Bachelor of Science in Electrical Engineering

Course Catalog

(Lec-Lab-Credit Hrs)

2112510 Electronic Devices & Circuits I (3-2-4)

Basic properties of semiconductor materials. Theory of operation and applications of p-n junction diodes, zener diodes and photodiodes. Theory of operation, biasing circuits, and small signal analysis of Bipolar Junction Transistor and Junction Field Effect Transistor. Transistor configurations and two-port network representation of transistor a.c. equivalent circuits. Analysis and design of transistor amplifier circuits.

Prerequisite: 2152110

2113520 Electronic Devices and Circuits II (3-2-4)

Operational amplifiers and their applications. MOSFETs: theory of operation and characteristics of depletion and enhancement type MOSFETs, analysis of various biasing circuits. Small-signal model and AC analysis of amplifiers. Frequency response of amplifiers. Multistage amplifiers. Feedback amplifiers and oscillator circuits. Power amplifiers.

Prerequisite: 2112510

2113670 Design with Integrated Circuits (3-2-4)

A review of Op-Amps and Digital IC families. Design of analog signal conditioning circuits. Design of power supplies using IC regulators. Op-amp applications. Design of systems for measuring and displaying the measured values on LEDs. Applications of ADC, DAC, and counter ICs. Optoisolators, triacs, and control of high-voltage systems and actuators. Design of signal generators. Applications of commonly used ICs such as VCO, PLL, Timer IC, F/V and V/F ICs.

Prerequisite: 2113520

2114180 VLSI Design (3-0-3)

Introduction to VLSI design. Review of basic logic gates in CMOS. Integrated circuit layers, sheet resistance, time delay, CMOS layers, designing FET arrays, stick diagrams, layouts of CMOS circuits. Fabrication of CMOS ICs. Design rules, physical limitations. Advanced techniques in CMOS logic circuits. General VLSI system components. Floor-planning and routing. DRAM, SRAM, ROM designs. Computer simulation using VHDL or Verilog.

Prerequisites: 2113520, 2132350

2114440 Optoelectronics (3-0-3)

Fundamental concepts of semiconductors optical properties. Characteristics and classification of detectors. Radiation sources, classification of radiation sources. Population inversion and gain in a two-level lasing medium. Optical feedback and laser cavity. P-N junction laser operating principles, threshold current, Hetero-junction lasers, Quantum well lasers, device fabrication and fiber coupling. Optical fibers and design of optical systems.

Prerequisites: 2113520, 2123850

2122210 Signals and Systems (3-0-3)

Continuous- and discrete-time signals and systems. Basic system properties. Linear Time-Invariant (LTI) systems. Properties of LTI systems. Convolution sum. Fourier series of periodic signals. Fourier transform of non-periodic signals. Filtering. Analysis of continuous-time LTI systems using Laplace transform.

Prerequisite: 2172030

2123150 Principles of Communication (3-2-4)

Introduction to fundamentals of communication systems. Amplitude Modulation (AM): Modulation index, spectrum of AM signals, AM circuits. Single side band modulation, frequency division multiplexing. Frequency Modulation (FM): Spectrum of FM signals, FM circuits. FM versus AM. Sampling, quantization, coding, pulse code modulation, delta modulation, time division multiplexing. Shift Keying methods.

Prerequisite: 2122210

2123850 Electromagnetic Fields and Wave Propagation (3-0-3)

Electrostatics: Coulomb’s Law, Gauss’s Law. Electric fields in material space, Polarization in Dielectrics. Ampere’s Law, Stoke’s Theorem. Time-varying Fields, Faraday’s Law, Maxwell’s Equations in point form, Maxwell's equations in integral form, boundary conditions. Wave equation, plane wave propagation, Poynting vector and average power. Transmission line theory, reflection and transmission on transmission lines.

Prerequisites: 2171220, 2172030

2124340 Digital Signal Processing (3-0-3)

Review of discrete-time signals and systems. Transform-domain representations of signals: Discrete-time Fourier Transform, Fast-Fourier Transform, applications of Z-Transform. Transform-domain representations of LTI systems: Types of transfer functions, stability condition and test. Frequency response of a Rational Transfer

Function. The difference equation and Digital Filtering. Concept of filtering: Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) Filters.

Prerequisite: 2122210

2124560 Communication & Switching Networks (3-2-4)

Introduction to computer networks, protocol architecture and OSI reference model. Local Area Network (LAN): Topologies and transmission media. high-speed LAN. Token-Ring, FDDI. Circuit switching and packet switching, ISDN, DSL, packet switching network, X.25, frame relay, ATM. Internetworking devices. UDP, TCP architecture, Internet protocols, TCP/IP. Application Layer: Client-server model, socket interface, SMTP, FTP, HTTP, and WWW. Wireless Networking.

Prerequisite: 2123150

2124610 Telecommunication Systems (3-0-3)

Introduction to telecommunication systems. Telecommunication fundamentals and transmission media characteristics. Design analog and digital data transmission schemes. Telephony systems: ISDN and PSTN, essentials of traffic engineering. Overview of Wireless LAN technology. Comparison of ZigBee with other standards and applications. Introduction to satellite and fiber optic based communications.

Prerequisite: 2123150

2124670 Wireless Communications (3-0-3)

Introduction to cellular mobile radio systems: Cellular-concept system design fundamentals, trunking and grade of service. Mobile channel, large scale and small-scale fading. Outdoor propagation models. Multiple access techniques for mobile communication. Modern wireless communication systems: Second-generation (2G) cellular networks, Third-Generation (3G) and Fourth Generation (4G) wireless systems.

Prerequisites: 2123150, 2123850

2131400 Computer Programming (3-0-3)

Problem solving using flowcharts, structure of a C++ program, data types, operators, variables and constants. Input and output, output formatting. Control Statements: IF and SWITCH, WHILE, DO-WHILE and FOR statements. Function definition and calling, library functions, arrays and strings, pointers. File input and output.

Prerequisite: 1041200

2132350 Logic Design (3-2-4)

Basic theorems and properties of Boolean Algebra and Boolean functions. Simplification of Boolean functions: Karnaugh Map and Tabulation Method. Product of Sums (POS) and Sum of Products (SOP) forms. Combinational logic circuits: Design and analysis procedures. Decoders, encoders, multiplexers, demultiplexers, ROM, PLA and PAL. Sequential logic circuits: Flip Flops (RS, D, JK, T), design procedure for clocked sequential circuits, counters. Registers and shift registers.

Prerequisite: 1041200

2132500 Engineering Analysis (3-0-3)

Developing C++ programs to solve electrical engineering problems. MATLAB programming environment, vectors and matrices, input/output, M-files: scripts and functions, control statements. Plotting with MATLAB. GUI in MATLAB. Introduction to SIMULINK. Electrical system modeling via SIMULINK. Introduction to LabVIEW. Development of Virtual Instruments using LabVIEW.

Prerequisite: 2131400

2133440 Microcontrollers and Applications (3-2-4)

Introduction to microprocessor and its internal architecture. Typical microprocessor bus systems. Addressing modes and address decoding. Memory and I/O interface. Assembly language programming. Microcontrollers and embedded systems. Programming of microcontroller using C language. Interrupt processing and interrupt-based control. Microcontroller interfacing to real-world applications. Design and implementation of course projects using a microcontroller.

Prerequisites: 2131400, 2132350

Control Systems (3-2-4)
2143520

Introduction to Control Systems: Characteristics, time response, steady-state error. Open loop and closed loop concepts, transfer function, time domain, frequency domain, stability of linear feedback control systems, Root Locus method, Bode diagram. Design of feedback control systems: Principles of design, design with the PD, PI, and PID controllers. Performance evaluation of feedback control systems. Compensation: phase-lead, phase-lag and lead-lag compensation.

Prerequisite: 2122210

2143750 Sensors and Instrumentation (3-2-4)

Basic measurement concepts, sources and types of measurement errors, sources of

noise and interference and how to minimize them. Analysis and design of DC and AC bridge circuits and their applications. Operating principles and specifications of DVM and DMM. Transducers and their applications in measurement systems. Operation analysis of electromagnetic sensors for flux, current and position sensing. Oscilloscopes: types, specifications, operation and measurements. Analyzers: types, architecture and the optimal tuning. Design projects related to different types of measuring instruments

Prerequisites: 2113520, 2132500

2144380 Power Switching Devices (3-0-3)

Introduction to power electronics devices, power transistors, IGBTs and SITs. Thyristors: characteristics, types, models, operations, thyristor commutation techniques and commutation circuit design. Analysis and design of uncontrolled and controlled rectifiers. AC voltage controllers with resistive and inductive load. DC choppers: principles and classifications. Principles of operation and performance parameters of different types of inverters. DC and AC drives. Power system applications.

Prerequisite: 2113520,2152120

2144420 Industrial Control Systems (3-2-4)

Industrial control principles. Block diagram representation of industrial control systems. Application of analog and digital signal conditioning in industrial control. Thermal, optical, displacement, position, strain, motion, pressure, and flow sensors used in industrial control. Actuators in industrial control. Data Logging, Supervisory Control, Computer-based Controllers. Programmable Logic Controllers (PLCs). Sequential programming, Ladder diagrams. Introduction to Process Control Systems. Foundation Fieldbus and Profibus standards.

Prerequisite: 2143520

2144440 Computer-Based Instrumentation and Control (2-2-3)

Introduction to PC-based instrumentation and control. Explanation of standard bus types: ISA, EISA, PCI, PXI busses. IEEE 488 (GPIB) and RS-232 standards. Hardware and software interrupts, programmable interrupt controllers, interrupt service routines, DMA control and DMA controllers. Parallel Port interfacing. Serial Port Interfacing. USB Port interfacing. Data acquisition and control using plug-in cards. Development of virtual instruments using LabVIEW, remote data transmission and control, telemetry. Applications for a variety of measurements involving different kinds of sensors/transducers.

Prerequisite: 2133440, 2143750

2144510 Fuzzy Logic and Neural Networks (3-0-3)

An introduction to Fuzzy Logic and Neural Networks history, applications, and implementations. Fuzzy logic fundamentals, fuzzy sets, types of membership functions, linguistic variables, creation of fuzzy logic rule base, fuzzy logic operations. Fuzzy inference system. Neural network fundamentals, neural type learning process, single layer perceptron. Artificial neural networks architectures, training algorithms, genetic algorithms and evolution computing, neuro-fuzzy technology, fuzzy control systems and applications. Associative memory Hopfield neural networks.

Prerequisite: 2132350

2144720 Biomedical Instrumentation (3-0-3)

Biomedical sensors and transducers. Biopotential amplifiers, pre-amplifier circuits, instrumentation amplifier, isolation amplifiers, surge protection, input guarding, filters and signal conditioning circuits. Physiological recording systems ECG, EMG, EEG, ERG, etc. Blood pressure and its measurement. Pace-makers and Defibrillators. Clinical laboratory instrumentation.

Prerequisite: 2143750

2144900 Selected Topics in Instrumentation and Control (3-0-3)

Topics of current interest in Instrumentation and Control as selected by the faculty and approved by the EE Department. The course is tailored according to market demands and the technology directions.

Prerequisite: 2143750

2144950 Directed Study in Instrumentation and Control (3-0-3)

Directed study in Instrumentation and Control is conducted under the supervision of a faculty member. A student interested to undertake such a study shall submit a proposal outlining the description of the work to be performed with clearly defined objectives and intended outcomes. The study may include experimental investigation, computer simulation or completely theoretical research. The proposal must be approved by the concerned faculty and the Head of EE Department.

Prerequisites: 2143750, Advisor's Approval

2152110 Circuit Analysis I (3-2-4)

Basic quantities: charge, current, voltage, resistance, energy and power. Analysis of series, parallel and series-parallel D.C. resistive circuits using Ohm's law, Kirchhoff's voltage and current laws. Star-Delta and Delta-Star Transformations. Analysis of more

resistive circuits using loop and nodal methods, superposition, source transformation, Thevenin's and Norton theorems, maximum power transfer theorem. Transient analyses of RC, RL, and RLC circuits with DC excitation.

Prerequisites: 2171220

2152120 Circuit Analysis II (3-2-4)

AC circuits: impedance and admittance, phasors and phasor diagrams, series and parallel circuits, power and power factor correction. Steady-state response using phasor method. Nodal and loop analysis, application of circuit theorems. Steady-state power analysis. Magnetically-coupled circuits. Analysis of balanced three-phase circuits. Frequency response of simple circuits. Series and parallel resonance.

Prerequisites: 2152110

2153650 Power Systems and Electrical Machines (3-2-4)

Introduction to power systems. Control of reactive power, voltage and frequency. Contemporary issues related to electrical energy. Basics of power system protection. Principles of DC and AC machines and their types. Ideal and practical transformer. Voltage regulation and efficiency of transformer.

Prerequisites: 2152120

2154380 Power System Protection and Control (3-0-3)

An overview of electric industry structure, modern power system, system protection and energy control center. Introduction to power system apparatus: power transforms, circuit breakers, CTs, VTs, CCVTs and line trap. Primary and backup protection of transmission lines. Protection of transformers and busbars. Protection schemes for rotating machinery. Operation, algorithms and advantages of digital relays. Techniques for voltage and frequency control of power systems.

Prerequisites: 2143520, 2153650

2154470 Power Generation and Transmission (3-0-3)

Introduction to different types of conventional power plants for generation of power. Operating principles of steam power plants, hydroelectric power plants, hydro turbines, hydro generators, gas-turbine plant, gas-power plant and combined-cycle gas-power plant. Comparison of different transmission line insulators. String efficiency and its improvement. Calculations for sag and tension in designing a transmission line. Classification and comparison of underground cables.

Prerequisite: 2153650

2154550 Renewable Energy Systems (3-2-4)

Introduction to renewable energy sources. Electrical characteristics and performance evaluation of PV cells, modules, panels and arrays. Optimization of PV arrays. Design of a stand-alone PV system with battery storage. Wind energy conversion systems, sizing and site matching. Hydro generation and types of hydropower turbines. Solar thermal and ocean thermal energy conversion. Tidal energy, wave power generation, geothermal and biomass energy systems. Types of energy storage systems.

Prerequisite: 2153650

2154620 Smart Grid Renewable Energy Systems (3-0-3)

Basic concept of electric power grid. Types and equipment at grid stations. Grid station automation. Fundamental concepts of power grid integration on microgrids of renewable energy sources. Modeling converters in microgrids. Smart meters and monitoring systems. Design of PV microgrid generating station. Microgrid wind energy systems.

Prerequisite: 2154550

2154640 Power System Analysis (3-0-3)

Explanation of Per Unit system and determination of the equivalent circuits of synchronous generator and three-phase power transformers. Parameters of transmission lines. The equivalent circuit models of transmission lines. Power flow analysis. Analyzing symmetrical and unsymmetrical faults in power system. Stability of power systems.

Prerequisite: 2153650

2154720 Electrical Power Distribution Systems (3-0-3)

Introduction to electrical power distribution. Power distribution equipment, underground distribution, radial, ring and network distribution systems. Conductors and insulators in power distribution systems. Electrical distribution inside buildings. Analyzing single phase and three phase power distribution systems. Measurement equipment for distribution systems. Discussion of various distribution system considerations. Design of a power distribution system for a small building.

Prerequisite: 2153650

2154900 Selected Topics in Power & Renewable Energy (3-0-3)

Topics of current interest in Power & Renewable Energy as selected by the faculty and

approved by the EE Department. The course is tailored according to market demands and the technology directions.

Prerequisite: 2154550,2153650

2154950 Directed Study in Power & Renewable Energy (3-0-3)

Directed study in Power & Renewable Energy is conducted under the supervision of a faculty member. A student interested to undertake such a study shall submit a proposal outlining the description of the work to be performed with clearly defined objectives and intended outcomes. The study may include experimental investigation, computer simulation or completely theoretical research. The proposal must be approved by the concerned faculty and Head of the EE Department.

Prerequisites: 2154550, Advisor's Approval

2164900 Selected Topics in Electr. and Comm. (3-0-3)

Topics of current interest in Electronics and Communication as selected by the faculty and approved by the EE Department. The course is tailored according to market demands and the technology directions.

Prerequisites: 2113520, 2123150

2164950 Directed Study in Electr. and Comm. (3-0-3)

Directed study in Electronics and Communication is conducted under the supervision of a faculty member. A student interested to undertake such a study shall submit a proposal outlining the description of the work to be performed with clearly defined objectives and intended outcomes. The study may include experimental investigation, computer simulation or completely theoretical research. The proposal must be approved by the concerned faculty and Head of the EE Department.

Prerequisites: 2113670, 2123150,Advisor's Approval

2171010 Engineering Mathematics I (3-0-3)

Limits of functions, theorems about limits, evaluation of limit at a point and infinity, continuity. Derivatives of algebraic and trigonometric functions, maxima and minima, engineering applications of derivatives. The definite and indefinite integrals and their applications. Integration by parts, Integration using powers of trigonometric functions, Integration using trigonometric substitution, Integration by partial fractions. Integration of improper integrals. Transcendental Functions.

Prerequisite: None

2171020 Engineering Mathematics II (3-0-3)

Matrix addition, subtraction, multiplication and transposition. Complex numbers, algebraic properties of complex numbers, absolute values, complex conjugate, polar representation, powers and roots. Functions of several variables. Double and triple integrals in rectangular and polar coordinates. Applications of multiple integrals in engineering. Infinite sequences, tests for convergence, power series expansion of functions, Taylor series, Laurent series, Fourier series and their applications in engineering.

Prerequisite: 2171010

2171210 Engineering Physics I (3-2-4)

Vectors, motion, and Newton's laws. Work, energy, momentum and conservation of momentum. Rotation of rigid bodies, dynamics of rotational motion. Equilibrium and elasticity. Stress and strain. Periodic motion. Engineering applications.

Prerequisite: None

2171220 Engineering Physics II (3-2-4)

Electric charge and electric field. Coulomb's law and Gauss's law with applications. Capacitance and dielectrics. DC circuits. Magnetic fields. Ampere's law and its applications. Electromagnetic induction, Faraday's law, Lenz's law, induced electric fields. Self- and mutual-inductance. Electromagnetic waves and Maxwell's equations. Optics and its engineering applications.

Prerequisite: None

2171410 Chemistry for Engineers (2-2-3)

Atoms, molecules, ions and formulas of ionic compounds. Electronic structure and the periodic table. Quantum numbers, energy levels and orbital. Orbital diagrams of atoms. Various types of bonds. Chemistry of the metals and semiconductors. Introduction to organic chemistry, bonding and types of hybridization in carbon atom, alkanes and cyclo alkanes, alkyl and halogen substituents. Alkenes and alkynes, Diels-Alder reaction. Types, properties, and use of polymers.

Prerequisite: None

2171500 Introduction to Engineering (1-0-1)

Engineering profession and the role of engineers in modern developments, engineering

ethics. Various engineering disciplines with special emphasis on electrical engineering. Importance of math and science to engineers. Engineering design and analysis, lab skills for engineers, computer skills for engineers. Electrical Engineering curriculum, curriculum planning and management. Critical thinking, soft skills for engineers, creativity, communication skills. Case studies on engineering ethics.

Prerequisite: None

2172030 Engineering Mathematics III (3-0-3)

Vector Calculus and its engineering applications. First order differential equations. Homogeneous linear second-order differential equations with constant and variable coefficients, non-homogeneous linear second-order differential equations with constant coefficients, higher-order linear differential equations with constant coefficients. Power series solution of differential equations. Laplace Transform, Inverse Laplace Transform. Application of Laplace Transform to solve ordinary differential equations. Introduction to partial differential equations (PDEs), first order PDEs, second order PDEs, boundary value problems, engineering applications.

Prerequisite: 2171020

2172040 Engineering Mathematics IV (3-0-3)

Linear Algebra: Matrices and determinants, solution of systems of linear equations, eigenvalues and eigenvectors, engineering applications, computer exercises. Complex Analysis: Complex functions, derivative of complex functions, analytic functions, Cauchy-Riemann equations, harmonic functions. Fourier analysis: Fourier Series, Fourier Integrals, Fourier series of even and odd functions with applications. Discrete Mathematics and its engineering applications.

Prerequisite: 2172030

2173220 Report Writing and Presentation (3-0-3)

Writing of technical reports, brief reports, and progress reports. Business communication: business letters and memos, executive summary, business reports. Oral presentation: planning, preparation of visuals, and delivering of an oral presentation.

Prerequisites: 2171500 + Junior Standing

2173630 Probability and Random Variables (3-0-3)

Concept of Probability. Discrete and continuous random variables. Operations on single random variable: Expected values and moments. Joint cumulative distribution function and joint probability density function. Sum of random variables. Independent random variables. Jointly Gaussian random variables. Definition and classification of random process, transmission of random process through linear filters, and optimum filtering.

Applications in signal processing and communication systems.

Prerequisite: 2171020

2174050 Engineering Management (3-0-3)

Introduction to engineering management and role of effective management. Strategic and operational planning, forecasting, action planning. Organization: activities, organizational structures, delegating, establishing working relationships. Basics of leadership. Controlling activities: setting standards, measuring, evaluating, and improving performance. Marketing Management: marketing process and strategies, pricing, promotion strategy, channels of distribution and types of distribution.

Prerequisite: 2173220

21x4910 Graduation Project I (1-4-3)

Teams of 3-4 students shall design, implement, test, and demonstrate their graduation project in two semesters. Graduation Project I is to be completed in first semester and it includes literature survey, action plan, design of complete project taking into account realistic constraints, computer simulation (if applicable), partial implementation and testing. Report writing and oral presentation.

Prerequisite: 2113670

21x 4930 Graduation Project II (1-4-3)

It is a continuation of Graduation Project I in the second semester. Students will complete the implementation and testing of the remaining part of their design. They will integrate the complete project, test it, and prepare a PCB. Report writing, oral presentation, poster presentation, and project demonstration.

Prerequisite: 21x 4910

2174940 Senior Seminar (1-0-1)

The course aims to develop students' understanding of contemporary issues as well as the impact of engineering solutions in a global, economic, environmental, and societal context. It will also improve their oral presentation skills.

Prerequisite: 2173220

2103001 Engineering Training -

To expose students to a learning environment where they can apply what they have learned in the classroom to a professional setting and enhance their abilities to correlate theoretical knowledge with professional practice. Prior to starting their external training, students shall take two weeks intensive internal training to prepare them for external training.

Prerequisite: Completion of 75 credit hours.