Postgraduate Courses of the Department of Electrical and Electronic Engineering

EEE 6000: Thesis (for PhD: 45 Credits. for M.Sc. Engg.: 18 Credits)/ Project (for M.Engg.: 6 Credits)

EEE 6001: Engineering Analysis
3 Credits
Wavelet transform. Chaos and bifurcation theorems Walsh function. Green's function. Finite element techniques. Fuzzy logic. Genetic algorithms,

EEE 6002: Selected Topics in Electrical and Electronic Engineering
3 Credits
Course contents to be decided by the course teacher with the approval of the Board of Postgraduate Studies (BPGS) of EEE Dept.

EEE 6101: Nonlinear System Analysis
3 Credits

EEE 6102: Artificial Neural Systems
3 Credits

EEE 6201: Information and Coding Theory
3 Credits
EEE 6202: Advanced Telecommunication Engineering
3 Credits
Telephone transmission, switching, networks, ITU recommendations. Communication links: coaxial, line-of-sight (LOS) links, tropospheric scatter, millimeter wave links, fibre optic links, HF, VHF and UHF radio systems. Local area network (LAN), fibre distributed data interface (FDDI), MAN, WAN, frame relay, narrow-band ISDN (NISON), switched multi-megabit data services (SMDS), broadband ISDN (BISDN). Mobile cellular communication systems: FDMA, TDMA, CDMA, satellite communication systems.

EEE 6203: Digital Signal Processing
3 Credits

EEE 6204: Optical Fibre Communication
3 Credits
Optical fibres; modes of propagation, transmission characteristics, waveguide analysis, Optical sources: light emitting diode (LED) and semiconductor laser diode (SLD), operational principles, characteristic curves, optical transmitter design, using LED/SLD. Optical amplifiers: laser and fibre amplifiers. Photodetectors: P-i-N and avalanche photodetectors [APDs], noise sources. Optical modulation and detection schemes, Direct and coherent detection, configuration, 0 peratton, noise sources, sensitivity calculation, performance curves. Design of analog and digital receivers. Transmission link analysis, point-to-point and point-to-multi-point links, system configuration, link power budget, rise time budget, line coding schemes, transmission system limitations, design of fibre-optic systems, Optical data buses, optical networks, fibre distributed data interface (FDDI) and synchronous optical network (SONET), Optical frequency division multiplexing (OFDM) and wavelength division multiplexing (WDM) transmission systems.

EEE 6301: Power Semiconductor Circuits
3 Credits
Static switching devices, characteristics of SCR, BJT, MOSFET, IGBT, SIT, GTO, MCT, Classifications of static power converters and their applications, Control
circuits for static power converters. Pulse width modulation; PWM control of static power converters. Switch mode DC to DC converters, resonant converters. Fourier analysts of static converter waveforms. HD, THD, pf, ZVS and ZCS of static converters. Hysteresis current control of AC drives.

**EEE6302: Design of Power Semiconductor Circuits and Drives**  
**3 Credits**  

**EEE 6401: MOS Devices**  
**3 Credits**  
The two terminal MOS structure: Oat-band voltage, inversion, properties of the regions of inversion and smallsignal capacitance. The four terminal MOS structure: charge-sheet model. strong inversion, moderate inversion and weak inversion. Threshold voltage-effects of ion implantation. short channel and narrow width. The MOS transistor in dynamic operation, small signal model for low, medium and high frequencies. Charge coupled devices (CCD).

**EEE 6402: Compound Semiconductor Devices**  
**3 Credits**  
Introduction to GaAs device technology. GaAs metal-semiconductor field effect transistor (GaAs MESFET): introduction, structure, equivalent circuits, current saturation, effects of source and drain resistances, gate resistance and applications of GaAs MESFET. High electron mobility transistor (HEMT): practical HEMT structure, energy band line-up, equivalent circuit, HEMT noise, pseudomorphic HEMT and applications. Optoelectronic integration of compound semiconductor devices: heterojunction phototransistor (HPT) and light amplifying optical switch (LAOS). Low-temperature compound semiconductor electronics. Design consideration of MMICs and power MMICs using compound semiconductor devices.

6403: Quantum Phenomena in Nanostructures  
**3 Credits**  
EEE 6404: VLSI Technology and Device Modelling
3 Credits

EEE 6405: VLSI Design
3 Credits
Overview of the design methodology: top-down design approach. technology trends and design styles. Brief review of MOS transistor theory: threshold voltage, body effect. V-I equations and characteristics, latch-up problem. Pass transistors and transmission gates. NMOS and CMOS inverter characteristics and noise margin. CMOS proce ssing technologies: design-labrcatton interface, layers of abstraction. CMOS design rules. CMOS circuit characteristics and performance estimation: resistance and capacitance, rise and fall times, delay, gate transistor sizing, power consumption. CMOS logic design: logic structures, electrical and physical design of logic gates. clocking strategies, I/O structures. Structured design methods: design styles. automated synthesis. circuit extraction, simulation and design rule checking (DRC). Design examples. CMOS subsystem design: adders and related functions, multipliers. memory systems, data paths, programmable logic arrays (PLAs), field programmable gate arrays (FPGAs).

EEE 6406: Testing VLSI Circuits
3 Credits
Design for testability: different techniques of enhancing testability, scan design techniques, built-in self test (BIST). Built-in current sensors (BICS) for IDDQ testing.
of CMOS circuits. Error detecting codes and self-checking circuits. Testable design of regular array architectures and PLAs: the concept of C-testability.

EEE 6501: Electric and Magnetic Properties of Materials
3 Credits


EEE 6502: Electronics of Solids
3 Credits
Crystal Structure: lattice types, basis, defects, reciprocal lattice, Miller indices. Free Electron Theory: Drude model and Sommerfield theory. Band Theory: Bloch's theorem and crystal momentum, the nearly free electron model, the tight binding model, band structures of Si and III-V semiconductors. Carrier Transport: Boltzmann transport theory, relaxation time approximation, high field transport and hot-carrier effects. Hall effect.

EEE 6503 Laser Theory
3 Credits

EEE 6504 Semiconductor Materials and Heterostructures
3 Credits
Solid state heterostructural LED and LASER. Optoelectronic functionality in silicon chip. Structural and electrical study of heterojunction bipolar transistor (BBT), heterojunction avalanche photodiode, and silicon-germanium MOSFET.

EEE 6601: Applied EM Theory
3 Credits
Generalized approach to field theory: introduction to reaction concept, wave propagation through isotropic, anisotropic, and gyrotroptic media. Scattering of EM Waves. Microwave antennas-theory and design. Advanced topics in EM theory.

EEE 6602: Microwave Theory and Techniques
3 Credits

EEE 6603: Microwave Tubes and Circuits
3 Credits

EEE 6604: Antennas and Propagation
3 Credits

EEE 6605: Microwave Solid State Devices and Circuits
3 Credits
Introduction to N port networks for lossless junctions. Resonant circuits and different types of resonators. Modern microwave transmission lines and microwave integrated circuits (MICs): TEM, quasi TEM and non TEM type MIC lines, microstrip lines. Microwave passive devices: directional couplers, hybrid junction/magic T. Wilkinson power divider, microstrip line filters, isolators, phase shifters, attenuators. Microwave amplifiers and oscillators.
EEE 6701: Nonlinear Control Systems
3 Credits

EEE 6702: Sampled Data Control System
3 Credits

EEE 6703: Modern Control Theory
3 Credits

EEE 6801: Generalized Machine Theory
3 Credits

EEE 6802: Special Machines
3 Credits
Course will be broadly on current research topics on electrical machines and devices. The following areas will be covered: permanent magnet machines. hysteresis machine. eddy current torque devices; homopolar machines. PAM motors, and reluctance machines.

EEE 6803: Advanced Machine Design
3 Credits
General treatment of Electrical Machine Design. Review of standard procedures in design of DC machines, AC machines. transformers and special machines. Optimization and
synt hes is of de sign proce dures. Applications of material balance and critical path principles in electrical design. Design economics and safety factors. Applications of computer in modern designs including the operation of the machine in nonlinear ranges; Magnetic Dux-plots and heat transfer process, etc. Mechanical design of electrical machinery and relation between mechanical and electric machine design.

EEE 6901: Optimization of Power System Operation
3 Credits
General principles of optimization, its application to power system planning, design and operation. Probability analysis of bulk power security and outage data. Economic operation of power system-economic operation of thermal plants, combined thermal and hydro-electric plants. Theory of economic operation of interconnected areas. Development and application of transmission loss formulae for economic operation of power systems. Method of optimum scheduling and dispatch of generators.

EEE 6902: Computer Methods in Power System Analysis
3 Credits

EEE 6903: Advanced Protective Relays
3 Credits

EEE 6904: Power System Stability
3 Credits
EEE 6905: Transients in Power Systems  
3 Credits  
Transients in simple electric and magnetically linked circuits, fundamentals; impacts of switching on rotating machinery. Parallel operation of interconnected networks: distribution of power impacts. Interaction of Governor's in power systems. Overvoltage during power system faults. Systems voltage recovery characteristics. Effect of arc restriking on recovery voltage. Switching surges and overvoltage arrester requirements. Overvoltage caused by sudden loss of load and by open conductor.

EEE 6906: Reliability of Power System  
3 Credits  

EEE 6907: Power System Planning  
3 Credits  

EEE 6908: Advanced Power System Control  
3 Credits  
Overview of requirements and constraints, real time operation and monitoring in power system: supervisory control and data acquisition (SCADA). Energy management system (EMS): on-line application functions: state estimation, short term load forecasting, unit commitment, automatic generation control (AGC), load frequency control (LFC) and security control. Open architecture EMS. On-line algorithm's speed enhancement: sparsity exploitation. fast decoupling, model/system decomposttton, parallel processing/hierarchical computer and array processor configuration, application of expert system, pattern recognition, artificial neural network (ANN), fuzzy logic and genetic algorithms. EMS in the context of deregulation of utilities and independent system operator (ISO).
EEE 6909: Energy Conversion
3 Credits
Energy conversion processes: general introduction, energy sources, principles of conservation of energy balance equations. Direct electrical energy conversion: introduction: magnetohydrodynamic (MHD); fuel cell; thermoelectrostatic; ferroelectric; photovoltaic, electrostatic and piezoelectric energy conversions: characteristics including efficiency, power density, terminal properties and limitations. Electromechanical energy conversion: general introduction of electrical to mechanical, mechanical to electrical and electrical to electrical conversions. Bulk energy conversion devices. General Formulations of equations: coordinate transformation and terminal characteristics.

EEE 6910: Modern Power System Modelling
3 Credits