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:

- Power and Control
- Signal Processing, Communications and Networks
- RF Engineering and Photonics
- 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.** For detailed information regarding eligibility and minimum qualifications, applicants should refer to http://www.iitk.ac.in/doaa/admissions.html and http://www.iitk.ac.in/ee/adm-pg-2009/MTech-2009-info-brochure.pdf

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, SYNOPSYS, 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.