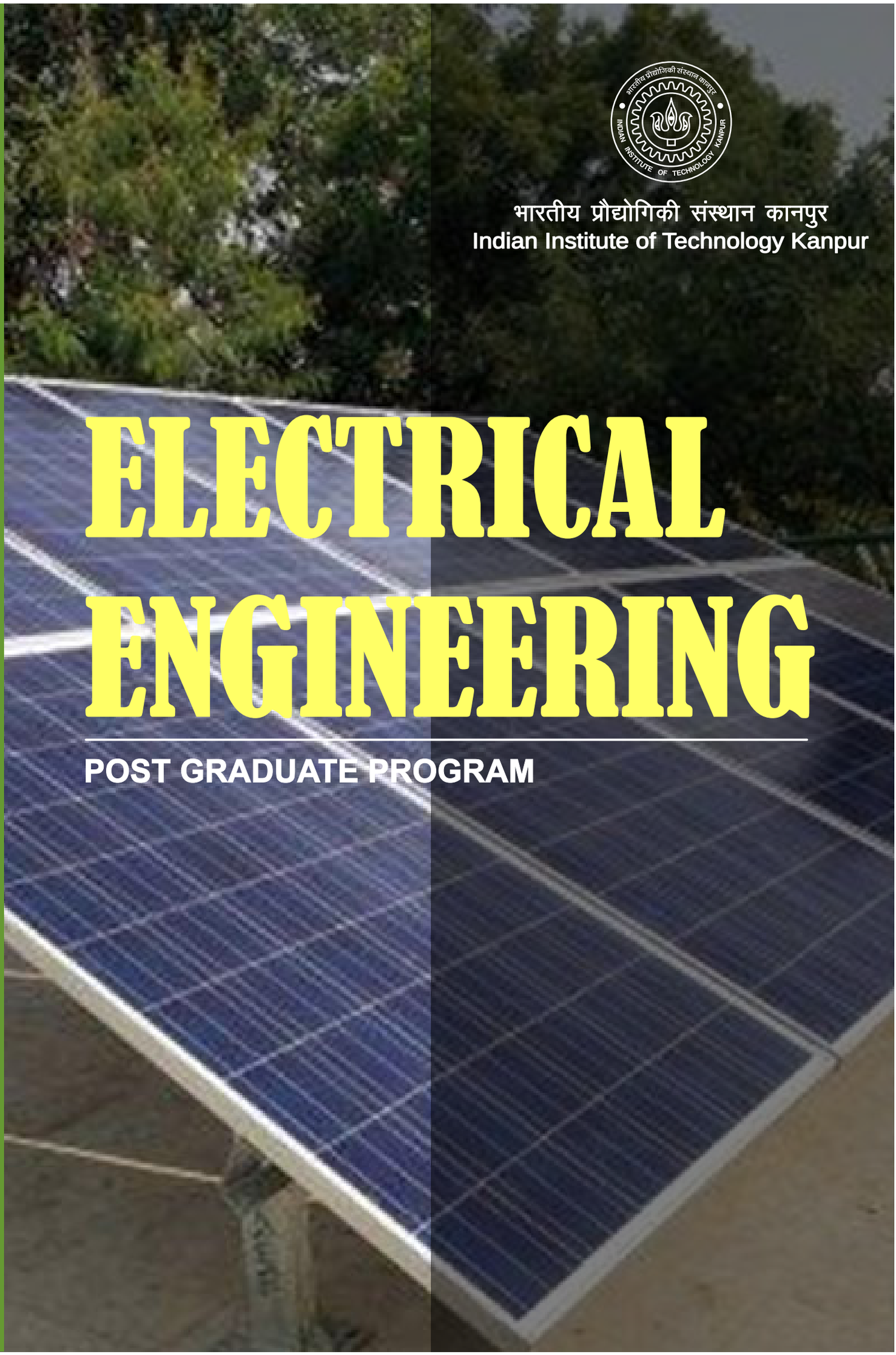

भारतीय प्रौद्योगिकी संस्थान कानपुर
Indian Institute of Technology Kanpur

ELECTRICAL ENGINEERING

POST GRADUATE PROGRAM

ELECTRICAL ENGINEERING

The Department of Electrical Engineering (www.iitk.ac.in/ee/) offers M.Tech, MS(R), and Ph.D programmes in almost all the sub-disciplines of Electrical Engineering. The areas include: Information and Coding Theory; Telecom and Wireless Networks; Peer-to-peer networks; Digital Switching Systems; 5G/ 6G Wireless Technologies; Digital Signal and Image Processing; Computer Vision; Inverse Problems and Tomography; Signals and Systems Theory; Control Systems and Robotics; Networked Control and Electric Vehicle Control; Electronic and Virtual Instrumentation; Fuzzy Logic; Neural Networks and their applications; Power Systems Economics; Optimization; Electricity Market; Power System Protection; HV Dielectrics and Insulation; HVDC & FACTS, Power Quality; Smart Grids and Synchrophasors; Power Electronics; Electric Drives; Active Power Filters and Static VAR Systems; Renewable Energy Interfaces; Microgrids; Microelectronics; VLSI System Design; Analog and Digital Circuit Design; Semiconductor Device Modelling and Simulation; Solid State Devices; Nano-electronics and Nano-scale Devices; Organic Electronics; Flexible Electronics; Photovoltaics; Electromagnetics; RF Engineering and Microwaves; Antennas, Metamaterials; MMIC; RF and Microwave Sensors; RFID; Microwave and Mm-wave Imaging; RF Energy Harvesting, Electromagnetic and Tomographic Imaging; Terahertz Imaging and Testing; Nanophotonics, Plasmonics, Quantum Dot based Devices; Optoelectronics; Signal processing for fiber-optics; Nonlinear fiber optics; Fiber-optic sensors; Quantum Cryptography and Quantum Optics; Spin waves; Photonic Networks and Systems.

POST-GRADUATE PROGRAMMES OFFERED

In the application form for M.Tech., the applicants must specify their choice of area(s) of specialization/code number mentioned above. Please note that the candidates must use only those code numbers given at the end of this section while filling up application form for Ph.D. programme. 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 website of the Dean of Academic Affairs (www.iitk.ac.in/doaa/). Candidates are also advised to check http://www.iitk.ac.in/ee/admissions for regular updates on EE admissions.

M.Tech.

In M.Tech. programme, a student takes eight courses, some of which may be compulsory for the area of specialization chosen, the rest being electives to be chosen in consultation with the programme advisors. The programme also includes a research/project component, which culminates in a thesis.

MS®

In MS(R) programme, a student has to complete a minimum of four courses in the area chosen by the student in consultation with the thesis advisor. After completing the course work, the student is expected to do research work leading to a thesis. Focus on research makes this program exciting and provides in-depth knowledge to the student.

Ph.D.

In the Ph.D. programme, a student with M.Tech qualification has to complete minimum of four courses and a student with B.Tech. qualification has to complete minimum of ten courses. The most important part of the doctoral programme is the research work leading to a thesis. Student works on exciting research problems to come up with innovative/original ideas.

Specialization in the M.Tech/MS(R)/Ph.D. Programmes is available in any of the following broad areas:

- Microelectronics and VLSI **(Code: 01)**
- Power Engineering **(Code: 02)**
- RF and Microwaves **(Code: 03)**
- Signal Processing, Communications and Networks **(Code: 04)**
- Control and Automation **(Code: 05)**
- Photonics **(Code: 06)**

LABS/FACILITIES

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

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

Three teaching/training labs have been developed to train students in areas related to organic electronics. These are the organic electronics processing lab, the organic electronics characterization lab and the organic electronics simulation lab.
Robotics lab equipped with 7 DoF manipulators, mobile robots, and visual systems for autonomous navigation of mobile robots, multi-robot formation and control. Control system lab with facilities for microprocessor-based control of PMDC motors, multi-motor coordination, networked control and control of electric vehicles.
Distributed Systems and Control (DiSCo) Lab is equipped with quadcopters, fixed wing UAVs, flight simulator, processor-in-loop testing facility for quadcopters, simulation of multi-agent systems.

The Dynamics and Control Lab focuses on the multidisciplinary aspects of control theory and engineering, primarily in systems and synthetic biology, microrobotics, and power system control. The lab is equipped with state-of-the-art molecular biology equipment to design genetic constructs and characterize their performance both in vivo and in vitro. It also features micro/nano robots, along with a magnetic manipulation system, simulation and computational platforms to carry out control engineering analysis and design.

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 static control laboratory with solid state control of electric drives; Power systems simulation laboratory equipped with Six Racks Real Time Digital Simulation (RTDS), Opal-RT and other modern simulation tools; NAMPET laboratory with complete fabrication and testing facilities for research in power electronics including frequency response analyzer, solar photovoltaic panels. Power management lab with solar simulator, frequency response analyzer, electronic loads and fabrication facility.

RF and Microwaves lab having network analyzers up to 67 GHz, spectrum analyzers, signal generators, power meters, noise figure meter, shielded anechoic chamber for antenna and RCS measurements, microwave imaging and material testing facility over a wide frequency range, dielectric probe kit, rectangular waveguide and coax calibration kits for various frequency bands.
Fiber optics laboratory equipped with optical spectrum analyzer (600 nm-2000 nm) and interface development facility for fiber optic links, clean room for semiconductor

LABS/FACILITIES

optoelectronic device fabrication and photonic measurement laboratory.

In addition, Advanced Fiber optics laboratory has WDM optical components, semiconductor optical amplifiers, single-mode standard and nonlinear fibers, Sampling oscilloscope (optical 40 GHz and electrical 65 GHz bandwidth), electronics to enable experiments on 40-100G optical links.

Networks laboratory with scalable and configurable test-bed for simulating complex network topologies, 802.11 WiFi links, software radio, multiservice network and QoS, etc. Wireless Communications laboratory is equipped with NI USRPs platform.

Quantum Photonics Research Laboratory is equipped with optical characterization facility, comprising of a home-built microscope attached to a high-resolution spectrometer and a CCD camera, for testing nanophotonic and plasmonic devices, and FDTD simulation tools for designing these devices.

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

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

5G testbed Lab is developed to build the testbed that closely resembles a real-world 5G deployment. The testbed will deliver an end-to-end 5G testbed comprising of 5G BS and UE nodes that support enhanced mobile broadband (eMBB), Ultra low latency communication (URLLC) and massive MTC including NBIoT services. This testbed could become a basis for many commercial deployments.

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

FACULTY LIST

- **Akhtar M J, Ph.D. (Magdeburg):** Microwave, mm-wave and THz imaging and nondestructive testing, RF Sensors, Artificial dielectrics and metamaterials, Wideband microwave absorbers, Microwave material processing, UWB antennas, Microwave filters, Electromagnetic and multi-physics modelling, RF energy harvesting, Interaction of electromagnetic waves with biological tissues.
- **Arora V, Ph.D. (IITK):** Audio signal processing, machine learning, automatic speech recognition, music information retrieval
- **Banerjee A, Ph.D. (Notre Dame):** Green communications, Cognitive radio, Error control coding, Wireless communications and Visible light communications.
- **Battula, Swathi, Ph.D. (Iowa State University):** electricity markets, modelling and design of electrical energy systems, energy policy and management.
- **Behera L, Ph.D. (IITD):** Intelligent control; Soft computing; Quantum computing and Information; Applied nonlinear control
- **Bhagat N R, Ph.D. (University of Houston):** Neural & Bio-signal processing, Medical Instrumentation, Brain-machine interfaces, Functional Electrical Stimulation, and Rehabilitation Engineering
- **Biswas A, Ph.D. (IITD):** Electromagnetics; Microwave and millimeter wave circuits and techniques; Optical guide structure and RFICs
- **Bose A, Ph.D. (IITB):** Spin-based electronics, Fabrication and characterization of nanoscale devices, 2D material heterostructure, topological quantum materials, generation of unconventional spin current, altermagnets, MTJs, spin-caloritronics, spin-orbitronics, spin-mechatronics, chiral spin textures among others.
- **Budhiraja R Ph.D. (IITM):** Applications of linear algebra, information theory and optimization to study problems in wireless communications, massive MIMO, cooperative communications, 5G algorithm design, building communication systems
- **Chakrabarti S, Ph.D. (Newfoundland):** Power system dynamics and stability; Power system state estimation; Synchrophasor applications in power systems; Power system reliability.
- **Chaturvedi A K, Ph.D. (IITK):** Communication theory and systems; Mobile communications; Spread spectrum systems.
- **Chaudhary R K, Ph.D. (IITK):** Reconfigurable Metamaterial/ Metasurface Antenna, Multifunctional MIMO-Cognitive-Radio Antenna, Phased Antenna Array, Dielectric Resonator Antenna, mmWave Circuits, Frequency Selective Surfaces and Intelligent Reflecting Surface.
- **Chauhan Y S, Ph.D. (EPFL):** Nanoelectronics; Compact modeling of semiconductor devices; Low and high frequency electrical characterization; Atomistic Simulation; RF Circuit Design.
- **Chithra, Ph.D. (IITM):** Analog and mixed-signal VLSI design, digital VLSI design, frequency and phase synthesis, time-to-digital converters
- **Das S P, Ph.D. (IITKGP):** Power electronics; Electric drives; Electrical machines; Microprocessor and microcontroller systems
- **Das U, Ph.D. (Michigan):** High speed photonic semiconductor devices and integrated optoelectronics.
- **Dey R, Ph.D. (UT Austin):** Topological Insulators, Transition Metal Chalcogenides and Di-Chalcogenides, Fabrication, Characterization and Analysis of micro and nano devices.

FACULTY LIST

- **Dutta A, Ph.D. (Louisiana State):** Semiconductor device modeling; IC fabrication tehnology, Analog/digital/mixed-signal VLSI circuits.
- **Gupta A K, Ph. D. (UT Austin):** Wireless Communications, Stochastic Geometry and Numerical Methods.
- **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. (UMCP):** Nanophotonics; Plasmonics; Quantum optics; Quantum dot based Devices.
- **Gururaj Mirle Vishwanath, Ph.D. (IITR):** Renewable penetration challenges to the grid, Machine learning applications to power systems, EV interfacing challenges
- **Harish A R, Ph.D. (IITK):** Antennas; RF Engineering; Electromagnetics.
- **Hegde R M, Ph.D. (IITM):** Multimedia information processing; Speech signal processing; Array processing; Application of signal processing in wireless networks.
- **Iyer S S K, Ph.D. (Berkeley):** Organic solar cell; semiconductor devices.
- **Jagannatham A K, Ph.D. (UCSD):** 5G/ 6G Wireless Technologies, Massive MIMO, mmWave MIMO, Non-Orthogonal Multiple Access (NOMA), OTFS (Orthogonal Time Frequency Space) Modulation, THz, IRS, VLC.
- **Jerripothula K R, Ph.D. (NTU Singapore):** Computer Vision, Artificial Intelligence & Machine Learning, Multimedia Signal Processing, Image Processing, and Healthcare Informatics.
- **Kant P, Ph.D. (IITD):** Multi-winding transformers for multi-pulse AC-DC converters, Multi-level inverters for medium voltage/power applications, Modulation techniques for voltage source inverters, Medium voltage drives, Power electronics, Electrical machines and drives, Electric vehicle drive system.
- **Lahgere A, Ph.D (IITD):** Semiconductor Devices, Compact Modeling, Emerging CMOS Devices, Emerging Volatile-Nonvolatile Memory, Variation, PPA Benchmarking, Analog/RF, and Neuromorphic computing.
- **R.S. Ashwin Kumar, Ph.D. (IITM):** Analog & mixed-signal integrated circuits and signal processing
- **Mazhari B, Ph.D. (Illinois):** Semiconductor device modeling and fabrication; VLSI design; Transducers and sensors.
- **Mondal I, Ph.D. (IITM):** Analog Integrated Circuit Design
- **Mondal Washim Uddin, Ph.D.(IIT Kharagpur):** Reinforcement Learning, Game Theory,Network Economics, Wireless Communication
- **Mohapatra A, Ph.D. (IITD):** Optimization for operation and planning of power networks; AC and DC microgrid protection; Stability, security and control of power networks with renewable resources.
- **Naik N, Ph.D. (IISC):** Reconstruction and analysis approaches to tomographic problems; Numerical solutions for wave propagation; Sub-surface imaging.
- **Patel A, Ph.D. (IITD):** Control and Dynamical Systems in Biology, Systems and Synthetic Biology, Microrobots, Robust Control Theory, and Wide-Area Control of Power Systems.
- **Potluri R, Ph.D. (Kentucky):** Control system theory; Practical applications of control theory; Electric vehicles; Networked control systems; Consensus and Cooperation.

FACULTY LIST

- **Poluri N, Ph.D. (The University of Sheffield):** Design of broadband power amplifiers and front-end modules, Power amplifier linearization techniques, and phased array systems.
- **Pradeep Kumar K, Ph.D. (IITM):** Signal processing for Optical Communications, Non-linear fiber optics; Quantum cryptography; Fiber-optic sensors, Spin Waves.
- **Rajawat K, Ph.D. (Minnesota):** Optimization Algorithms, Network Optimization, Signal Processing in Networks, Online Machine Learning.
- **Rajshekhar G, Ph.D. (EPFL):** Biomedical Optics; Light Microscopy; Optical Metrology; Digital Holography.
- **Ray Debdatta, Ph.D.(EPFL, Switzerland):** Nanophotonics, nanofabrication (with and without lithography), optical metasurfaces
- **Rituraj, Ph.D. (Stanford):** Nanophotonics, optoelectronic devices, quantum optics and waveguide quantum electrodynamics.
- **Sahay S, Ph.D. (IITD):** Hardware Platforms for Neuromorphic Computing, Hardware Security Primitives, Novel Device Architectures for Scaling CMOS Technology, Analytical and Compact Modeling of Semiconductor Devices, Non-volatile Memories, and Spintronics.
- **Samanta S., Ph.D. (Concordia):** Power Electronics, Electric Vehicles, Wireless Power Transfer, Resonant Converters with WBG devices.
- **Sahoo S R, Ph.D. (IITB):** Linear and Nonlinear systems, Adaptive Control, Time-delay systems, Control of unmanned vehicles, Multi-agent systems and coordinated control, AC and DC Microgrids.
- **Sandhan, Tushar, Ph.D. (SNU, Seoul):** Computer vision, Machine learning and Robotics
- **Sensarma P, Ph.D (IISc):** Power electronic converters; Power quality; FACTS devices; Renewable energy delivery systems; Motor drives.
- **Sharma A, Ph.D. (IITK):** Power Systems, Smart Grid Technology, State Estimation, IT Application into Power Systems, Smart City, Multi-Agent Systems, Wide Area Monitoring & Control of Power System, Energy Market, Demand Response Management, Internet of Things.
- **Singh S N, Ph.D. (IITK):** Power system restructuring; FACTS technology; Optimal power dispatch and security analysis; Power system dynamics, operation and control; Power quality; Application of genetic algorithms and artificial neural networks in power systems; Wind power.
- **Singh Y N, Ph.D. (IITD):** Telecommunication networks; Optical communications; Optical networks; Digital switching systems; Wireless networks; Wireless sensor networks; P2P networks.
- **Srivastava K V, Ph.D. (IITK):** Metamaterials, Microwave Antennas, Printed Antennas, MIMO Antennas, Microwave Metamaterial Absorbers, Microwave Cloaking, Finite-Difference Time-Domain (FD-TD) Technique.
- **Swamy S P, Ph.D. (IITM):** Wireless Networks, Artificial Intelligence and Probabilistic Graphical Models.
- **Tripathy T, Ph.D. (IITB):** Guidance of autonomous vehicles, Formation control problems in multi-agent systems, Study of nonholonomic systems, Missile guidance
- **Vasudevan K, Ph.D. (IITM):** Communication systems; Signal processing for communications.
- **Venkatesh K S, Ph.D. (IITK):** Signal/Systems theory, Image and video

FACULTY LIST

processing; Computer vision applications.

- **Verma A, Ph.D. (Notre Dame):** Epitaxial growth and characterization of semiconductor thin films, Semiconductor Device Design and Fabrication, Electron Transport measurements and modelling.
- **Verma, A R, Ph.D. (IISc Bangalore):** High Voltage Engineering, Dielectrics and Electrical Insulation, Computational Electrostatics, Polymeric Insulation for High Voltage Application, Over-voltages in Power Systems
- **Verma N K, Ph.D. (IITD):** Big Data; Internet of Things/Cyber physical systems; Intelligent Data Mining Algorithms and Applications; Diagnosis and Prognosis of Rotating Machines; Soft-Computing in Modelling and Control; Machine Learning Algorithms; Computer Vision; Bioinformatics; Smart Grid; Intelligent Agents and their Applications; Intelligent Informatics; Fuzzy Controllers; Image frame generation; Brain Computer/Machine Interface.

BROAD RESEARCH AREAS

- Digital Communication Systems; Information and Coding Theory; Telecom and Wireless Networks; Peer-to-peer networks; Digital Switching Systems; 5G Wireless Communication Systems; Digital Signal and Image Processing; Computer Vision; Inverse Problems and Tomography; Signals and Systems Theory;
- Control and Dynamical Systems and Robotics; Networked Control and Electric Vehicle Control; Electronic and Virtual Instrumentation; Fuzzy Logic; Neural Networks and their applications;
- Power Systems Economics; Optimization and Markets; Power System Protection; HVDC & FACTS, Power Quality; Smart Grid and Synchrophasors; Power Electronics; Electric Drives; Active Power Filters and Static VAR Systems; Renewable Energy Interfaces;
- Microelectronics; VLSI System Design; Analog and Digital Circuit Design; Semiconductor Device Modeling and Simulation; Solid State Devices; Nano-electronics and Nano-scale Devices; Organic Electronics; Flexible Electronics; Photovoltaics;
- Electromagnetics; RF Engineering and Microwaves; Antennas, Metamaterials; MMIC; RF and Microwave Sensors; RFID; Microwave and Mm-wave Imaging; RF Energy Harvesting, Electromagnetic and Tomographic Imaging; Terahertz Imaging and Testing;
- Nanophotonics, Plasmonics, Quantum Dot based Devices; Optoelectronics; Signal processing for fiber-optics; Nonlinear fiber optics; Fiber-optic sensors; Quantum Cryptography and Quantum Optics; Spin waves; Photonic Networks and Systems.

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ELECTRICAL ENGINEERING DEPARTMENT

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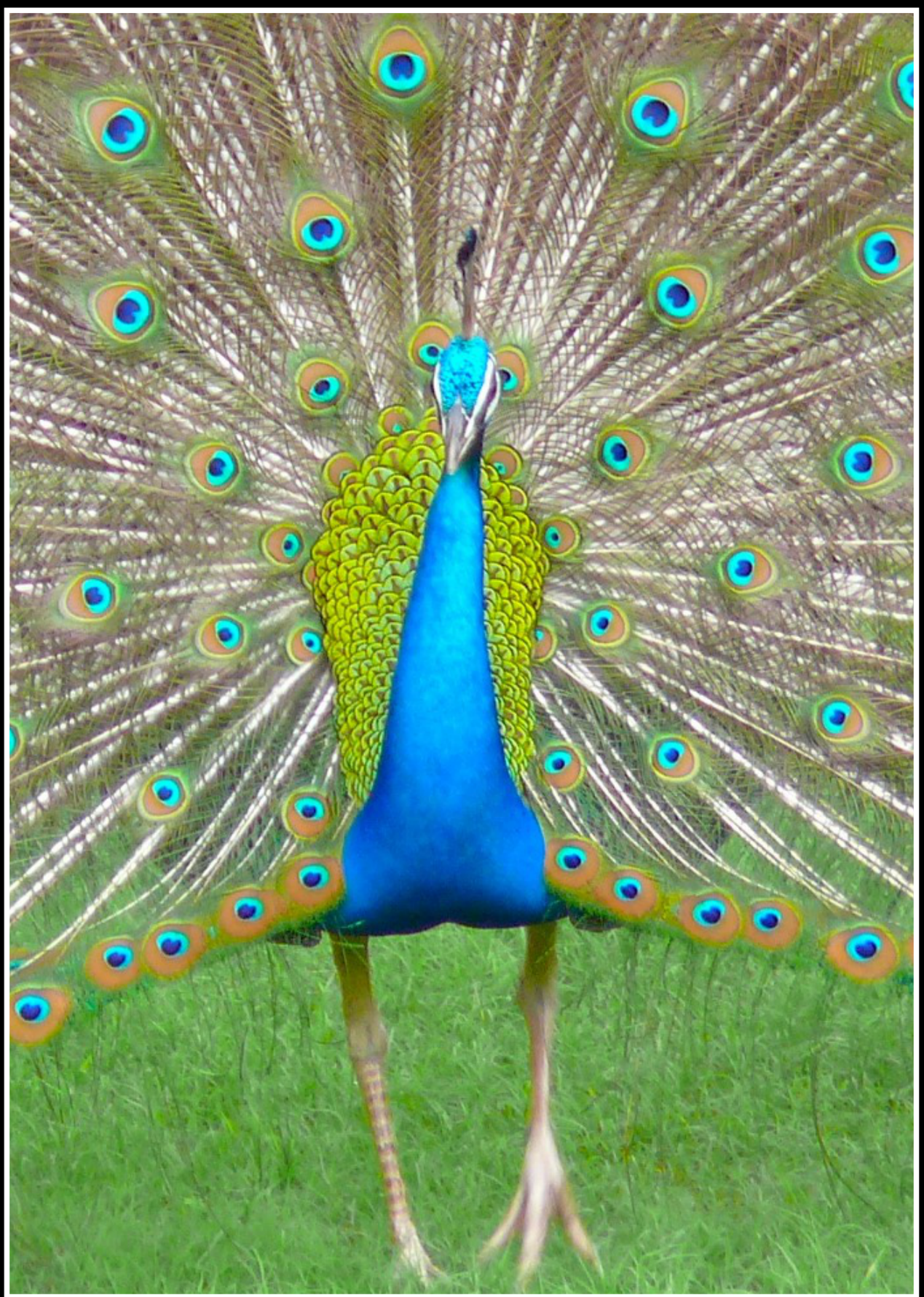

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