his/her interests. Thesis work forms a major component of the programmer and begins after the second semester. Admissions to M. Tech. programme is open to candidates holding a B. Tech./B.E in any discipline or Masters degree in science, and have qualified GATE. GATE with CS stream is strongly preferred. The 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.

The Ph. D. programme is designed for students with strong motivation for doing research in computer science. Admission is to Ph. D. 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 PhD. 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 PhD Programme. The students choose these course depending on their interest and on suggestion of the supervisor. Each student must also qualify comprehensive examination which test 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 supports 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. student with an M. Tech. degree receives an assistantship of up to Rs.25,000/- per month depending on his/her performance. A number of industry supported fellowships are also available to Ph.D. students.

LABORATORY

The department has its own well-equipped laboratory apart from the state of the art Computer Centre which is a central facility. All systems are on fast Ethernet. This network is a part of the Institute-wide network with Internet connectivity. IIT Kanpur has one of the largest campus-wide networks in the educational sector in the nation. The Institute has 100 Mbps 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 important newsletters. The department publication cell is also run by the library.

ELECTRICAL ENGINEERING

The Department of Electrical Engineering offers M.Tech. and Ph.D. programmes in almost all the subdisciplines of Electrical Engineering. The areas include Digital Communication Systems; Information and Coding Theory; Telecom Networks; Mobile and Wireless Communication Systems; Optoelectronics and Optical Communication; Photonic Networks and Systems; Digital Systems and Microprocessors; Digital Signal and Image Processing; Computer Vision and Robotics; Signals and Systems Theory; Control Systems and Mathematical Control Theory; Fuzzy Logic, Neural Networks and their applications; Power Systems; Power Distribution Automation; High Voltage Engineering; HVDC Transmission; Power Electronics; Electric Drives; Active Power Filters and Static VAR Systems; Microelectronics and VLSI Systems; Semiconductor Device Modeling and Simulation; Solid State Devices; Organic Electronics; Transparent Semiconductors and Photovoltaics; Electromagnetics, RF Engineering and Microwaves; Antennas; Electronic Instrumentation and Virtual Instrumentation.

PROGRAMMES

Specialization in the PG Programmes is possible in any of the following broad areas:

- 1 Power and Control
- 1 Signal Processing, Communications and Networks
- 1 RF Engineering and Photonics
- 1 Microelectronics, VLSI and Display Technology.

In the application form, the applicants must specify their choice of the area(s) of specialization **from the above list only**. 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's programme 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.D. programme, a student has to complete a 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 on the part of the student 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.

PG students are encouraged to generate their own problems for research. They have freedom to choose their thesis supervisors from among the faculty members of the department and, if required, also from outside the department.

OPPORTUNITIES IN SPONSORED RESEARCH

Sponsored research and development activities are pursued in the department along with the Advanced Centre of Electronics Systems (ACES) - the R & D wing

of 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-the-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 substantially additional remuneration than the MHRD norms for PG scholarships.

FACULTY

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. (IIT/D): Intelligent control; Soft computing; Quantum computing and information; Applied nonlinear control

Biswas A, Ph.D. (IIT/D): Electromagnetics; microwave and millimeter wave circuits and techniques; optical guide structure and RFICs

Chaturvedi A K, Ph.D. (IIT/K): Communication theory and systems; Mobile Communications; Spread spectrum systems

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

Das Utpal, Ph.D. (Michigan): High speed Opto electronics semiconductor discrete and integrated devices and microwave circuits

Dutta Aloke, Ph.D. (Louisiana State): Semiconductor device modeling; IC fabrication technology; 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 S, Ph.D. (London): Digital signal processing; Image processing; Digital video signal processing

Harish A R, Ph.D. (IIT/K): Microwave and Antenna; Electromagnetics

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

Iyer S S K, Ph.D. (Berkeley): Organic solar cells; Semiconductor devices

John J, Ph.D. (Birmingham): Fibre optics and optoelectronics; Communication systems; Electronic circuits and instrumentation systems

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

Kalra P K, Ph.D. (Manitoba): Power systems; Expert systems applications; HVDC transmission; fuzzy logic and neural networks applications

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

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

Potluri R Ph.D. (Kentucky): Control systems; Optimization in control; Engineering applications of optimization and control

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

Sachidananda M, Ph.D. (IISc): Antennas; Microwave & RF circuits; Computational electromagnetics

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

Sharma G, Ph.D. (Southern California): Signal processing; Communication systems; Video signal processing; Medical image processing

Singh S N, Ph.D. (IIT/K): Power system restructuring; FACTS technology; Optical 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. (IIT/D): Telecommunication networks; Optical communications, networks and switching systems; Wireless networks; Wireless sensor networks; eLearning systems development

Sinha R M K, Ph.D. (IIT/K): Artificial intelligence; Pattern recognition; Document processing; Natural language processing; Expert systems

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

Srivastava Kumar Vaibhav, Ph.D. (IIT/K): Computational electromagnetics, Microwave engineering

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

Umesh S, Ph.D. (Rhode Island): Signal processing; Speech recognition; Detection and estimation theory.

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

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

COURSES

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

Mathematical Structures of Signals and Systems; Mathematical Methods in Signal Processing; Statistical Signal Processing I; Advanced Topics in Digital Filtering; Image Processing; Architecture and Applications of Digital Signal Processors; Wavelet Transforms for Signal and Image Processing; Statistical Signal Processing II; Introduction to signal Analysis.

Representation & Analysis of Random Signals; Communication Theory; Detection and Estimation Theory; Information & Coding Theory; Satellite Communications; Topics in Stochastic Processes; Speech Signal Processing; Topics in Cryptography & Coding; Digital Switching, Mobile and Wireless Communication Systems; Queuing Systems; Digital Mobile Radio Systems, Digital Communication Networks; Computational Electromagnetics; Advanced Engineering Electromagnetics; Antenna Analysis & Synthesis; Radio Wave Propagation; Microwave Measurements and Design; Microwave Circuits; Fibre Optics Systems I and II; Optical Communication; Photonic Networks and Switching; Smart Antennas for Mobile Communication; Wireless Communications.

Analog/Digital VLSI Circuits; Fluctuation Phenomena in Microelectronics; Fiber Optic Systems I; Measurements, Parameter Extraction and VLSI tools in Microelectronics; Solid State Devices I; Semiconductor Device Modeling; Fiber Optic Systems II; Semiconductor Device Technology; VLSI System Design; Topics in Microelectronics and Instrumentation; Virtual Instrumentation; High Frequency Semiconductor Devices and Circuits; Organic Electronics, Monolithic Microwave ICs; Introduction to MEMS; Monolithic microwave integrated circuits.

Economic Operation & Control of Power Systems; HVDC Transmission; Flexible AC Transmission Systems; Advanced Power System Stability; High Voltage Engineering - Behavior of Dielectrics; Power Systems Planning; Simulation of Modern Power Systems; Electric Power System Operation and Management Under Restructured Environment.

Nonlinear Systems; Linear Stochastic Dynamical Systems; Digital Control; Robust Control Systems; Optimal Control; Control Systems Design; Basics of Modern Control Systems.

Fundamentals of Electric Drives; Basics of Power Electronics Converters; Power Electronics Applications in Power Systems; Control Techniques in Power Electronics; Modelling & Simulation of Power Electronic Systems; Advanced Electric Drives; Special Topics in Power Electronics; Insulation Engineering in Power Apparatus and Systems, The finite Element Method in Electric and Magnetic Fields

Digital Circuit Design; Architecture of Advanced Microprocessors & Microcomputers; Knowledge based Man-Machine systems; Computational Bio-Instrumentation & Neural Networks; Fuzzy Logic Systems and Control; Data Mining; Neural systems and Networks.

FACILITIES

The department has excellent research laboratories and support facilities in several areas. The microfabrication lab allows basic semiconductor processing in silicon as well as organic material based device (OLED, Solar Cells, OTFT) fabrication can be carried out. Basic organic materials for organic LEDs and solar cells are also synthesized in semiconductor device lab. There is a mask making facility in the photo mask making facility. There is also a solar cell characterization lab; Integrated Circuits simulation and VLSI Design laboratory with all modern EDA tools, e.g., CADENCE, SYNOPSIS, Mentor Graphics, MAGMA, COWARE, XILINIX based Gate Array design & programming tools, etc. and adequate

hardware in the form servers and good number of workstations for research and course work; Digital Image Speech Processing laboratory equipped with several workstations, PCs and relevant accessories; Digital Signal Processing laboratory with several PCs and DSP hardware based on Texas Instrument's DSPs; Computer vision lab with chroma keying, controlled illumination, structured light sources, various kinds of cameras and associated computational resources; Robotics lab is equipped with 7 DOF manipulators, mobile robots, and visual systems and is involved in autonomous navigation of mobile robots, multi-robot formation and 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 has complete fabrication and testing facilities for research in power electronics including frequency response analyzer, solar photovoltaic panels. Electromagnetics and Microwaves laboratory 50 GHz Network Analyzer, Spectrum Analyzers, Signal Generators, Power Meters, Noise Figure Meter, and Shielded Anechoic Chamber for antenna and RCS measurements; Fibre Optics laboratory equipped with optical spectrum analyzer and interface development facility for Fibre-optic Links; Clean room for Semiconductor Optoelectronic Device Fabrication and Photonic measurement laboratory; Millimeter wave Circuits. Three teaching/training labs have been developed to train students in areas related to organic electronics. There are the Organic Electronics Processing Lab, the Organic Electronics Characterisation Lab and the Organic Electronics Simulation Lab.

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 also exists in the Department.

The department is well supported by an extensive LAN / WLAN with several servers and Internet connections including WWW. The department has excellent computing resources spread over a number of servers, workstations and PCs connected over a LAN spanning various laboratories. This LAN is bridged to the Institute-wide network, which provides additional computing library resources and WAN link to access the Internet through VSNL. Besides, the department runs a well-stocked library for specialized books, research reports and data catalogues.

The wide-ranging research facilities and the 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 teaches management concepts, techniques and skills relevant to the students with diverse backgrounds who may wish to subsequently pursue a career in academics or in managerial position. The Department covers all areas of management that include Economics, Infrastructure and Public Systems; Finance and Control Systems; Information and Knowledge Systems; Management of Innovation and Entrepreneurship; Marketing Management; Operations Management; Operations Research and Quantitative Methods; Organizational Behaviour and Human Resource Management; Strategic Management and Business Policy.

The Department offers MBA, M.Tech. and Ph.D. degrees. A Bachelor's degree in any branch of engineering is the minimum requirement for admission to M.Tech. A Master's degree in Management or Industrial Engineering is required for admission to Ph.D. The process of admission to M.Tech. and Ph.D. programmes includes a written aptitude test and a personal interview. In addition department has a 2 years' MBA programme leading to Master of Business Administration. Admission to the MBA programme is made once a year in the first Semester (July admission). The admission process is normally carried out in February-March after the announcement of results of JMET (Joint Management Entrance Test).

Ph.D Programme

Students in the Ph.D. program are required to take at least four courses. A student may be required to take additional courses depending on his/her background and research interest. 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 about the field of research and should identify their thesis supervisor by the time of their comprehensive examination.

M.Tech. Programme

M.Tech. students can select specialization either in Management Science and Information Systems Stream or Business Analysis Stream. Management and Information Systems Stream aims at developing quantitative modeling and analysis skills for solving Management problems, as well as skills for use of Information Technology in Management. Business Analysis stream permits in-depth study to understand and analyze one or more of management disciplines such a Marketing, Finance, Strategy, Technology Management, Organization Systems.

Students in the M.Tech Programme take a minimum of four courses per semester during the first two semesters. The last two semesters are dedicated mostly to working on a thesis.

Facilities

The Department has created state-of-art facilities for computational and decision support. The system optimization laboratory provides computational support both for academic teaching and for research. It includes personal computers and workstations connected in the form of a local Area Network, and access to Internet and the IIT computing facilities.

FACULTY

Veena Bansal, Ph.D. (IIT/K) (On Leave): Information Technology, ERP system

Jayanta Chatterjee, Ph.D. (IIT/Delhi) (On Leave): Knowledge Management, Entrepreneurship, Service Management

Peeyush Mehta, Fellow in Management (IIM, Ahmedabad): Supply Chain Management , Operations Management

Subhas Chandra Misra, Ph.D. (Carleton University) (Visiting Faculty): Information Systems

A K Mittal, Ph.D. (Case Western): Operations Research, Operations Management, TQM, IPR

B V Phani, Fellow in Management (IIM, Calcutta): Accounting & Finance

Runa Sarkar, Fellow in Management (IIM, Calcutta): Micro & Macro Economics Environment Economics

R N Sengupta, Ph.D. (Fellow in Management, IIM Calcutta): Statistical Analysis, Risk Management, Operations Management

Kripa Shanker, Ph.D. (Cornell): Production/Operations Management, FMS/ CIMS; Quantitative Decision Modelling

N K Sharma, Ph.D. (Delhi Univ.): Consumer Behaviour, Marketing Management, Marketing Research

R R K Sharma, Fellow in Management (IIM Ahmedabad): Quantitative Methods for Management, Manufacturing Policy, Strategic Management

Anoop Singh, Ph.D. (IGIDR Mumbai): Infrastructure finance and Regulations, Energy and Environment Managerial Economics

Arun P Sinha, Fellow in Management (IIM Ahmedabad): Strategic Management, International Business, Service Marketing

Rahul Varman, Fellow in Management (IIM Ahmedabad): Personnel Management and Industrial Relations, Organizational Theory

COURSES

Accounting for Management, Economic Analysis for Management, Financial Management, Measuring and Driving Corporate Programme, Financial Intermediates, Financial Institutions and Regulators, Organization Structure and Design, Managing Change in Organization, Organizing for Services, Human

Resources Management, Social Political and Legal Environment of Business, Managerial Communication, Manufacturing Strategy, Strategic Management, Corporate Innovation & Entrepreneurship, Management of Technology, Managing High Technology, International Business Management, Marketing Management, e- Marketing, Marketing Research, Consumer Behaviour, Marketing of Services, Advertising and Marketing Strategy, Business to Business Marketing, Computing for Management, Database Management, Simulation of Business Systems, Management Information Systems, Quantitative Methods for Decision Making, Production and Operations Management, Total Quality Management, Supply Chain Management, Knowledge Strategies & Knowledge Systems, Manufacturing Planning and Control, Project Management, Managing Service Operations, Advanced Manufacturing Systems, Infrastructure Regulation, Policy and Finance, Security Analysis, Derivatives and Portfolio Management, Project Financing and Management, Probability and Statistics, Introduction to Computing, Operations Research for Management, Computer Aided Decision Systems, Network Flows Algorithms, Combinatorial Optimization, Design of Production Systems, Operations Management, Analysis and Control of Quality, Quality Assurance and Taguchi Methods, Software Engineering and Project Management, Computer Integrated Manufacturing Systems, Flexible Manufacturing Systems, Intelligent Manufacturing Systems, Globalisation, state and corporations.

MATERIALS & METALLURGICAL ENGINEERING

The Department of Metallurgical Engineering was set-up at IIT Kanpur in 1960. With time, department grew noticeably and established new areas of research and teaching in Materials Science, while retaining its strength in traditional areas in Metallurgical Engineering. In 1993, the name of the department was changed to the Department of Materials & Metallurgical Engineering (MME) to reflect department's new profile. Since its inception, MME Department has been very active in teaching, research, development and consultancy activities. Present research profile of the department covers a wide spectrum of materials science and metallurgy from extraction of materials to the processing and development of a variety of materials and devices. The field of engineering materials has expanded enormously in past few decades and, in addition to traditional metal and alloys, the department is actively pursuing computational and experimental research in the areas of modern ceramics and composites, biomaterials, intermetallics and electronic, magnetic and optical materials and devices.

This department has pioneered a unified approach in teaching and research to develop state-of-the art materials and processes for specialized applications. We are a leading department in the country in materials education and research.

The department offers both undergraduate (B.Tech.) and postgraduate (M.Tech. and Ph.D.) programmes. The undergraduate programme is aimed at providing basic understanding of the principles underlying metal extraction and refining, materials characterization, structure-property relationships, and processing of metals and alloys, ceramics and electronic materials. Students also undertake studies of their special interest through the departmental elective courses and project work. In addition to the fundamentals of materials engineering, the postgraduate programme is designed to provide an in-depth study in the area of specialization of the student through Interdisciplinary course work and research. Currently, the student strength of the department consists of nearly 230 B.Tech., 30 M.Tech. and 35 Ph.D. students.

FACULTY

R. Balasubramaniam, Ph.D. (RPI): Environmental degradation of materials (corrosion and oxidation); Indian archaeometallurgy; Materials-hydrogen interactions.

K. Balani, Ph.D. (Florida International University): Biomaterials; Nanomechanics; Tribology; Ab-initio molecular modeling; Carbon nanotube (CNT) reinforced composites.

B. Basu, Ph.D. (Katholieke Universiteit, Leuven, Belgium): Structural ceramics; Biomaterials.

B. Deo, Ph.D. (Burdwan): Automation; Process control and process optimization in iron and steelmaking; Artificial intelligence methods for metallurgical processes.

K. Biswas, Ph.D. (IISc Bangalore): Solidification; Electron microscopy; Phase transformations; Nanomaterials.

R. K. Dube, Ph.D. (Wales): Mechanical processing; Powder metallurgical processing; Composite materials.

A. Garg, Ph.D. (Cambridge): Thin films growth and characterization of materials; Ferroic materials; Organic solar cells.

D. Gupta, Ph.D. (Berkeley): Organic Electronics (OLEDs, Displays, TFTs), Oxide and Transparent Semiconductors, Defects in Semiconductors, Modeling and Simulation of Materials and Processes..

Gouthama, Ph.D. (IISc Bangalore): Electron microscopy; Surfaces and interfaces; Processing; Structure property correlations in materials.

M. Katiyar, Ph.D. (Urbana-Champaign): Opto-electronic materials processing, characterization and applications.

S. C. Korla, Dr. Ing. (Aachen): Steelmaking; Transport phenomena in materials processing; Fuels; Economy and energy conservation in furnaces; Injection metallurgy; Continuous casting.

K. Mondal, Ph.D. (IIT Kharagpur): Phase transformations; Corrosion; Oxidation; Non-equilibrium processing; Metallic glasses; Nanocrystalline alloys.

D. Mazumdar, Ph.D. (McGill): Steelmaking; Process modeling; Heat, mass and momentum Transfer in materials processing.

S. P. Mehrotra, Ph.D. (IIT Kanpur): Mathematical modeling and simulation of metallurgical and mineral processes; Process design and development; Extractive metallurgy.

B. K. Mishra, Ph.D. (Utah): Mineral processing; Particulate materials; Colloidal systems; Electrophoretic deposition; Discrete element modeling; Flow visualization.

R. Shekhar, Ph.D. (Berkeley): Electrochemical processing and reactor design; Molten salt electrolysis; Aluminium electrolysis; Electrodeposition; Electrochemical remediation of contaminated soil.

S. Sangal, Ph.D. (Manitoba): Mechanical properties of materials; Computational materials science.

R. C. Sharma, Ph.D. (McMaster): Phase equilibria; Thermodynamics and kinetics of phase transformations; Heat treatment of metals.

Anandh Subramaniam, Ph.D. (IISc Bangalore): Physical materials science; Nanomaterials; Quasicrystals; Amorphous materials; Metastable materials; Epitaxial systems; Defects & interfaces in materials; Symmetry; Crystallography; Transmission electron microscopy; Finite element modeling.

A. Upadhyaya, Ph.D. (Penn State): Materials processing; Liquid phase sintering; Structure-property relationship; Alloy design; Metal matrix composites; Nano-crystalline alloys.

ADMISSION INTO THE POSTGRADUATE PROGRAMMES

The minimum qualification for admission to the M.Tech. programme is a Bachelor's degree in Metallurgy, Ceramic Engineering, Chemical Engineering, Mechanical Engineering or a M.Sc. degree in Chemistry, Materials Science or Physics with Mathematics at the B.Sc. level. Students with M.Tech. degree in Metallurgical Engineering / Materials & Metallurgical Engineering / Materials Science are eligible for admission to the Ph.D. programme.

A number of postgraduate courses are available for the Ph.D. and M.Tech. students covering various aspects of materials & metallurgical engineering. Students enrolled in the M.Tech. programme have to credit a minimum of 6 courses, while those for Ph.D. have to credit at least four courses. The Department also admits exceptionally bright students directly into the Ph.D. programme after B.Tech. and M.Sc. Such Ph.D. students are required to credit a minimum of 10 courses. The M.Tech. students are also allowed to take one undergraduate course. The courses are selected by the students in consultation with their respective thesis supervisors.

POST GRADUATE COURSES

Advanced thermodynamics, Display materials and technologies, Electrochemistry and corrosion, Non-equilibrium processing of materials, Surface phenomena in chemistry and metallurgy, Computing applications in metallurgy, Computer application in mineral engineering, Soft computing methods in engineering problem solving, Hydrometallurgy, Electrochemical technology in materials processing, Physico-chemical behaviour of materials at high temperature, Advanced mineral engineering, Materials separation and purification, Advanced chemical metallurgy, Heat and mass transfer, Injection metallurgy, Application of transport phenomena in metal processing, Physical and mathematical modelling of steel making

processes, Advances in iron and steel making, Advances in alloy steel making, Analysis of particulate systems, Mineral and metallurgical wastes recycle and resource recovery, Mathematical modelling of metallurgical and mineral processes, Process control in metallurgy and mineral processing, Process metallurgy, Physical metallurgy, Solid state transformations, Order-disorder transformations, Quantitative microscopy, Theory of alloys, Physical metallurgy of steels, Interfacial phenomena in metals and alloys, X-ray crystallography-I & II, Electron microscopy and electron diffraction, Diffusion in solids, Deformation phenomena, Fundamentals of stereology and applications to microstructural analysis, X-ray crystallography II, Modern trends in metal forming processes, Texture in metals and alloys, Mathematical theory of dislocations, Engineering application of dislocation in materials, Process ceramics-i: crystal structure, phase equilibria and microstructure development, Process ceramics-ii: fabrication technology, Tribology of materials, Electrical and magnetic properties of ceramic materials, Science and technology of magnetic materials, Selection and designing with engineering materials, Material for biomedical applications, Solidification processing, Analysis and application of solidification, Advanced structural ceramics, Sintering and sintered products, Design of sintered products, Sintered tool materials, High temperature oxidation and corrosion, Grain boundary engineering, Nuclear materials, Thin film: physics and applications, Semiconductor devices and their processing, Physical metallurgy, processing and applications of refractory metals and alloys, Nanomaterials: processing and properties, Multifunctional oxides: thin films and devices.

FACILITIES

Conventional laboratory facilities for teaching and research in all the major areas exist in the department and in the Advanced Centre for Materials Science. These include, induction and arc melting units, material fabrication facilities, modern metallographic facilities, i.e., optical microscopes, transmission and scanning electron microscope and automatic image analyzer, EPMA, atomic force microscope, computational facilities, X-ray diffractometers, mechanical testing units such as Instron and MTS, differential thermal analysis and thermo-gravimetric equipments, ceramic fabrication facilities, hot press, mechanical attritor & cold iso-static press, corrosion and oxidation testing facilities, fretting wear tester, laser surface profilometer, microwave sintering, cryogenic wear tester, processing and special testing facilities for ceramics and composites, physical vapour and chemical thin film deposition systems, temperature dependent electrical, ferroelectric, optical and magnetic measurement systems and device fabrication facilities with clean room access.

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 Robot Applications.

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 first class Bachelor's degree in Mechanical Engineering. Candidates with a first class Bachelor's degree in Production Engineering are eligible for admission to the Robotics & Robot Applications and Manufacturing Science streams. 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. 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. A Ph.D. student is required to take a minimum of 4 courses but the number is decided by the department. 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 first class Master's degree in Mechanical Engineering. In exceptional cases, candidates with B.Tech. (Mechanical), first class Master's degree in other branches of engineering and M.Sc. will be considered. Admission is based on the performance in the interview/written test.

FACULTY

A K Agarwal, Ph.D. (IIT Delhi): IC Engines, alternate Fuels, Vehicular Pollution, Laser Diagnostic Techniques, Micro-sensor Development, Lubricating Oil Tribology

B N Banerjee, Ph.D. (Northwestern): Aerostatic Bearings, Thermo-mechanical Interactions in Sliding Contact

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

B Bhattacharya, Ph.D. (IISc): Smart Structures, Composite Joints, Structural Vibration, Flexible Manipulator, Control

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

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

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

M Das, Ph.D. (Penn State): Electrochemical Energy Conversion, I.C. Engine, Ignition and Combustion of Energetic Materials, Multi-scale Thermo physical Phenomena

Ashish Dutta, Ph.D. (Akita, Japan): Robotics and Intelligent Control Systems for Humanoids, Microsensors and MEMS, Development of Human Interfaces for Teleoperation, Multifinger Grippers for Robot-Human Cooperation

Kalyanmoy Deb, Ph.D. (Univ of Alabama): Optimization, Optimal Design, Computer Aided Design, Artificial Intelligence, Genetic Algorithms, Soft Computing

S G Dhande, Ph.D. (IIT/K): CAD/CAM, Rapid Prototyping and Rapid Tooling, Geometric Modelling, Computer Graphics Simulation, Mechanisms

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

V Eswaran, Ph.D. (Stonybrook): Computational Fluid Mechanics and Heat transfer

A Ghosh, Ph.D. (Calcutta): Manufacturing Science, Design and Dynamics, Robotics

P S Ghoshdastidar, Ph.D. (South Carolina): Computational Heat Transfer, Rotary Kiln modelling, Non-Newtonian Flow and Heat Transfer, Simulation of Boiling Heat Transfer

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

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

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

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

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

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

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

Sivasambu Mahesh, Ph.D. (Cornell): Solid Mechanics, Composite Materials, Manufacturing Processes

A K Mallik, Ph.D. (IIT/K): Kinematics, Design of Mechanisms, Dynamics of Machinery, Vibrations, Robotics

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

K Muralidhar, Ph.D. (Delaware): Laser measurements, flow control hierarchical porous media.

P K Panigrahi (LSU): Laser Based Instrumentation, Flow Control, CAD of Thermal Systems, Turbulence

B P Pundir, Ph.D. (Roorkee): IC Engines, Combustion and Emissions, Vehicular air Pollution and Control, Engine Fuels including Alternate Fuels.

J RamKumar, Ph.D. (IIT/M): Manufacturing Science, Composite Materials, Tribology

N Venkata Reddy, Ph.D. (IIT/K): Metal Forming, Die and Mould Design, CAM, Machining Processes

A K Saha, Ph.D. (IIT/K): Turbulence, Chaos & Bifurcation, Vortex Dynamics, Hotwire Anemometry, Gas Hydrates.

S Sarkar (IIT/M): Turbomachinery, Computational Fluid Flows, Heat Transfer

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

A Sengupta, Ph.D. (IIT/K): Non-linear Mathematics, Bifurcation Theory, Neutron Transport Theory

B L Sharma, (Cornell): Theoretical and Applied Mechanics, Analytical Techniques

Ishan Sharma, (Cornell): Mechanics of Granular media, Planetary science.

M Sivasambu, Ph.D. (Cornell): Stochastic Fracture Mechanics, Polycrystalline plasticity and Material Processing

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

N S Vyas, Ph.D. (IIT/D): Vibrations, Rotor Dynamics, Virtual Instrumentation, Condition Monitoring

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

COURSES

The following courses are offered other by the various streams of the department. Any suitable PG course from any department can also be credited.

Robotics and Robot Applications: Introduction to Robotics, Robot Manipulators: Dynamics and Control, Organization of Microcomputer Systems, Artificial Intelligence, Robot Motion Planning, Mechatronics.

Solid Mechanics and Design: Finite Element Methods in Engineering Mechanics; Introduction to Solid Mechanics, Theory of Plasticity, Wave Propagation in Solids, Fracture Mechanics, Fracture and Fatigue, Composite Materials, Experimental Stress Analysis; Principles of Dynamics, Advanced Dynamics of Machinery,

Vibration of Continuous Systems, Nonlinear Vibration, Random Vibration, Vibration Control; Kinematic Analysis and Synthesis of Mechanisms, Compliant Mechanisms, Micro electro mechanical Systems (MEMS) Dynamics of Multibody Systems, Computer Aided Engineering Design, Optimisation Methods in Engineering Design, Optimal Control Systems, Evolutionary Algorithms for Engineering Optimization. Materials selection in Design, Rapid Prototyping and Tooling Technology, Smart Materials and Structures.

Fluid Mechanics and Thermal Sciences: I C Engines, Alternative Fuels, Engine Lubrication and Tribology, Laser Diagnostic and Micro-Sensor Development, Turbomachinery, Thermal Environmental Control, Numerical Fluid Flow and Heat Transfer; Viscous Flow Theory, Conduction and Radiation, Convective Heat and Mass Transfer, Combustion and Environment, Turbulence, Computer-aided Design of Thermal Systems, Experimental Methods in Heat Transfer and Fluid Dynamics, Heat Exchanger, Design, Heat Transfer in Materials Processing, Advanced Computational Fluid Dynamics, Optical Measurement Techniques in Mechanical Engineering, Boiling and Two-Phase Flow, Microscale Thermal Engineering, Boiling and Condensation, Combustion and Pollution, Transport, phenomena in porous media.

Manufacturing Science: Machining Science, Non-traditional Machining Process, Metal Forming, Analysis and Design of Machine Tools, Vibrations in Machine Tools, Numerical Control of Machine Tools, Computer Aided Manufacturing, Computer Integrated Manufacturing Systems, Manufacturing Automation, Plastic part Manufacturing and Tool Design.

Other Courses: Engineering Mathematics, Programming and Numerical Analysis, Communication Skill.

FACILITIES

The Department maintains the following laboratories for research: Experimental Stress Analysis and Composite Materials, Laser-Ultrasonics NDT, Vibration and Dynamics, Fluid Mechanics, Internal Combustion Engine, Heat Transfer, Refrigeration and Air Conditioning, Solar Energy and Manufacturing Science. Many laboratories have highly sophisticated special purpose equipments, for example, hot-wire anemometer, laser interferometer, Particle image velocimeter, Programmable Manipulators and Wave Analyzers, NC machines, Electrochemical deburring machine, High Speed Camera, Computerised photoelasticity measurement set-up, FDM 1650 Stratasys and Solider 4600 Cubital Rapid Prototyping Machines, HEK and MCPTAFA Rapid Tooling Equipments, FAROARM Scanner for Reverse Engineering and Split-Hopkinson Bar (Compression and Torsion). The department has a Computer Aided Design Facility having three Silicon Graphics and SUN workstations. Besides a number of software packages are available. The CFD laboratory has a 48-node SUN cluster, a Silicon Graphics Workstation, two SUN-60 Workstations and a SUN Enterprise Server. A laboratory for doing research on genetic algorithm and soft computing has been set up. Students working in the Robotics stream can avail the facilities of the Centre for Robotics, which has a PUMA 560 besides other table top manipulators.

DESIGN

(Interdisciplinary programme)

About Design Programme

Design Programme aspires to develop and provide innovative solutions towards the betterment of society. The methodology adopted to achieve this aim involves encouraging creative minds to think out-of-the-box and synthesize varied knowledge domains. Design Programme at IIT Kanpur has come to be known for its broad-minded philosophy and multidisciplinary approach. The environment encourages interactivity among students, faculty and industry. The curriculum lays emphasis on functional, as well as aesthetic aspects of design. User-centered design principles are practiced, to keep pace with the ever-changing need and desires of people. Backed by state-of-the-art infrastructure, students are given freedom and encouragement to explore virtually any creative field of their interest.

Design Archive-Product Design

Product Design Projects at Design Programme deal with a wide spectrum of issues pertaining to appliances, lifestyle products, packaging design and transportation design. Special emphasis is given in understanding the user's need and aspirations, resulting in sensitive and effective solutions. Several of the projects taken up at Design Programme address special needs, such as products for defense purposes, spastics or age specific users for instance children. Students experiment with materials ranging from foam, wood and metals to plastics and FRP. They have access to sophisticated manufacturing facilities available at the 4i laboratory of IIT Kanpur, such as CNC Turning and Milling Centers, Rapid Prototyping Machine and Water jet Cutting Machine

Design Archive-Visual Communication

Students at Design Programme undertake a variety of projects that come under the domain of Visual Communication addressing informational as well as entertainment needs. Print media has an important share, with academic. On-screen design initiatives cover software interface, interaction Design and Web design. Design Programme also undertakes projects to design corporate identity for companies. Motion Graphics is one of the strengths of Design Programme-student project include documentary films, promotional advertisements videos and animation projects. Students extensively use the Media Technology Centre of IIT Kanpur, which houses state of the art facilities for recording and editing.

Life at Design Programme

The family of students at Design Programme is composed of people from varied backgrounds having unique talents. This diversity is threaded together by mutual understanding and cooperation, which characterizes the way of life here. Creativity at Design Programme is not limited to academic projects. Students regularly take up design work for other departments of IIT. Creative minds come together with enthusiasm to find innovative way of celebrating cultural and fun events.

FACULTY

S G Dhande, Ph.D. (IIT/K): CAD/CAM, Rapid prototyping and Tooling, Computer Graphics Simulation

B Bhattacharya, Ph.D. (IISc): Sensor embedded Products, Micro Electro-Mechanical Systems (MEMS), Smart Composites

Satyaki Roy, Ph.D. (Visva Bharati Univ.): Communication Design, Interaction Design, Media Studies, History of Art

Koumudi P Patil, MFA (Visva Bharati Univ.): Creative visualization, Communication design, Form development, Handicrafts

Jayanta Chatterjee; Ph.D. (IIT Delhi): Design Management

Munmun Jha, Ph.D. (Glasgow): Social Anthropology, Indian Society.

Braj Bhushan, PhD(BRAB University)

Cognitive Neuropsychology, Clinical Psychology, Cognitive Engineering

VISITING FACULTY

Shatrupa Roy, MFA (Visva Bharati Univ.): Design Theory, Art & Aesthetics, Print Media, Visual Communication

DESIGN CONSULTANTS:

Susmit Sen: Digital Electronics, M-P/M-C based systems, Robotics & Sensors
V Raghuram, Ph.D. (IIT/M): Virtual Instrumentation, Mechatronics, Sensors and Sensor Embedded Products, Measurements, Closed-loop Systems, Wavelet Analysis

A Chatterjee: Rapid Prototyping, Reverse Engineering, Digital Image Processing

A Kulkarni: Micro Fabrication, Physical Program of Educational Arts, Motion Control, Virtual Instrumentation, Process Measurement, Sensor Based Applications

Soundara Pandiyan: Digital & Analog Electronics, Embedded Programming, VLSI, FPGA, ASIC, DSP – Digital Signal Processing

COURSES

Design Theory, Design Practice I, Design Practice II, Design Project I, Design Project II, Topics in Design, MDes Thesis, Topics in Motion Pictures, Special Studies in Design, interaction Design , Form & Style, 2D and 3D Visual Design, Elements & Principal of Design, Management of Design Innovation.

Students may choose courses as electives from other departments such as Knowledge Strategies and Knowledge Systems, High Performance Polymers & Composites, Introduction Strategies and Knowledge Systems, High Performance Polymers & Composites, Introduction to Virtual Instrumentation I, Introduction to Polymer Science & Technology, Reliability Based Analysis & Design, Introduction to Computer Graphics & Simulation, Fundamentals of Interactive Computer Graphics, Image Processing, Knowledge Based Man-Machine System, Ecological & Biological Principles, Ethics & Society, Consumer Psychology, Marketing Management, Organization Methods in Engineering Design, Finite Element Method, Modelling & Simulation, Composite Materials, Artificial Intelligence, MBA special projects Modern Art, Art Appreciation & Criticism, Video Production-Theory & Practice, Communication Design etc.

ENVIRONMENTAL ENGINEERING AND MANAGEMENT

(Interdisciplinary M. Tech. Programme)

Recognizing the emerging challenges for environmentally sustainable economic development a broad based programme in Environmental Engineering and Management was started in 1997. This is primarily to meet the growing human resources requirements of high quality to provide leadership in various sectors such as, environmental policy and planning, implementation and legal aspects sustainable industrial development, environment friendly infrastructure management, resource cleanup through remediation of land, water and air resources, over and above the traditional "end-of-the-pipe" pollution control measures. The need for an integrated approach to environmental issues that transcend the boundaries of traditional disciplines in social sciences, physical sciences, engineering sciences and management sciences has been recognised. This programme builds on the past rich experience in environmental engineering, and the available expertise and infrastructure across various branches of engineering, sciences and humanities in the Institute. This inter disciplinary M. Tech Program is administered by the Department of Civil Engineering.

The programme offers M.Tech (4 semesters) in Environmental Engineering and Management. A doctoral Programme in Environmental Engineering leading to a Ph. D degree is offered by the Civil Engineering Department. A bachelor's degree in the following branches of Engineering: civil, mechanical, chemical, agriculture, biotech, environmental or equivalent, or a Master's degree in most branches of sciences with mathematics till 10+2 level is the minimum requirement for admission to the M.Tech Programme.

The M.Tech students take a minimum of four courses in first semester. In second semester, students take three courses and work on thesis. The summer term and the third and fourth semester are fully devoted for working on a thesis. Admission to the M. Tech Programme is generally in the semester beginning July/ August, while Ph.D. admissions are offered in both semesters.

COURSES

Physiochemical Principles and Processes; Ecological and Biological Principles and Processes; Environmental Economics, Legislation and Social Impacts; Environmental Quality and Pollution Monitoring Techniques; Principles and Design of Water supply and Treatment Systems; Principles and Design of Wastewater Treatment and Disposal systems; Air pollution and Its Control; Fate and Transport of contaminants in the natural systems. Environmental Management and Impact Assessment; Industrial Waste Management, Environmental Audit and Atmospheric physics and chemistry. In addition, the students can take courses from other departments/programmes depending on the background/ interest in consultation with programme advisor / thesis supervisor.

FACILITIES

The environmental engineering laboratory is well equipped for routine and advanced analyses of water, air and solid samples. In addition, facilities are available for air, water and soil sampling, and for conducting laboratory, bench and pilot scale studies for water treatment and effluent/emission/ waste control, and air quality measurements.

FACULTY

Purnendu Bose, Ph.D. (Massachusetts, Amherst): Environmental Engineering and Management: Physico-chemical processes for water and wastewater treatment, Advanced oxidation processes, Environmental Systems modelling and management.

Saumyen Guha, Ph.D. (Princeton): Fate and transport of pollutant in natural environment, Biological processes and kinetics, Heavy metals in the environment, Bioremediation of Hazardous substances

Binayak Rath, Ph.D. (IIT/K), on leave: Project Evaluation, Development Economics, Economics of Energy and Water Resources

Mukesh Sharma, Ph.D. (Waterloo): Environmental Engineering and Management; Air Quality Modeling and Management, Fate Processes of Organic Pollutants and Parameter Estimation, Mitigation of Greenhouse Gases, Environmental Health and Risk Analysis.

S N Tripathi, Ph.D. (Reading): Environmental Engineering: Atmospheric Aerosol Modelling, Cloud Physics, Atmospheric Electricity, Fog Analysis, Aerosol Chemical and Optical Properties

Vinod Tare, Ph.D. (IIT/K): Environmental Engineering and Management: Water and Wastewater Treatment, Modelling and Simulation of Environmental Systems, Environmental Management - EIA and EA.

Tarun Gupta, Sc.D. (Harvard): Development of instruments for aerosol measurements, Physiochemical characterization of atmospheric pollutants, Personal exposure assessment and health effects of inhaled particles, source apportionment of air pollution and risk assessment.

LASER TECHNOLOGY (Interdisciplinary Programme)

Since their invention in 1960s, LASERS are transforming the 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. It is hard to imagine our lives without laser based optical communications and networks; compact disc players; laser printers, laser -surgery; lasers-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 in any one of the laboratories 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, Metallurgical 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 Laser Technology, which consolidates the research and developmental activities in this field. In addition to the usual classroom teaching, emphasis is on hands-on experience on lasers. The compulsory courses on Laser Technology Laboratory Techniques facilitate the process. Depending on the problem chosen, students carry out their M.Tech. projects in the laboratories of the centre for Laser Technology (CELT) or in those of the departments stated above.

Students of suitable background generally coming from Electronics Engg., Electrical Engg., Mechanical Engg, Chemistry and Physics are accepted into the program. Candidates having a Bachelor's degree in 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 Laser Technology.

FACULTY

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

Tapas K Chakraborty, Ph.D. (Jadavpur): Fluorescence Spectroscopy

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

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

Joseph John, Ph.D. (Birmingham): Fibre Optics, Electronic Circuits and Instrumentation

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

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

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

Pradipta K Panigrahi, Ph.D (Louisiana State): Optical tomography and flow dynamics and heat transfer

Asima Pradhan, Ph.D. (CUNY, N Y): Laser Spectroscopy, Medical Applications.

Yatindra N Singh, Ph.D. (IIT/D): Fiber Optic Networks, Optical Switching

Raj K Thareja, Ph.D. (Delhi): Laser Physics, Laser Plasma Interaction

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

RESEARCH SCIENTIST

Bansi Lal, Ph.D. (IIT/K): Carbon Dioxide Laser, Fiber Crystal Growth.

Compulsory Courses:

Introduction to Lasers, Introduction to Coherent and Laser Optics, Laser Systems and Applications, Laser Technology Laboratory Techniques, One Course on Electronics, M.Tech. Thesis Research.

Electives

Lasers and their Applications, Fourier Optics and Optical Information Processing, Lasers in industry, Laser induced Processes in Spectroscopy, Fiber Optic Systems I & II, Semiconductor Lasers, Optical Communication Systems, Optical Computing, and Optical networks & Switching.

FACILITIES

Besides the central facilities at the Institute level, the Centre for Laser Technology has its own precision machine shop and library, which supports the Laser Technology Programme. A micro-Raman facility is available.

MATERIALS SCIENCE **(Interdisciplinary Programme)**

Materials are at the root of man's progress in the modern world. Advances in technology today are limited by the availability of newer materials with superior properties. Thus, the development of new solar cell materials would make greater use of solar energy feasible, new ceramic materials would make automobile and other engines lighter and more fuel efficient, new optoelectronic materials would revolutionize the communication industry, etc. For this, a thorough study of the existing materials and tailor making of new materials have to continue with ever increasing vigour. Such a task, however, requires an integrated approach to the subject employing established disciplines in science and engineering. Keeping this very objective in view and to provide focus and coordination for teaching, research and development, the Institute offers an Interdisciplinary Programme in Materials Science at the post-graduate level leading to M.Tech. and Ph.D. degrees. This provides an opportunity to young engineers and scientists to undergo an extensive training in different aspects of materials science and engineering. The courses of study are designed to demonstrate the application of fundamental principles to understand and utilize the properties of broad range of materials including metals and alloys, semiconductors, ceramics, glasses, composites, polymers, etc. Emphasis is given to various aspects of preparation, structural properties and applications of materials. Each student, besides undertaking course work, participates in research activities and submits his/her individual contributions in the form of a thesis to fulfil the requirements of the degree.

About two thirds of the graduates of the programme are placed in industries and research establishments in the country while others pursue doctoral or postdoctoral work at universities in India or abroad. Excellent infra-structure has been established for materials research at the Advanced Centre for Materials Science and at various other laboratories in the Institute. It includes a large number of modern sophisticated equipment for preparation, processing and characterization of materials.

Specialisation of the faculty members who are currently engaged on a full time or half time basis in the activities of the Programme are given below. Besides these, several other faculty members from the engineering and the science departments of the Institute participate in the academic activities of the Programme. Research is being conducted in the broad areas of electronic materials, ceramics, metals, composites, thin films, nano-materials, ferroelectrics, opto-electronic materials, solid state ionics, energy storage materials, polymers, magnetic materials, magneto rheology and specialised techniques.

FACULTY

Rajeev Gupta, Ph.D. (IISc Bangalore): Optical Spectroscopy (Raman IR, Photoluminescence), Manganites, Nanotubes and Nanowires, Multi-ferroics, Ruthenates.

K K Kar, Ph.D. (IIT/Kh): Polymer, Processing and Rheology, Mechanical Properties, Magnetorheology, High Performance Plastics, Polymer blends-alloys & Composites, Carbon nano tubes, Functionally graded materials, FEA of polymer products

Jitendra Kumar, Ph.D. (BHU): Nanosize Particles, Inorganic Membranes, Electronic, Magnetic and Hydrogen Energy Storage Materials, Thin Films, Electron Microscopy

Y N Mohapatra, Ph.D. (IISc Bangalore): Electronic and Optoelectronic Materials. Physics of Semi-conductor Devices and Defects, Organic Semiconductors, Polymer Light-emitting diodes and photo electronic applications

K Shahi, Ph.D. (Gorakhpur): Superionic/Fast-ion Conductors, Solid Electrolytes, High Energy Density Batteries

EMERITUS FELLOW

K N Rai, Ph.D. (BHU): Energy Storage Materials, Magnetic Materials, Catalysts, Amorphous Ceramics, X-Ray Diffraction and Electron Microscopy, Nanoparticulate Processing.

ADJUNCT FACULTY

S Ajaya Ghosh, Ph.D. (Calicut): Organic semiconductors, Light Emitting Polymers, Self Assembly of Conjugated Molecules

PROGRAMMES

The eligibility requirements for admission to M.Tech. and Ph.D. programmes are:

M.Tech.: Master's Degree in Physics, Applied Physics, Chemistry, Materials Science with Mathematics and Physics or Chemistry at Bachelors level or B.Tech./B.E./B. Sc. (Engg.) in Ceramic/Chemical/Electrical/Electronics and Communication/Materials/ Mechanical/ Metallurgical Engineering or any equivalent branch of engineering/technology.

Ph.D.: M.E., M.Tech. or M. Sc. (Engg.) Degree in Materials Science or any equivalent branch of engineering/technology. B.Tech./B.E/B.Sc. (Engg.) in relevant branch of engineering/ technology or Master's degree in Science in an allied area with exceptional academic records.

The requirements for completion of the programmes are:

M.Tech.: At least seven courses and a research project leading to a thesis.

Ph.D.: At least four/ten (if entering with Master's degree in engineering or technology/Bachelor's degree in engineering or technology or Master's degree in sciences) courses, passing a comprehensive examination and a research project leading to a thesis.

COURSES

Structural and Magnetic Properties of Materials; Electrical and Dielectric Materials; Mechanical Properties of Materials; Characterization of Materials; Materials Engineering; Electronic Ceramics; Materials for Energy Conversion and Storage; Electron Microscopy and Microanalysis; Crystal Growth - Theory and Practice; Engineering Polymers; Principles of Ceramic Processing; Electronic Materials; High Performance Polymers and Composites, Introduction to nano-materials and nanotechnology; Any relevant course from other department/programme.

NUCLEAR ENGINEERING TECHNOLOGY (Interdisciplinary Program)

Nuclear Engineering and Technology is an interdisciplinary post graduate 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. Selection of students is through interview and scores in GATE and qualifying examination.

FACULTY

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

P Munshi, Ph.D. (IIT/K): Two-Phase Flow Modeling, Computer Tomography, Non-destructive Testing, Nuclear Safety Analysis

S Qureshi, Ph.D. (Berkeley): Radiation Detection/Nuclear Instrumentation

A Sengupta, Ph.D. (IIT/K): Non-linear Mathematics, Bifurcation Theory, Neutron Transport Theory

Compulsory Courses: Mathematics for Engineers, Nuclear and Reactor Physics, Nuclear Power Engg I, Nuclear Measurements Laboratory, Nuclear Power Engineering II.

Elective Courses: Advanced Reactor Physics, Neutron Transport Theory, Nuclear Fusion, Radioisotope Applications in Engineering, Computer Tomography, Nondestructive Evaluation, Risk Analysis, Special Topics, Interaction of Radiation with Matter, Nuclear Power Engineering III.

FACILITIES

The nuclear engineering laboratory is well equipped with radiation detectors, radioisotope gauges, PC-based multi-channel analyzer, signal correlator, 5 Ci Pu-Be neutron source, 1.7 MeV Tandemron accelerator, and single-detector CT system using Cs-137 source.

CHEMISTRY

The Department of Chemistry has programmes designed to train chemists at all levels, 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 to 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 twenty nine faculty members, about three hundred sixty students at the master's and doctoral levels, several post-doctoral and project research associates.

The Department offers a two-year programme leading to a Master's degree for those with a Bachelor's degree from other Institutions admitted via "Joint Admission Test to MSc (JAM)" and a five-year integrated programme leading to a Master's degree for those entering after (10+2) level studies (i.e.intermediate) through the Joint Entrance Examination (JEE). The five- year M.Sc. programme is unique in that it combines the best of the engineering science curriculum with that of the chemistry curriculum. The graduates of this programme have been acclaimed as well-trained chemists in India and abroad.

FACULTY

G Anantha Raman, Ph.D. (Goettingen Univ.): Organometallic Chemistry, Coordination Chemistry.

Jitendra K Bera, Ph.D. (IISc Bangalore): Coordination Chemistry, Inorganic Materials, Supramolecular chemistry, Electronic properties and theoretical calculations.

P K Bharadwaj, Ph.D. (IIT, Kharagpur): Supramolecular Chemistry, X-ray Crystallography.

A Chandra, Ph.D. (IISc Bangalore): Statistical Mechanics, Computer Simulations.

T K Chandrashekar, Ph.D. (IISc Bangalore): Chemistry of Macrocyclic Systems; Porphyrins, Metalloporphyrins and other Tetrapyrrole Pigments of Biological interest.

V Chandrasekhar, Ph.D. (IISc Bangalore): Polymers, Main Group Inorganic Chemistry.

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.

M. Ranganathan, Ph.D. (Stanford Univ.) : Statistical Mechanics of Crystals & Polymers.

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

B D Gupta, Ph.D. (Flinders Univ., Australia): Organometallic Chemistry, Modelling Vitamin B12 Chemistry.

P Gupta-Bhaya, Ph.D. (Columbia Univ.): Biophysical Chemistry, Experimental and Theoretical Study of Cooperative Biological Systems, Metal Ion Induced Fusion and Lipid Vesicles.

R Gurunath, Ph.D. (IISc Bangalore): Bio-chemistry, Bio-organic Chemistry.

F A Khan, Ph.D. (Univ. Hyderabad): Organic Synthesis, New Synthetic Methods, Metalloorganic Chemistry, Chemical Synthesis in Ionic Liquids.

S Manogaran, Ph.D. (IISc, Bangalore): Molecular Conformation and Electronic Structure using Spectroscopy and Molecular Orbital Calculations including Macromolecular Structure and Dynamics using 2D-NMR and Computational Methods.

R N Mukherjee, Ph.D. (Calcutta Univ.): Biomimetic Inorganic Chemistry: Synthesis, Structure and Reactivity.

J Narasimha Moorthy, Ph.D. (IISc Bangalore): Organic Photochemistry and Organic Supramolecular Chemistry.

SP Rath, (IACS, Calcutta): Bioinorganic Chemistry, Metalloporphyrin Chemistry, NMR of Paramagnetic Systems and X-ray Crystallography.

S Sarkar, Ph.D. (Gorakhpur Univ.): Synthetic & Structural Aspects of Homo and Heteronuclear Metal Clusters of Biological Relevance, Functional Model of Oxomolybdo-enzyme, NO-Synthase, Fullerenes and Carbon nanotubes, Environmental Chemistry.

N Sathyamurthy, Ph.D. (Oklahoma State Univ.): Theoretical Molecular Reaction Dynamics.

V K Singh, Ph.D. (M.S. Univ., Baroda): Synthetic Organic Chemistry with Particular Emphasis on Enantio-selective Reactions, Synthesis of Biologically Active Molecules.

S Sundar Manoharan, Ph.D. (IISc, Bangalore): Nanomaterials, Spintronics, Organic L.Eds and Biodegradable Polymers for drug Delivery.

Y D Vankar, Ph.D. (BHU): Synthetic Carbohydrate Chemistry of Biological relevance, Asymmetric Synthesis, Total Synthesis of Natural Products.

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.

K Srihari, Ph.D. (Univ. Calif., Berkeley): Semi classical Methods in Chemistry (Theory).

S Verma, Ph.D. (Univ. Illinois, Chicago): Bioinspired Molecular Scaffolds for Nucleic Acid and Protein Cleavage, Modeling of Prebiotic Catalysis and Drug design.

M L N Rao, Ph.D. (Univ. Hyderabad): Organometallic Method for Organic Synthesis, Green chemistry, Combinatorial Chemistry, Organic Synthesis, Heteroatom chemistry.

Nisanth Nair (Univ. of Hanover, Germany): Computational Chemistry

Pratik Sen, Ph.D. (IACS Kolkata): Ultrafast Laser Spectroscopy Fluorescence Spectroscopy, Interface selective non-linear Spectroscopy

PH.D. PROGRAMME

The postgraduate programme leading to the Doctorate degree was started in September 1963. The Ph.D. programme includes an integrated sequence of course work and research. A student is admitted to the candidacy of the Ph.D. programme only after successful completion the comprehensive (written and oral) examinations. The importance of post-doctoral training is being increasingly recognised, particularly for those planning academic careers. Opportunities for post-doctoral research exist in the Department in the various branches of chemistry.

COURSES

Compulsory: Two courses are to be taken as compulsory: (i) Modern Physical Methods in Chemistry or Applications of Modern Instrumental Methods, (ii) Principles of Physical Chemistry or Principles of Inorganic chemistry or Principles of Organic Chemistry, as advised by thesis guide.

Elective Courses: Four courses from the following electives with the consent of thesis guide should be taken. Course are: Scientific Instrumentation, Modern Instrumental Methods for Structure Determination, 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, 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, Statistical Mechanics and its application to chemistry, Molecular Modelling in chemistry, Computer Simulations 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.

Besides courses from the above list of compulsory courses which are not taken in the slots of compulsory courses can be taken as electives if so advised by the thesis guide.

FACILITIES

The Department is equipped with excellent 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 fluorescence 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, 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 MHz multinuclear NMR spectrometer, ESI Mass spectrometer, Bruker EPR spectrometer, FT-IR spectrometer CHNSO analyser and CCD diffractometer 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 in other departments within the institute. The department also has access to the Institute's Computational facility low-temperature laboratory, glass blowing and machine shops.

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.

HUMANITIES AND SOCIAL SCIENCES

The Department consists of five major disciplines Economics, English Literature and Linguistics, Philosophy, Psychology and Sociology and each of these disciplines has a Ph.D. programme. The department has a Fine-Arts component as well which offers only undergraduate courses. 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 has a five year integrated MSc. Programme in Economics.

FACULTY

Boruah Bijoy H, Ph.D. (Guelph, Canada): History of Modern Western Philosophy, Analytical Philosophy, Philosophy of Mind, Philosophical Aesthetics

Braj Bhushan, Ph.D. (BRAB Univ.): Clinical Psychology, Cognitive Neuropsychology and Engineering Psychology

Chakrabarti, Anindita, Ph.D. (Delhi Univ.): Sociology of Religion and Social Movements.

Chandran Mini, Ph.D. (Kerala): Modern British Literature, European Literature, Indian Literature & Aesthetics

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

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

Krishnan Lilavati, Ph.D. (McMaster, Canada): Experimental Social Psychology and Cross-Cultural Psychology

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

Madan Amman, Ph.D. (JNU): Sociology of Education, Political Culture and Social Stratification.

Mathur Somesh K, Ph.D. (JNU): Quantitative Methods, International Economics, Efficiency and Productivity Analysis, New Trade and Growth Theories, WTO issues like TRIPS and IT Policy

Mathur Suchitra, Ph.D. (Wayne State, USA): Indo-Anglian Literature, Postcolonial Theory and Literature, Women's Studies, Cultural Studies.

Neelakantan G, Ph.D. (IIT/K): Twentieth-Century American Literature, Modernism and Post-Modernism, American Jewish Literature, Literary Theory

Murali Prasad, P. Ph.D. (Univ. Hyderabad): Law and Economics, Microeconomic Theory, Environmental Economics, Intellectual Property Rights.

Patil Koumudi, (MFA, Visva-Bharati Univ.): Art history, Installation Art, Participatory/Community Arts.

Pattnaik B K, Ph.D. (Pune Univ): Science and Technology Policy, Sociology of Development, Sociology of Voluntary Sector and Social Movements.

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

Raina A.M., Ph.D. (IIT/K): Cognitive Linguistics, Computational Linguistics, Communication Theory and Practice, Language Acquisition and Learning

R R Barthwal, Ph.D. (IITK): Industrial Economics, Environmental Impact Assessment, Development Economics

T Ravichandran, Ph.D. (Pondichery Univ.): Postmodern American Literature, Literary Theory, Cyberpunk Literature, Indian Writing in English, English Language Teaching

Rath Binayak, Ph.D. (IIT/K), on leave: Project Evaluation/Appraisal, Development Economics, Economics of Energy and Water Resources, Environmental Economics and EIA

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

Saha Bhattacharya Sarani, Ph.D. (Univ. of California, Santa Barbara) Environmental Economics, Public Economics, Political Economy, Applied Micro-economics.

Sarma, Ravishankar, Ph.D. (IIT Bombay): Logic; Philosophy of Science.

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

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

Singh Sanjay Kumar, Ph.D. (IGIDR, Mumbai): Applied Economics, Industrial Organisation, Transport Economics

Sinha Arvind K, Ph.D. (Patna): Organizational Behaviour and Social Psychology

Sinha Surajit, Ph.D. (McMaster): Macro-Money.

Sahu Vineet, Ph.D. (Hyderabad): Philosophy of Mind

VISITING FACULTY

Eggert Axel, Ph.D. (Siegen University, Germany): International Management, Global Enterprises, Cross-Cultural Marketing, Managerial Economics

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. At present about 65 Ph.D. scholars may be taken in the department in various programmes. The following are among the important courses offered by the department.

ECONOMICS

Industrial Economics, Project Evaluation/Appraisal, Input-output Economics, Development Economics, Environmental Economics, Macroeconomic analysis, Econometrics, Microeconomic Theory, Energy Economics, Monetary Economics, Law and Economics, Environmental Impact Assessment .

ENGLISH (Qualifying degree: Masters in English Literature/Linguistics)

British and American Literature, Commonwealth Literature, Indian Literature, Feminist Theory and Literature, Postmodern Theory and Literature, Indian Writing in English, Critical Theory, Linguistic Theory, Cognitive Linguistics, Communication, Computational Linguistics, and Sociolinguistics.

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, Logic and Philosophy of Science.

PSYCHOLOGY

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

SOCIOLOGY

Sociological Theories, Research Methods and Social Statistics, Social Stratification and Social Change, Sociology of Development and Underdevelopment, Social Demography, Urban Sociology, Industrial Sociology, Sociology of Environment, Participatory Rural appraisal, Sociology of Education, Sociology of Science and Technology, Rural Sociology, Human Rights, Third sector (NGO) Research, Sociology of Religion.

FACILITIES

The Department has full access to the Computer Centre of the Institute. In the Department there are three academic laboratories. The Language Laboratory is a sophisticated one containing 32 booths. 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. Emphasis is being given to the modernization of these laboratories and provide them with latest equipment and facilities.

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.

MATHEMATICS & STATISTICS

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 front line areas of basic sciences as well as in interdisciplinary areas of science and technology.

The department currently has 34 faculty members who are engaged in research and teaching in various areas of Pure Mathematics, Applied Mathematics and Statistics. The faculty of the department aims to achieve high quality research and teaching standards in various disciplines of Mathematics and Statistics with flavor of unified approach towards both pure and applied aspects. The faculty of the department has also responded enthusiastically to the growing demands of research and teaching. As Mathematics and Statistics have penetrated 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 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 agencies are undertaken by the faculty.

FACILITIES

The Computer Centre of the institute provides E-mail, Web, DNS, FTP, Internet access, high performance computing and other services 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 a PC lab with high end Linux and Windows desktops that provide computing and remote access facilities exclusively to the department students. 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 students of the department and the collection in this library has come from retired faculty members, gifts from visitors, and complimentary copies of books from publishers.

Ph.D. PROGRAMME

In addition to a five year integrated M. Sc. Program in Mathematics & 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. Admissions to these Ph.D. programs are through qualification in GATE/NET followed by a departmental interview/test. These programs attract good students from all over India. Research work leading to the Doctorate 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 includes 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 285 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 70 research scholars working in state of the art research areas. Regular seminars keep everyone charged and updated. The Ph.D. students also actively participate in the teaching of core courses of U.G. Program (B. Tech, B.Tech-M.Tech Dual Degree and Five Year Integrated M.Sc. programs). This helps them in tuning their communication and teaching skills.

FACULTY AND THEIR AREAS OF RESEARCH SPECIALIZATIONS

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

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

Pravir K Dutt, Ph.D. (UC Los Angeles): Numerical Analysis, Fluid Mechanics
J Dutta, Ph.D. (IIT/Kgp): Non-smooth Optimization/Abstract Convexity and Global Optimization

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

S Ghorai, Ph.D. (Univ. of Leeds): Computational Fluid Dynamics, Mathematical Biology, Adaptive Unstructured grid.

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): Convex 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

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

A K Lal, Ph.D. (ISI Delhi): Coding Theory

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

A K Maloo, Ph.D. (Bombay Univ./TIFR): Commutative Algebra

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, Data Mining of Financial/Economic Time Series

Sharmishtha Mitra, Ph.D. (IIT/K): Order Statistics, Survival Analysis, Econometrics.

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

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

S R Patel, Ph.D. (Sardar Patel Univ.): Functional Analysis, Harmonic Analysis

V Raghavendra, Ph.D. (IIT/K): Non-linear Analysis, Differential and Integral Equations

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

S K Ray, Ph.D. (ISI Kolkatta): Harmonic Analysis on R and Lie groups

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

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

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

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

U B Tewari, Ph.D. (U C Berkeley): Functional Analysis, Harmonic Analysis

PHYSICS

The Department of Physics has at present 34 members in the Faculty, and one each of Distinguished Honorary Professor, Emeritus Professor and Visiting Faculty, and is assisted by a team of Chief Scientific Officer, Research Associates and Postdoctoral Fellows as part of the academic staff. There are around 90 Ph.D. scholars engaged in doctoral research.

The Department participates in the undergraduate Core courses in the B.Tech. programme and runs an exclusive Five-year (Integrated) M.Sc. course in Physics, making effective use of the features of the undergraduate Core programme, which includes basic and engineering sciences, workshop practices, courses on computation as well as courses on humanities and social sciences. The Department has Two-year M.Sc. programme as well as a Ph.D. programme with specialization in many major areas of Physics. The Physics Department 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 participates in the Laser Technology and the Materials Science programmes of the Institute. A brief description of the course structure for various programmes and courses is given in this bulletin.

The Department actively participates in front-line research in several major areas of Physics. There is a large group focusing on the physics of Condensed Matter in all its aspects, from strongly-correlated systems to biophysics to the physics of plasmas. Interests are more or less evenly divided between theoretical and experimental work, with strong cross-pollination of ideas between experiment and theory. This is particularly true in the developing fields of Nanotechnology, Bio-materials and Biological systems. There is also an increasing use of computational physics and insights of non-linear dynamics in a variety of systems cutting across many disciplines. There is a focused group on the applications of Nuclear Physics and Ion Beam techniques in studying materials, and engineering nano-structures. The High Energy Physics group has a wide-range of expertise ranging from the subtleties of renormalization in quantum field theories to down-to-earth numerical simulation of experimental processes and the analysis of vast quantities of statistical data. The Laser Physics and Quantum Optics group has interests ranging from laser ablation and laser synthesis of materials to quantum optics to medical applications of lasers.

FACULTY

S Banerjee, Ph.D. (TIFR, Mumbai), Condensed Matter Physics (Experiment)
S Bhattacharjee, Ph.D. (RIKEN, Japan), Condensed Matter Physics (Experiment)

K Bhattacharya, Ph.D. (SINP, Kolkata), High Energy physics (Theory)
R C Budhani, Ph.D. (IIT, Delhi), Condensed Matter Physics (Experiment)
D Chakrabarti, Ph.D. (Jadavpur, Kolkata), High Energy Physics (Theory)
D Chowdhury, Ph.D. (IIT, Kanpur), Condensed Matter & Statistical Physics (Theory)
S. Dhamodaran, Ph.D. (Hyderabad), Nuclear Physics (Experiment)
A Dutta, Ph.D. (SINP, Kolkata), Condensed Matter Physics (Theory)
T K Ghosh, Ph.D. (IMSc, Chennai), Condensed Matter Physics (Theory)
A K Gupta, Ph.D. (Kentucky), Condensed Matter Physics (Experiment)
R Gupta, Ph.D. (IISc., Bangalore), Condensed Matter Physics (Experiment)
M K Harbola, Ph.D. (CUNY), Condensed Matter Physics (Theory)
Z Hossain, Ph.D. (TIFR, Mumbai), Condensed Matter Physics (Experiment)
P Jain, Ph.D. (Syracuse), High Energy Physics (Theory)
S D Joglekar, Ph.D. (Stony Brook), High Energy Physics (Theory)
V N Kulkarni, Ph.D. (Marathwada), Nuclear Physics & Material Science (Experiment)
S Kumar, Ph.D. (IIT, Delhi), Condensed Matter Physics (Experiment)
Y N Mohapatra, Ph.D. (IISc, Bangalore), Condensed Matter Physics (Experiment)
S Mukherji, Ph.D. (IOP, Bhubaneswar), Condensed Matter & Statistical Physics (Theory)
A Pradhan, Ph.D. (CUNY), Laser Spectroscopy & Medical Applications (Experiment)
R Prasad, Ph.D. (Roorkee), Condensed Matter Physics (Theory)
K P Rajeev, Ph.D. (IISc, Bangalore), Condensed Matter Physics (Experiment)
S A Ramakrishna, (RRI, Bangalore), Condensed Matter Physics & Optics (Theory)
V Ravishankar, Ph.D. (Mysore), High Energy Physics (Theory)
D Sahdev, Ph.D. (Case Western), High Energy Physics (Theory)
T Sarkar, Ph.D. (IMSc, Chennai), High Energy Physics (Theory)
G. Sengupta, Ph.D. (IOP, Bhubaneswar), High Energy Physics (Theory)
K Shahi, Ph.D. (Gorakhpur), Condensed Matter Physics (Experiment)
A Singh, Ph.D. (Urbana-Champaign), Condensed Matter Physics (Theory)
V Subrahmanyam, Ph.D. (TIFR, Mumbai), Condensed Matter Physics (Theory)
R K Thareja, Ph.D. (Delhi), Laser Physics (Experiment)
H C Verma, Ph.D. (IIT, Kanpur), Nuclear Physics (Experiment)
M K Verma, Ph.D. (Maryland), Turbulence & Plasma Physics (Theory)
H Wanare, Ph.D. (Hyderabad), Nonlinear Optics (Theory)
EMERITUS PROFESSOR
S C Agarwal, Ph.D. (Chicago), Condensed Matter Physics (Experiment)
DISTINGUISHED HONORARY PROFESSORS
G K Mehta (NSC, Delhi), Nuclear Physics (Experiment)

VISITING FACULTY

S Auluck, Ph.D. (Chicago), Condensed Matter Physics (Theory)

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 Condensed Matter Physics, Nuclear Physics (Expt.), Dynamical Systems and Statistical Physics, Quantum Field Theory, High Energy Physics, Lasers and Laser Spectroscopy imaging and Bio-physics and a substantial degree of inter-disciplinary activity.

Students with good academic record and strong motivation for a career in Physics after earning Master's degree can apply for admission to the Ph.D. programme. 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, statistical mechanics, solid state physics and nuclear physics 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, Special Topics in Quantum Mechanics, Non-equilibrium Statistical Mechanics.

Physics of Soft and Bio-materials, Condensed Matter II, Magnetism in Materials, Computational Methods in Physical Sciences, Computer Simulations in Physics, 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, Elements of Bio and Medical Physics.

Lasers and Laser Spectra, Quantum Electronics, Coherence Optics, Nuclear Physics I, Quarks, Nucleons and Nuclei, General Relativity and Cosmology, Atmospheric Science I, Particle Physics, 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, Advanced Low Temperature Physics, High Energy Physics II.

FACILITIES

Low Temperature Laboratory: Nitrogen and Helium Liquefiers, Superconducting magnets, Closed cycle Helium Refrigerators, Experimental Setup for Resistivity, Hall Effect and Magnetic Susceptibility, Magnetoresistance, Specific Heat, Thermoelectric Power, Tunneling Conductance, Magnetostriction.

SQUID Facility: The Superconducting Quantum Interference Device (SQUID) based Magnetic Properties Measurement System (MPMS) is a highly integrated instrument system specified for experimental and materials characterization tasks

that require highest detection sensitivity over a broad temperature range (1.7K-350K) and in applied magnetic fields as high as 5 tesla (50,000 Gauss). It is configured to detect the magnetic moment of a sample of material, from which magnetization and magnetic susceptibility can be determined. The SQUID laboratory also has a complementary technique called the Physical Properties Measurements System (PPMS). The heart of this system is a 14 tesla (140,000 Gauss) superconducting magnet, which utilizes the hybrid Nb₃Sn and Nb-Ti superconducting technology. Additionally, the PPMS system has helium-3 fridge (He-3 a rare isotope of helium-4 which liquefies below the lambda transition of He-4). The lowest temperature that can be achieved with this option is 0.3 K. With such extremely large fields and low temperatures, the PPMS system offers unique opportunity to study quantum phase transitions in a variety of material systems.

Magnetism Laboratory: Mossbauer Spectrometer, Vibrating Sample Magnetometer, EPR Spectrometer with variable temperature accessory.

Laser Laboratories: Argon ion lasers, Ring Dye lasers, ND:YAG lasers, Excimer Laser, Home-made 100 W CO laser, Electron-Beam System, Double Monochromators, Photon Counters, Box Car Averagers, Vibration free tables. Facilities exist for High Resolution Spectroscopy, Raman and Micro-Raman Spectroscopy, Laser-Plasma Studies and Nonlinear Optics, Semiconductor Lasers and Biological imaging.

Ion Beam and Nuclear Techniques Laboratory: Focused Ion Beam System (Nova Lab 600) for Nano Microfabrication. A modern 1.7 MV Tandemron accelerator with capabilities of producing ion beams of all most all elemental species. The facility is equipped with a nuclear microprobe station for science and engineering application such as proton and heavy ion beam writing, RBS, PIXE and ion Channeling E-beam deposition, Positron Annihilation, Mossbauer Studies at Low Temperatures.

Computational Facility: The Department has a computer lab with many high-end Pentiums and dedicated server. High performance computing facilities based on modern clusters are being installed in the Department. The Computer Centre, a central facility at the Institute has two super computers (IBM-SP2, PARAM) in addition to many workstations and pentiums.

Condensed Matter Physics, Low Dimensional Systems Laboratory: Pulsed Excimer Laser ablation facility for synthesis of magnetic, superconducting and dielectric superlattices. Transport measurements at low temperature (4.2K) and high field (4 Tesla). High frequency measurements of vortex dynamics in superconductors. Laser based pump – probe measurements, non-equilibrium dynamics in

Semiconductor Laboratories: Well equipped facilities have been setup for optoelectronic characterization of semiconductor materials and devices. State of the art search facilities for organic semiconductors are available.