Department of Electrical & Electronics Engineering

Department of Electrical & Electronics Engineering established in the year 1960 is one of the oldest departments of MIT Manipal. The core competence of the department is in the areas of Lighting & Energy Studies, Power & Control systems, Power Electronics & Drives and Microelectronics & Embedded Systems. The faculty members actively participate in consultancy, testing and research work. The department has successfully organized national & international level conferences on Advanced energy conversion Technologies (AECT) for the last six successive years.

Academic Programmes Offered

- B.Tech. in Electrical & Electronics Engineering (since 1960)
- M.Tech. in Energy Management, Auditing & Lighting (since 1989)
- M.Tech. in Power Electronic Systems & Control (since 2008)
- Ph.D.

The B.Tech. programme offers a unique mix of Electrical, Electronics and Computer related courses enabling the students to take up professional career / higher studies in any of these areas. The department has excellent link with leading industries like Schneider Electric, Bangalore, and jointly collaborated to set up an Advanced Energy Systems lab. The curriculum based on a credit scheme is updated periodically to reflect changes in the Electrical & Electronics profession in consultation with experts from industries and renowned academic institutions.

The M.Tech in Energy management, Auditing & Lighting (EMAL) offered by the Department of E & E is an advanced and broad based PG programme with the former PG course in Illumination Technology', duly modified. This PG program is designed to meet the academic requirements in the energy and Illumination Engineering fields and to train the students to assume responsibilities in the design, R & D and manufacturing areas of lighting industry and as ‘Energy managers’ in all the process industries. In the present context of acute energy crisis and the need to have good energy managers / auditors in every industry; there is wide scope for this PG program.

The objective of the program M. Tech in Power Electronic Systems and Control (PESC) is to cater to the increasing academic and industry needs of the specialized human resource requirement in the area of Power Electronics applications in Energy Conversion.

A wide range of elective subjects that covers the related areas of power electronics and energy conversion technologies are also offered so that the graduates develop the desire to get into the advanced design methodologies for different applications that includes power system operation and control, high frequency converter for solid state lighting, power supplies etc.

Facilities and Resources:

- Integrated Electronics Lab
- Circuits and Measurements Lab
- Electrical Machinery Lab
- System Simulations Lab
- Microcontroller & Embedded Systems Lab
- Energy System Simulations Lab - Research Lab 1
- Advanced Energy System Lab - Research Lab 2
- Power Electronics & Drives Lab
- Electrical Drives Lab - PG (PESC)
- Lighting Measurements & Calibration Lab - PG (EMAL)
- Advanced Research Lab
- Departmental Library
- Department Seminar room
Faculty List:

Professor & Head
Dr. Savitha G. Kini, Ph.D. (Jadavpur University)

Professors
Dr. Vinod V. Thomas Ph. D. (IIT Madras)
Dr. Chandrashekara Adiga S. Ph.D. (Manipal University)
Dr. Ciji Pearl Kurian Ph.D. (Manipal University)
Dr. B. K. Singh Ph.D. (Manipal University)
Dr. P. Giridhar Kini. Ph.D. (Manipal University)

Associate Professor Senior Scale
Mr. V. Nagaraj M.E
Mr. Mohan Kumar S. M.Tech
Mr. T. Sudheer Kumar S M.Tech.
Mrs. Jayalakshmi N. S. M.Tech.

Associate Professors
Dr. R. Shivarudraswamy. Ph.D (NITK, Surathkal)

Assistant Professor Selection Grade
Mr. Gururaja Rao H.V. M.Tech
Mrs. R. C. Mala M.Tech
Mrs. Vijayalakshi M.Tech
Mrs. Sandhyalaxmi G Navada M.Tech
Mr. Harish Kumar J. R. M.Tech
Mr. Shailesh K. R M.Tech
Mr. Laxman Rao S. Paragond. M.Tech

Assistant Professors Senior Scale
Mrs. Chandrika B. K. M.Tech.
Mr. K. Shankaranarayana M.Tech
Mr. James Antony Pinto. M.Tech

Mrs. Soubhagyaseetha N. M.Tech
Mrs. Bindu S. M.Tech (Ph.D)
Mrs. Bharathi R. B. M.Tech
Mr. Ganesh Kudva, M.Tech
Mrs. Susan G. Varghese M.Tech (Ph.D)
Mr. Sudheendra Prabhu M.Tech
Mr. Pramod Antony D’Sa M.Tech

Assistant Professors
Mrs. R. Srividya M.Tech
Ms. Swathi Tangi M.Tech
Mr. Vikas Kumar Jhunjhunwala M.Tech
Mr. Siddaraj M.Tech
Mr. Sarun Soman M.Tech
Mrs. Divya Shetty M.Tech
Mrs. Shwetha V. M.Tech
Mr. Siddhartha M.Tech
Ms. Ranjana G M.Tech
Mr. Adarsh S M M.Tech
Mr. Satyakum M.Tech
Mr. Vipin V M.Tech
Ms. Akshatha Lakshmi M.Tech
Mr. Lokes J M.Tech
Mrs. Sowmya R M.Tech
Mr. Vedavyasa Kamath M.Tech
Ms. Namrata Pai M.Tech
Mr. Vineeth Patil M.Tech
Ms. Geetha Krishnan M.Tech
Ms. Athulya Jyothi M.Tech
Ms. Shruthi Ramachandra M.Tech
Mr. Harshendra N. Shet K. M.Tech
Ms. Suprabha Padiyar U. B.Tech (on contract)
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Minor Specializations

I. Embedded Systems
1. ELE 4001: Embedded System Design
2. ELE 4002: FPGA Based System Design
3. ELE 4003: Embedded Processor Architecture
4. ELE 4004: Real Time Systems

II. Energy Management
1. ELE 4005: Advanced Energy Management
2. ELE 4006: Energy Auditing
3. ELE 4007: Lighting Science: Devices and Systems
4. ELE 4008: Power System Operation and Control

III. Energy Systems
1. ELE 4008: Power System Operation and Control
2. ELE 4009: Computer Techniques in Power System Analysis
3. ELE 4010: Modern Power Converters
4. ELE 4011: Solid State Drives

IV. Signal Processing & Control
1. ELE 4012: Advanced Digital Signal Processing
2. ELE 4013: Control System Design
3. ELE 4014: Applications of DSP
4. ELE 4015: Industrial Automation & Control

V. Business Management
1. HUM 4011: Financial Management
2. HUM 4012: Human Resource Management
3. HUM 4013: Marketing Management
4. HUM 4014: Operations and Systems Management

Other Programme Electives
1. ELE 4016: Building Automation Systems
2. ELE 4017: Computer Networks
3. ELE 4018: Data Structures & Algorithms
4. ELE 4019: Database Management Systems
5. ELE 4020: Electrical Machine Design
6. ELE 4021: HVDC & FACTS
7. ELE 4022: Lighting Controls: Technology and Applications
8. ELE 4023: Digital Control Systems
9. ELE 4024: Renewable Energy
10. ELE 4025: Smart Grid Technologies
11. ELE 4026: Soft Computing
12. ELE 4027: Solid State Lighting and Controls
13. ELE 4028: Utilization of Electrical Energy
14. ELE 4029: VLSI Design

Open Electives
1. ELE 3281: Analog & Digital Electronic Circuits
2. ELE 3282: Electric Drives
3. ELE 3283: Electrical Energy Systems
4. ELE 3284: Energy Auditing
5. ELE 3285: Energy Conversion Technologies
6. ELE 3286: Microcontrollers
7. ELE 3287: MATLAB for Engineers
8. ELE 3288: Lighting Design

THIRD SEMESTER

MAT 2102: ENGINEERING MATHEMATICS - III [2 1 0 3]

References:

ELE 2101: ELECTRICAL CIRCUIT ANALYSIS [2 1 0 3]

References:

ELE 2102: DIGITAL ELECTRONIC CIRCUITS [2 1 0 3]

References:
ELE 2103: ELECTRICAL MACHINERY - I [3 1 0 4]
Principle, Construction, phasor diagram, Equivalent circuit, Voltage Regulation, Losses and Efficiency, energy efficiency. Tests on single phase transformer, Inrush current, Harmonics Tap changing transformers, Auto transformer, 3 phase transformer operation, Scott connection.
Types of DC & AC windings, DC generator principle, Construction, Types of DC generators, Magnetization characteristic, Armature reaction, Commutation, Load characteristics

References:
1. P.S.Bimbhra, “Electrical Machinery”, (7e), Khanna publishers, 2012

ELE 2104: ELECTROMAGNETIC THEORY [2 1 0 3]
Electrostatics: Coulomb's law, Gauss's law, Divergence theorem, Electrical potential, Poisson's and Laplace's theorem and capacitance. Application Electrostatic Discharge (ESD), High dielectric constant materials
Time-varying field: Faraday's law, Displacement current, Maxwell's equations
Waves: Uniform plane wave, Poynting's Theorem, Skin effect, Normal and oblique Incidence. Application Microwaves

References:

ELE 2105: ANALOG ELECTRONIC CIRCUITS [2 1 0 3]
Junction Diode Characteristics and applications, MOSFET Characteristics, Uses of MOSFET, MOSFET biasing, Biasing requirements Current Mirrors, Current source, Current sink, Basic Amplifier Configurations, Cascade and Cascade configurations, Small signal model, high frequency model, frequency response of the CS, CD and CG configurations, Distortion in amplifiers, Large signal amplifiers, Basic Differential amplifier, Slow rate considerations.

References:

ELE 2111: ELECTRICAL CIRCUITS LAB [0 0 3 1]
Module I: Transient analysis of RL, RC, and RLC circuits using ODE solver; Simulation of linear models of mechanical and electrical systems using Simulink; data acquisition and analysis; curve fitting & interpolation, Converting MATLAB code to executable format; Familiarization of graphical design tools.
Module II: Electric circuit simulation using PSPICE Steady state & transient analysis of DC & AC circuits.

References:
3. www.mathworks.com

ELE 2112: INTEGRATED ELECTRONICS LAB - I [0 0 62]
Module II: Design and Testing of combinational circuits using gates, multiplexers, decoders, arithmetic circuits etc. Design and Testing of sequential digital electronic circuits such as counters, shift registers & sequence generators, sequence detectors etc.

References:
2. David Bell, “Electronic Devices and Circuits”, (5e), Oxford University Press.
References:

ELE 2201: SIGNALS AND SYSTEMS [2 1 0 3]

References:

ELE 2202: ELECTRICAL MACHINERY - II [3 1 0 4]
Operating principle of DC motors, Types, Characteristics, speed control, starters, Losses, Efficiency and testing
Principle of synchronous generator, Types, Construction, Field MMF, Armature windings, Emf equation, harmonic suppression, Modeling of alternator, Phasor diagrams, Armature leakage reactance, Armature reaction, Pre-determination of voltage regulation, Synchronization, Load sharing, Governor characteristics, Power angle characteristics, Synchronizing power and torque, effect of varying excitation, effect of varying the input torque, Alternator connected to infinite bus, Two reaction theory for salient pole synchronous generator
Construction, operating principle of synchronous motor, Starting methods, power input and power output as a function of torque angle, Synchronizing power and torque, Performance characteristics, V curves, Inverted V curves, Power and excitation circles, O-curves, Hunting, Natural frequency of Oscillations, power factor improvement by Synchronous motor.

References:

ELE 2203: DIGITAL SYSTEM DESIGN & COMPUTER ARCHITECTURE [3 1 0 4]
Digital implementation options, Digital system modeling: Domains, levels of abstraction, Introduction to Verilog: Behavioral, data-flow and Gate level modeling, Design case studies - combinational, sequential, FSM, arithmetic units. Verilog HDL Synthesis, Programmable ASICs, Programming Technologies
Introduction to Computer Architecture, Op code encoding techniques, Instruction Types and Addressing modes, Reduced Instruction Set Computers, Pipelining, I/O interfacing, Interrupts, Memory Organization, Data path design, Control path design, control unit optimization, Multiplication and Division algorithms.

References:

ELE 2204: ANALOG SYSTEM DESIGN [2 1 0 3]
Feedback amplifiers, Barkhausen criterion for sustained oscillation, Feedback Topologies for Controlled sources, Operational Amplifier Architecture, OPAMP in linear Mode, OPAMP under Positive and Negative feedback, Linear applications of OPAMP, Differential amplifier, Instrumentation amplifier, Voltage to current converter, Integrator, Differentiator, Phase shifter, Active Filters, Nonlinear applications of OPAMP, Zero Cross detectors, Comparator, Schmitt trigger circuits, Multivibrator circuits, Precision rectifiers, Clamping circuits, Peak detectors, sample and hold circuits, PLL, 555 timer, Analog Multipliers.

References:

ELE 2211: ELECTRICAL MACHINERY LABORATORY - I [0 0 3 1]
OC and SC tests on single phase transformer, Sumpner's test, Polarity tests and connection of single phase transformers as three phase bank, Parallel operation of single phase transformers, Scott connection, Open delta connection, No load and blocked rotor tests, Load test on three phase squirrel cage Induction motor, torque-slip characteristics. Load test on induction generator. Load test on Single Phase induction Motor.

References:
Fifth Semester

ELE 2212: Integrated Electronics Laboratory - II [0 0 6 2]
Module I: Design, Simulation and Testing of Operational Amplifier-based circuits in linear and nonlinear mode, Timer circuits.
Module II: Digital Circuit Design using Verilog HDL - Functional simulation and synthesis of the combinational and sequential circuits using Verilog HDL simulator and testing on FPGA demo boards.

References:

ELE 3101: Linear Control Theory [3 1 0 4]
Mathematical models: electrical, mechanical and electro-mechanical systems, block diagram reduction, signal flow graph, Mason’s gain formula; Time Response: transient response specifications of second order systems, steady state error, sensitivity; Stability: BIBO stability, Routh-Hurwitz criterion, Root locus plot; Frequency domain specifications; Frequency Response plots: Polar plots, Nyquist stability criterion, Bode plots; PI, PD & PID controllers; State Space Model: canonical forms, solution of state equation, controllability and observability, pole placement design; Lyapunov stability for LTI systems.

References:
5. Frazzoli, Emilio, and Munther Dahleh, 6.241J “Dynamic Systems and Control”, Spring 2011. (MIT Open Course Ware: Massachusetts Institute of Technology)

ELE 3102: Digital Signal Processing [2 1 0 3]
Review of time-domain and frequency domain properties of discrete-time signals and systems, Sampling in time and frequency domain. Discrete Fourier Transform - Linear convolution using DFT. Computation of DFT-Fast Fourier Transform, Decimation in time and Decimation in frequency FFT algorithms, Computational considerations. Digital Filters: Digital filter structures, FIR and IIR filters, finite word length effects. FIR filter design- FIR design by Fourier approximation, Window method, Frequency sampling method, Optimal FIR design, IIR filter design: Classical filter design using Butterworth and Chebyshev approximations, Impulse invariant and bilinear transformation methods, Frequency transformation technique for HP, BP and BS filter design, Direct design of IIR filters. Real time implementation of DSP algorithms.

References:

ELE 3103: Communication Systems [2 1 0 3]

References:

ELE 3104: Generation, Transmission & Distribution [3 1 0 4]
Introduction. General layout of a power system, voltage levels, conventional ways of generating electric power, computation of line parameters for single phase and three phase, line performance, need for reactive power compensation mechanical design of lines sag and tension calculation, overhead insulators, underground cables, corona.

References:

ELE 3105: Power System Analysis [3 1 0 4]
ELE 3106: MICROCONTROLLER BASED SYSTEM DESIGN [2 1 0 3]
Introduction to microprocessors and microcontrollers, general purpose and embedded systems, CISC and RISC architectures, 8051 microcontroller: Architecture, pin diagram, addressing modes, instruction set, programming, stack, subroutines, GPIO, timers, serial port, interrupts. Interfacing keyboard, LCD and DAC to 8051. ARM processor: Processor modes, visible registers, ARM and Thumb instruction sets, programming, stack, subroutine exceptions, pipelined architecture. NXPLPC21XX microcontroller: architecture, programming, timers, watchdog timer, ADC, interfacing DC motor, stepper motor and seven segment LED.

ELE 3111: ELECTRICAL MACHINERY LAB - II [0 0 3 1]
Magnetisation characteristics of DC generator. Load test on DC machines. Speed control of D.C. shunt motor. Tests on DC Machines. V- and inverted V-curves of synchronous machines. Measurement of 
X_s and X_1 of a salient pole synchronous machine. Predetermination of regulation of alternator.

ELE 3112: MICROCONTROLLER LAB [0 0 6 2]
Module I: Experiments using 8051 Microcontroller
Module II: Interfacing exercises using 8051 microcontroller
Module III: Experiments using ARM processor based microcontroller.

References:

References:
4. LPC21XX User Manual

SIXTH SEMESTER

HUM 4002: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [3 0 0 3]

ELE 3201: POWER ELECTRONICS [3 1 0 4]
Power Semiconductor Devices: SCR, Power MOSFET, IGBT- structure, characteristics, safe operating area, base/gate driver requirements, ratings, protection, GTO, Triac- structure, operation; Converter Topologies: single phase and three phase half and fully controlled bridge rectifiers-operation with different loads, triggering sequence, expression for voltage and current, THD, input power factor, effect of source inductance, inverter mode, dual converters; AC voltage regulators; DC-DC converters-buck and boost converters, quadrants of operation; DC-AC converters-circuit topologies, switching, harmonic spectrum, multi-level inverters; Principle of space vector modulation and soft switching.

References:

ELE 3202: MEASUREMENTS And INSTRUMENTATION [2 1 0 3]
Basic concepts of measurements - System configuration, calibration - Errors in measurements: Measuring instruments: Permanent magnet moving coil; Moving iron; and Electrodynamometer type Applications - Measurement of Resistance, Inductance & Capacitance: A.C. Bridges,

References:

ELE 3211: MEASUREMENTS AND INSTRUMENTATION LAB [0 0 6 2]
Design & implementation of measurement systems on microcontroller platform, Sensing power signals, Sensing ECG signal, Realisation of instruments such as voltmeter, ammeter, wattmeter, Design & Realisation of common analog signal conditioning blocks using Analog System design starter kit - ASLKv2010, Study of ADC & DAC, Real-time data acquisition, measurement & monitoring on Virtual instrumentation platform.

References:

ELE 3212: SYSTEM SIMULATION LAB [0 0 3 1]
Analyze and predict stability (absolute and relative) and performance of linear continuous time control systems. P, PI, PD and PID Control; Controller Design / tuning with SIMULINK; state feedback controllers, Implement real-time controllers to meet system performance specifications; Modelling and control of physical systems, System Dynamics with SIMSCAPE;
Analysis of Discrete-Time systems using MATLAB and SIMULINK; Design of IIR Filters and FIR filters and implementation using real time data; Rapid prototyping and code generation. Model based analysis of electrical machines.

References:
4. www.mathworks.com

SEVENTH SEMESTER

HUM 4001: ESSENTIALS OF MANAGEMENT [2 1 0 3]

References:

ELE4101: SWITCHGEAR AND PROTECTION [3 1 0 4]

References:

ELE 4111: POWER ELECTRONICS LAB [0 0 3 1]

References:
ELE 4112: ADVANCED ENERGY SYSTEMS LAB [0 0 3 1]

Module I:
Experiments onY Bus formation, analysis of Short, Medium and long transmission lines using ABCD constants, Load flow analysis using Gauss Seidel and Newton Raphson methods, Transient Stability Analysis, Short Circuit Fault Analysis, Power quality studies and relay coordination using MATLAB, MiPower / PSCAD software packages.

Module II:
Experiments on Numeric over current Relay, Smart Energy meter, Solar simulator

References:
3. MiPower and PSCAD user manuals.

EIGHTH SEMESTER

ELE 4297: SEMINAR
- Each student has to present a seminar individually, on any technical topic of current interest / latest advancement / topics not covered in the syllabus.
- The topic has to be approved by the Department and a report of the same has to be submitted a week before the day of the presentation.

ELE 4298: INDUSTRIAL TRAINING
- Each student has to undergo industrial training for a minimum period of 4 weeks. This may be taken in a phased manner during the vacation starting from the end of third semester.
- Student has to submit to the department a training report in the prescribed format and also make a presentation of the same. The report should include the certificates issued by the industry.

ELE 4299: PROJECT WORK / PRACTICE SCHOOL
- The project work may be carried out in the institution/industry/ research laboratory or any other competent institutions.
- The duration of the project work shall be a minimum of 16 weeks which may be extended up to 24 weeks.
- A mid-semester evaluation of the project work shall be done after about 8 weeks.
- An interim project report on the progress of the work shall be submitted to the department during the mid-semester evaluation.
- The final evaluation and viva-voice will be conducted after submission of the final project report in the prescribed form.
- Student has to make a presentation on the work carried out, before the department committee as part of project evaluation.

MINOR SPECIALIZATIONS

I. EMBEDDED SYSTEMS

ELE 4001: EMBEDDED SYSTEMS DESIGN [3 0 0 3]
Embedded Systems: Evolution, Issues and challenges, Design Metrics.; System and Processor Architecture: Instruction Set and Addressing Modes; Improving processor performance; Memory Architecture and Types: Memory Interfacing; Memory Hierarchy and Cache;Timers, Counters and Watchdog Timers; Analog-to-Digital Converters; Design of Data Acquisition System;Bus I/O and Networking Considerations; Parallel and Serial bus and bus protocols; Wireless Protocols; Error detection and correction; Interrupts; Real-time Operating Systems: Scheduling, Memory and I/O Management; Embedded Software Development: Flow, Environments and Tools.Low Power Embedded System design; Software and hardware co design; Testing of Embedded Systems.; System Design Example.

References:
5. http://nptel.iitm.ac.in/coursecontents_elec.php

ELE 4002: FPGA BASED SYSTEM DESIGN [3 0 0 3]
Overview of Digital Systems Implementation options , FPGA Architecture, Programming technologies, Altera & Actel logic cells, I/O Blocks, Programmable interconnects, Logic implementation , Design verification- Test bench codes, Hardware testing, FPGA Architectural options; granularity of function and wiring resources, reconfigurable architectures- Fine grained, Coarse grained , Medium grained , Embedded multipliers, adders, MACs, processor cores, Configuring an FPGA ; Vendor specific issues, Logic block architecture, timing models- static and dynamic timing analysis, Input and Output cell characteristics , Power dissipation, Partitioning and placement, Routing resources ,Embedded system design using FPGAs, DSP using FPGAs, Multi FPGA systems, Reconfigurable systems, Application case studies

References:
3. W. Wolf, “FPGA based system design”, Pearson, 2004

ELE 4003: EMBEDDED PROCESSOR ARCHITECTURE [3 0 0 3]

References:

ELE 4004: REAL TIME SYSTEMS [3 0 0 3]
Difference between real time embedded systems and non-real time systems, characteristics of real time systems, real time concepts, terminology, real time design issues, examples, Real time specifications and design techniques, Basic Features of an Operating System, Real time operating systems. Kernel Features, Real-time Kernels, Processes and
Threads and scheduling, Inter-process Communication, Synchronous and Asynchronous I/O, Interrupt Handling, Device Drivers, Example Real-time OS, Evaluating and Optimising Operating System Performance.

References:
5. http://nptel.iitm.ac.in

II. ENERGY MANAGEMENT

ELE 4005: ADVANCED ENERGY MANAGEMENT [3 0 0 3]

References:
5. Herbert Schildt, “C++ The Complete Reference”, (3e), TMH.

ELE 4006: ENERGY AUDITING [3 0 0 3]

References:

ELE 4007: LIGHTING SCIENCE: DEVICES AND SYSTEMS [3 0 0 3]

References:

ELE 4008: POWER SYSTEM OPERATION AND CONTROL [3 0 0 3]
Generator & voltage control system: Energy conversion, application to synchronous machines, Park's transformation, voltage & mechanical equations, synchronous operation, steady state model, simplified dynamic model, generator connected to infinite bus - Exciter system block diagrams, generator models, stability of excitation systems. Voltage regulation, generator with excitation system connected to infinite bus, small signal stability analysis - Load frequency control, single area systems, speed governing system, static response characteristics, closed ALFC loops, static & dynamic response, secondary ALFC loops, two area system, Reactive power & voltage control - Generation & absorption of reactive power, methods of voltage control, performance requirements of transmission lines, uncompensated lines, voltage & current profiles, power/voltage characteristics, principles of transmission system compensation, Introduction to facts controllers-Economic load dispatch.

References:
1. R. Bergen, Vijay Vital, “Power system analysis”, (2e), prentice Hall
ELE 4009: COMPUTER TECHNIQUES IN POWER SYSTEM ANALYSIS [3 0 0 3]

References:

ELE 4010: MODERN POWER CONVERTERS [3 0 0 3]
Switched Mode Power converters: generalized comparison between switched mode and linear DC regulators, operation and steady state performance of buck, boost, buck-boost, cuk and sepic converters, continuous conduction mode, discontinuous conduction mode; DC-DC converters with isolation- Fly back converter, Forward converter, push-pull converter, half bridge and full bridge DC-DC converters; Resonant Converters- series and parallel loaded converters in continuous and discontinuous mode of operation, zero current switch resonant converter (ZCS), zero voltage switch resonant converter (ZVS); Control techniques- Voltage feed forward PWM control, current mode control, digital pulse width modulation control; Converter modelling- equivalent circuit modelling of converters using state space averaging technique; Closed loop converter design- case studies; Uninterruptible Power Source (UPS)

References:
1. Robert W. Erickson, Dragan Maksimovic; “Fundamentals of Power Electronics”, (2e), Springer, 2005
5. Pressman A. I., S"witching Power Supply Design".

ELE 4011: SOLID STATE DRIVES [3 0 0 3]
Fundamentals of Electric Drives: components, dynamics, multi-quadrant operation, equivalent moment of inertia and torque, nature and classification of load torque, steady state stability; DC Drives: single phase and three phase controlled rectifier fed dc drives-controlled freewheeling, speed torque characteristics, waveforms, expressions for voltage, current, speed, torque and power, Dual converter fed dc drives, Chopper fed dc drives- quadrants of operation; AC drives: Induction Motor Drives- stator voltage control, rotor resistance control, slip power recovery scheme, frequency control-control strategies, DG model, principle vector control, direct and indirect vector control scheme.; Synchronous Motor Drives-overview of scalar and vector control schemes of PMSM, SRM and BLDC motors , brushless DC excitation; UPS.

References:
6. “Signal Processing And Control”

ELE 4012: ADVANCED DIGITAL SIGNAL PROCESSING [3 0 0 3]

References:

ELE 4013: CONTROL SYSTEM DESIGN [3 0 0 3]
Control system performance objectives, Design of cascade & feedback compensation. Scalar and multivariable control systems, Industrial PID controllers, state space systems and PID control, PID tuning, Pole placement techniques for design of controllers and observers, Kalman filter, Robust control, techniques, Non-linear control system design: Linearization, compensation and design of non-linear systems, design of non-linear control system using phase plane analysis. Lyapunov stability: optimal control theory and applications; Adaptive Control; Self tuning control; Model reference adaptive control; practical aspects: Control system design examples; MATLAB & SIMULINK for Control system Design.

References:
III. BUSINESS MANAGEMENT

HUM 4011: FINANCIAL MANAGEMENT [3 0 0 3]
Introduction to financial management, Principle of accountancy. Sources of long term finance, Valuation of securities, Leverages, Working capital management, Capital budgeting, Cost of capital, Cash management, and Dividend decisions.

References:

HUM 4012: HUMAN RESOURCE MANAGEMENT [2 1 0 3]

References:

HUM 4013: MARKETING MANAGEMENT [2 1 0 3]

References:
HUM 4014: OPERATIONS AND SYSTEMS MANAGEMENT [2 1 0 3]

References:

OTHER PROGRAMME ELECTIVES

ELE 4016: BUILDING AUTOMATION SYSTEMS [3 0 0 3]

References:

ELE 4017: COMPUTER NETWORKS [3 0 0 3]

References:

ELE 4018: DATA STRUCTURES AND ALGORITHMS [3 0 0 3]
Analysis of algorithms - Stacks - application to evaluation of postfix expressions, conversion from infix to postfix representation - Queues - Sequential representation, operations, priority queues, and array implementation Linked Lists Trees Graphs Sorting - Searching - Greedy techniques - Prim's &Kruskal's algorithms for minimum spanning trees, shortest path, optimal tape storage, job scheduling with deadlines, Knapsack problem - Divide and Conquer - General technique, maximum and minimum., multiplying long integers, Strassen's matrix multiplication, finding the closest pair of points - Dynamic programming - matrix chain ordering, all pairs shortest paths, optimal BST Backtracking - NP completeness - Introduction to parallel algorithms.

References:

ELE 4019: DATABASE MANAGEMENT SYSTEMS [3 0 0 3]

References:
ELE 4020: ELECTRICAL MACHINE DESIGN [3 0 0 3]
Design of Transformers: Output equation, specific loadings, design of core, coils, tank and cooling systems, calculation of equivalent circuit parameters, temperature rise from design data.
Design of DC machines: Output equation, specific loading, choice of poles and speed, design of armature, main field, commutator, temperature rise from design data.
Design of Alternators: Output equation, specific loadings, main dimensions, armature slots, calculation of machine constants and temperature rise from design data.
Three phase induction motors: Output equation, specific loadings, main dimensions, stator and rotor windings, armature slots, Squirrel cage rotor designs, equivalent resistance of rotor, calculation of machine constants and temperature rise from design data.

References:

ELE 4021: HVDC & FACTS [3 0 0 3]
HVDC transmission system, merits and demerits application and schemes of HVDC, equivalent circuit diagram of a two terminal HVDC link, HVDC control, grid firing units for converters. Introduction to FACTS controllers- configuration and working principle of SVC, STATCOM, TCSC, SSSC, SPS and UPF- Steady state characteristics, effect of FACTS devices on transient stability, power flow, power oscillation damping and voltage stability.

References:

ELE 4022: LIGHTING CONTROLS: TECHNOLOGY AND APPLICATIONS [3 0 0 3]
Introduction to lighting controls & strategies - Energy management strategies - Switching control - Sensor technologies - Stand-alone v/s Interconnected panels - Centralized & Localized control - Dimming control scheme for light sources - Lighting control system design (Design process) - Commissioning and energy codes (ASHRAE/IESNA & IECC standards) - Daylight harvestings systems - Central and distributed control - Control signals and Protocols - Wireless RF lighting control - Integration of lighting control with building management system - Design patterns to different applications.

References:

ELE 4023: DIGITAL CONTROL SYSTEMS [3 0 0 3]
Discrete time signals: sampling, ZOH, Mapping between s-plane and z-plane; Pulse transfer function; steady state error; Stability criterion in the z-plane: Jury's test, bilinear transformation, stability analysis using root locus, Bode & Nyquist plot; State models for discrete-time systems; Diagonalization, state transition matrix, solution of state equation for discrete time systems by recursion and z-transform method, discrete-time equivalent of continuous-time systems; Controllability and Observability; Design of cascade & state feedback controllers in discrete time domain, Zeigler Nichols tuning, pole placement design, Ackermann's formula, design of state observers, Deadbeat control; Lyapunov stability for LTI discrete-time systems; Optimal regulator.

References:
1. Ogata K., “Discrete Time Control System”, (2e), Pearson, 2005

ELE 4024: RENEWABLE ENERGY [3 0 0 3]

References:

ELE 4025: SMART GRID TECHNOLOGIES [3 0 0 3]
Evolution of Electric Grid, Introduction to Smart Grid - Advantages - Indian Smart Grid, Need of Smart Grid; Overview of Technologies for Smart Grid, Difference between conventional & Smart Grid Technology, Transmission & Distribution Automation, Home and Building
Automation, Communication and Measurement; Monitoring, PMU,
Smart Meters and Measurements Technologies; Micro-grids and
Distributed Energy Resources: Concept and applications of micro-grid;
Issues of interconnection, protection and control of micro-grid;
Sustainable energy sources, Integration of renewable energy sources;
Power Quality issues of Grid connected Renewable Energy Sources;
Information and Communication Technology for Smart Grid; Advanced
Metering: Home Area Network (HAN), Neighborhood Area Network
(WAN), Wide Area Network (WAN), Broadband over Power line (BPL),
Control of the Power Grid Standards

References:
1. Ali Keyhani, Mohammad N. Marwali, Min Dai “Integration of Green
2. James Momoh, “Smart Grid: Fundamentals of Design and
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu,
   Akihiko Yokoyama, “Smart Grid: Technology and Applications”,
4. Peter S. Fox Penner, “Smart Power: Climate Changes, the Smart
5. S. Chowdhury, S. P. Chowdhury, P. Crossley, “Microgrids and Active
   Distribution Networks” Institution of Engineering and Technology, 30
   Jun 2009
6. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press,
   2012.
7. Jean Claude Sabonnadière, Nouredine Hadjsaid, “Smart Grids”,
   Wiley Blackwell.

ELE 4026: SOFT COMPUTING [3 0 0 3]
Fundamentals of Artificial Neural Networks- Feed forward and feed back
networks, learning rules- Single-layer feed forward networks - Multi layer
feed forward networks - Linearly non-separable pattern classification,
generalized delta learning rule, error back propagation training
algorithms - Single layer feed back network - Energy function -
Application of neural networks. Introduction to Fuzzy control - Inference
rules - Fuzzy knowledge based controllers - Fuzzification, membership
function evaluation, Defuzzification methods, Application of fuzzy logic
to control systems - fuzzy-neural systems. Familiarization with MATLAB
Fuzzy logic & neural network Toolbox. Introduction to Genetic
Algorithms

References:
1. J. S. T. Jang, C.T Sun and E. Mitzutani “Neuro-Fuzzy and Soft
   Hall International, Inc.1996.
3. S. Haykin, “Neural Networks - A Comprehensive Foundation”, (2e),
4. T. J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw-
5. Jacek M. Zurada, “Introduction to Artificial Neural Networks”, Jaico,
   1997

ELE 4027: SOLID STATE LIGHTING AND CONTROLS [3 0 0 3]
Introduction to Lighting Technology, Light generation principles
Incandescence & luminescence, Review of Light Sources, Solid state
lamps basics & life cycle of a photon, Optical Characteristics of LED,
LED Classification & material technology, White Light Generation
Techniques - Challenges & issues, Electrical Characteristics of LEDs,
LED driver considerations - Power management topologies (SPMS), LED
Dimming approaches, Color control feedback and schemes, Thermal
management considerations - Heat sink design, SSL test standards,
Data Sheet analysis, Remote Phosphor Technology, OLED.

References:
3. Patrick Mottier, “LEDs for Lighting Applications”, John Wiley,
   2009
5. Ron Lenk, Carol Lenk, “Practical Lighting Design with LEDs”, Wiley
   IEEE press, 2011

ELE 4028: UTILIZATION OF ELECTRICAL ENERGY [3 0 0 3]
Traction - Traction Drives - dc and ac traction drives, power
semiconductor controlled drives, dc and ac traction employing
polyphase ac motors, diesel electric traction Electroploation:
Preparation of work for electroplating, Electro extraction, electrolysis of
water. Electric Welding: Resistance welding, spot, seam, butt, projection
and flash welding, Power supply, Arc welding, Carbon arc and metallic
arc welding, Control of current in welding transformers. Electric
Heating, types, modes of heat transfer, resistance heating, resistance
ovens, Design of heating element, Temperature control, Induction
heating, Core type furnace, Coreless Induction furnace, indirect
induction oven, High frequency eddy current heating, Dielectric heating,
Arc furnaces.

References:
1. J.B.Gupta, “Utilization of Electrical Power and Electrical Traction”,

ELE 4029: VLSI DESIGN [3 0 0 3]
MOS Devices and circuits: Device operation, characteristics, second
order effects, Gate and junction capacitance, modeling, spice
parameters. Inverter Design Using MOS. Delay models, super buffers.
Performance optimization: Fan-In, Fan-out, Power dissipation, layout,
area, speed. CMOS fabrication process, Introduction to CAD tools for
Layout and functional simulation. MOSFET logic gates: Pass transistors
and transmission gates. Implementation of Boolean functions and
combinational circuits using switch logic & gate logic. Pseudo NMOS
inverter. Stick diagrams, Design rules and layouts, Scaling of MOS
circuits. Introduction to Analog VLSI Design; Issues, Challenges, Small
signal modeling, Discussion on basic building blocks.

References:
5. D. A. Hodges, H G Jackson, R.A. Saleh, “Analysis and Design of
   Digital Integrated Circuits”, TMH
   2001
   Wiley India, 2010.
OPEN ELECTIVES

ELE 3281: ANALOG And DIGITAL ELECTRONIC CIRCUITS [3 0 0 3]
(Not Applicable to E&C, ICE, Mechatronics)
Operational amplifiers and applications - DC voltage follower, bridge amplifier, integrator, differentiator, low pass, high pass and band pass active filters, precision diode and clamp, log antilog amplifiers, astable, monostable and triangular wave generators, Schmitt Trigger, Analog multiplier - Phase locked loop and applications - Phase comparator, Voltage controlled Oscillator, Functional block Schematic of PLL, PLL applications in communication - Number systems - Conversions between Number Systems - Subtraction using 1's and 2's. Complements - Karnaugh maps, Logic gates - Truth tables, Realization of Boolean functions using Gates, Universal Gates - MSI combinational circuits - Half and Full adders, magnitude comparator, Decoder, Encoder, Multiplier, ROM, PLA - Sequential circuits - Flip Flops Synchronous and Asynchronous Counters, Design of counters, 74194 Shift Register IC based design.

References:
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Prentice Hall of India

ELE 3282: ELECTRIC DRIVES [3 0 0 3]
(Not Applicable to Mechatronics & Printing)
Electric Drives - Components of electric drives, factors affecting choice of drives, dynamics of electrical drives, fundamental torque equation, speed-torque conventions, multi-quadrant operation of electric drives, load torque components, nature and classification of load torque, equivalent moment of inertia, steady state stability, load equalization - Motor power rating, thermal model, classes of motor duty - Introduction to thyristors, characteristics, power converters: AC to DC, DC to AC, AC to AC, DC to AC - DC Drives Systems - characteristics, starting, speed control, braking - AC Drives Systems: characteristics, starting, speed control, braking - Closed loop motor control schemes - Constant Torque, Speed, Position control systems.

References:

ELE 3283: ELECTRICAL ENERGY SYSTEMS [3 0 0 3]

References:

ELE 3284: ENERGY AUDITING [3 0 0 3]

References:
2. IEEE Std. 739-1995, "IEEE recommended practice for energy management in industrial and commercial facilities".

ELE 3285: ENERGY CONVERSION TECHNOLOGIES [3 0 0 3]
(Not Applicable to Mechatronics)

References:

ELE 3286: MICROCONTROLLERS [3 0 0 3]
(Not Applicable to E&C, ICE, CSE ICE)
programming the 8051 serial port. Interrupts: 8051 interrupts, programming 8051 interrupts, interrupt priority - System design using 8051: Interfacing keyboards, LCD display, ADC to 8051 - Interfacing a stepper motor to 8051. Programmable peripheral interface: Programming the 8255, Interfacing 8255 to 8051 - Development tools: Simulators, debuggers, cross compilers, in circuit emulators for microcontrollers

References:
3. Predko, “Programming and customizing the 8051 Microcontroller”, TMH.

ELE 3287: MATLAB FOR ENGINEERS [3 0 0 3]
Introduction to MATLAB - Numeric, Cell, and Structure Arrays - Functions and Files - Decision-Making Programs - Linear Algebraic Equations- data processing and visualization-importing & organizing data - Advanced Plotting SIMULINK ;System Dynamics ; Model Building and Regression; curve fitting & interpolation; ODE & PDE Solvers; Simulation of linear models of mechanical and electrical systems using Simulink; data acquisition and analysis; building GUI; Converting MATLAB code to executable format; Project based learning building interactive applications (demos & mini project).

References:
2. www.mathworks.com

ELE 3288: LIGHTING DESIGN [3 0 0 3]

References: