Course Curriculum of the Department of Electrical and Electronic Engineering

COURSE OFFERED BY EEE DEPARTMENT

EEE 101 Electrical Circuits I
3 Credit Hours, 3 Contact Hours per Week


EEE 102 Electrical Circuits I Laboratory
1.5 Credit Hours, 3 Contact Hours per Week
In this course students will perform simulation study and experiments to verify practically the theories and concepts learned in EEE 101.

**EEE 105 Electrical Circuits II**  
3 Credit Hours, 3 Contact Hours per Week

Circuits with non-sinusoidal excitations, power and power factor of ac circuits with multiple sources of different frequencies; Transients in AC circuits, Passive Filter Networks: basic types. Characteristic impedance and attenuation, ladder network, low pass, high pass filters, propagation coefficient and time delay in filter sections, practical composite filters. Resonance in AC circuits: Series and parallel resonance and Q factors. Magnetically coupled circuits. Analysis of three phase circuits: Three phase supply, balanced and unbalanced circuits, power calculation and measurements, Power factor improvement.


**EEE 106 Electrical Circuits II Laboratory**  
1.5 Credit Hours, 3 Contact Hours per Week

In this course students will perform simulation study and experiments to verify practically the theories and concepts learned in EEE 105.

**EEE 201 Electronic Circuits I**  
3 Credit Hours, 3 Contact Hours per Week
Semiconductor diodes: semiconductor material and properties, pn junction, diode circuits: dc analysis and models, diode circuits: AC equivalent circuits, other diode types, single phase rectification and regulators, zener diode circuits, clipper and clamper circuits, multiple diode circuits, photo diodes and LED circuits, DC power supply; MOS Transistors: Structure of MOSFET, Current-Voltage Characteristics, MOS Device Models, DC circuit analysis, basic MOFET applications, Biasing, constant current biasing, multistage MOSFET circuits, Junction Field effect transistor (JFET), MOSFET amplifier: basic transistor amplifier configurations-Common-Source, Common-Gate Stage, Source Follower (common drain); single stage integrated circuit MOSFET amplifiers, multistage amplifiers, basic JFET amplifiers; Bipolar Junction transistor (BJT): BJT, DC analysis of power amplifier, Class-AB push pull complimentary output stage.

**EEE 202 Electronic Circuits I Laboratory**

1.5 Credit Hours, 3 Contact Hour per week

In this course students will perform simulation study and experiments to verify practically the theories and concepts learned in EEE 201.

**EEE 203 Energy Conversion I**

3 Credit Hours, 3 Contact Hours per Week

Transformer: principle of operation, construction, no load and excitation current, behavior during loading, effect of leakage flux, ideal transformer, leakage reactance and equivalent circuit of a transformer, equivalent impedance, voltage regulation, per unit quantities, regulation, losses and efficiency, determination of parameters by tests, polarity of transformer windings, vector group, transformer parallel operation. Harmonics in excitation current, transformer inrush current, three phase transformer connections, three phase transformers, harmonic suppression in three phase transformer connection. Autotransformer, instrument transformers.
Three phase induction motor: rotating magnetic field, reversal of rotating magnetic field, synchronous speed, torque in induction motor, induction motor construction: squirrel cage, wound rotor; slip and its effect on rotor frequency and voltage, equivalent circuit of an induction motor, air gap power, mechanical power and developed torque, torque speed characteristic, losses, efficiency and power factor, classification, motor performance as a function of machine parameters, shaping torque speed characteristic and classes of induction motor, per unit values of motor parameters, determination of induction motor parameters by tests, methods of braking, speed control

Induction generator: operation, characteristics, voltage build up, applications in wind turbine.

**EEE 205 Energy Conversion II**  
*3 Credit Hours, 3 Contact Hours per Week*

Synchronous generator: construction, armature (stator) and rotating field (exciter), excitation system with brushes and brushless excitation system, cooling, generated voltage equation of distributed short pitched armature winding, armature winding connections and harmonic cancellation in distributed short pitched winding, equivalent circuit, synchronous impedance, generated voltage and terminal voltage, phasor diagram, voltage regulation with different power factor type loads, determination of synchronous impedance by tests, phasor diagram, salient pole generator d-q axes parameters, equivalent circuit, generator equations, determination of d-q axes parameters by tests, equation of developed power and torque of synchronous machines (salient and non salient pole motor and generator). Parallel operation of generators: requirement of parallel operation, conditions, synchronizing, effect of synchronizing current, hunting and oscillation, synchronoscope, phase sequence indicator, load distribution of alternators in parallel, droop setting, frequency control, voltage control, house diagrams.

Synchronous Motors: construction, operation, starting, effect of variation of load at normal excitation, effect of variation of excitations, V curves, inverted V curves and compounding curves, power factor adjustment, synchronous capacitor and power factor correction.

DC motors: principle of operation, constructional features, back emf and torque equations, armature reaction and its effect on motor performance, compensating winding, problems of commutation and their mitigations, types of dc motors and their torque speed characteristics, starting and speed control of dc motors, applications of different types of dc motor.
types of dc motor.

Single Phase Induction Motor: operation, quadrature field theory, double revolving field theory, split phasing, starting methods, equivalent circuit, torque-speed characteristic and performance calculation.

Introduction to photovoltaic systems.

EEE 206 Energy Conversion Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 203 and EEE 205. In the second part, students will design simple systems using the principles learned in EEE 203 and EEE 205.

EEE 207 Electronic Circuits II
3 Credit Hours, 3 Contact Hours per Week

Ideal operational amplifier and op-amp circuits;
Op-amp applications: inverting amplifier, non-inverting amplifier, summing amplifier, differential amplifier, logarithmic amplifier, operational transconductance amplifiers exponential amplifier, differentiator, integrator, voltage to current converter, voltage follower, and other applications.

Non-ideality of op-amp: Non-ideal op-amp characteristics and its effects.

Integrated circuit biasing and active loads: BJT current sources, FET current sources, small signal analysis of active loads, design applications: an NMOS current source; differential and multistage amplifiers: BJT differential amplifier, FET differential amplifier, differential amplifier with active load, BiCMOS circuits, gain stage and simple output stage, BJT operational amplifier circuit, Frequency response of amplifiers: Poles, zeros and Bode plots, amplifier transfer function, techniques of determining 3 dB frequencies of amplifier circuits, frequency response of single-stage and cascade amplifiers, frequency response of differential amplifiers;

Feedback and stability: Basic feedback concept, feedback topologies: voltage(series-shunt) amplifiers, current
EEE 208 Electronic Circuits II Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

In this course students will perform simulation study and experiments to verify practically the theories and concepts learned in EEE 207.

EEE 209 Engineering Electromagnetics
3 Credit Hours, 3 Contact Hours per Week

Static electric field: Postulates of electrostatics, Coulomb's law for discrete and continuously distributed charges, Gauss's law and its application, electric potential due to charge distribution, conductors and dielectrics in static electric field, flux density- boundary conditions; capacitance- electrostatic energy and forces, energy in terms of field equations, capacitance calculation of different geometries; boundary value problems- Poisson's and Laplace's equations in different co-ordinate systems. Steady electric current: Ohm's law, continuity equation, Joule's law, resistance calculation. Static Magnetic field: Postulates of magnetostatics, Biot-Savart's law, Ampere's law and applications, vector magnetic potential, magnetic dipole, magnetization, magnetic field intensity and relative permeability, boundary conditions for magnetic field, magnetic energy, magnetic forces, torque and inductance of different geometries. Time varying fields and Maxwell's equations: Faraday's law of electromagnetic induction, Maxwell's equations - differential and integral forms, boundary conditions, potential functions; time harmonic fields and Poynting theorem. Plane electromagnetic wave: plane wave in loss less media- Doppler effect, transverse electromagnetic wave, polarization of plane wave; plane wave in lossy media- low-loss dielectrics, good conductors; group velocity, instantaneous and average power densities, normal and oblique incidence of plane waves at plane boundaries for different polarization.
EEE 211 Continuous Signals and Linear Systems
3 Credit Hours, 3 Contact Hours per Week

Classification of signals and systems: signals- classification, basic operation on signals, elementary signals, representation of signals using impulse function; systems- classification. Properties of Linear Time Invariant (LTI) systems: Linearity, causality, time invariance, memory, stability, invertibility. Time domain analysis of LTI systems: Differential equations- system representation, order of the system, solution techniques, zero state and zero input response, system properties; impulse response- convolution integral, determination of system properties; state variable- basic concept, state equation and time domain solution. Frequency domain analysis of LTI systems: Fourier series- properties, harmonic representation, system response, frequency response of LTI systems; Fourier transformation- properties, system transfer function, system response and distortion-less systems. Applications of time and frequency domain analyses: solution of analog electrical and mechanical systems, amplitude modulation and demodulation, time-division and frequency-division multiplexing. Laplace transformation: properties, inverse transform, solution of system equations, system transfer function, system stability and frequency response and application.

EEE 212 Numerical Techniques Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

Laboratory on numerical techniques using computer solution of differentiation and integration problems, transcendental equations, linear and non-linear differential equations and partial differential equations.

EEE 303 Digital Electronics
3 Credit Hours, 3 Contact Hours per Week

Introduction to number systems and codes. Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, combinational logic design, minimization of combinational logic. MOSFET Digital circuits: NMOS inverter, CMOS inverter, CMOS logic circuits, Clocked CMOS logic circuits, transmission gates, sequential logic circuits,
Memories: classification and architecture, RAM memory cells, Read only memory, data converters, BJT digital circuits: ECL, TTL, STTL, BiCMOS, Design application A static ECL gate.

Modular combinational circuit design: pass transistor, pass gates, multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements and ALU design.

Sequential circuits: different types of latches, flip-flops and their design using ASM approach, timing analysis and power optimization of sequential circuits. Modular sequential logic circuit design: shift registers, counters and their applications. State Machine Design.

Asynchronous and synchronous sequential circuits.

**EEE 304 Digital Electronics Laboratory**
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 303. In the second part, students will design simple systems using the principles learned in EEE 303.

**EEE 305 Power System I**
3 Credit Hours, 3 Contact Hours per Week

Network representation: Single line and reactance diagram of power system and per unit system. Line representation: equivalent circuit of short, medium and long lines, reactive compensation of lines, introduction to DC transmission.

Load flow: Gauss- Siedel and Newton Raphson methods. Power flow control.

Synchronous machines: transient and subtransient reactance and short circuit currents. Symmetrical fault calculation methods. Symmetrical components: power, unsymmetrical series impedances and sequence
networks. Different types of unsymmetrical faults: solid faults and faults through impedance.

Protection: fault level calculation, selection of circuit breakers, introduction to relays and circuit breakers. Typical layout of a substation.

Power plants: types, general layout of a thermal power plant and major components of gas turbine, steam turbine and combined cycle power plants.

**EEE 306 Power System I Laboratory**  
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments and do simulations to verify practically the theories and concepts learned in EEE 305. In the second part, students will design simple systems using the principles learned in EEE 305.

**EEE 307 Electrical Properties of Materials**  
3 Credit Hours, 3 Contact Hours per Week


Dielectric properties of materials: Dielectric constant, polarization- electronic, ionic, orientational and interfacial; internal field. Clausius-Mosotti equation, spontaneous polarization, frequency dependence of dielectric constant.
dielectric loss, piezoelectricity, ferroelectricity, pyroelectricity.

Magnetic properties of materials: Magnetic moment, magnetization and relative permittivity, different types of magnetic materials, origin of ferromagnetism and magnetic domains.

Introduction to superconductivity: Zero resistance and Meissner effect, Type I and Type II superconductors and critical current density. BCS theory. Magnetic recording materials, Josephson theory.
Introduction to meta-materials.

**EEE 309 Communication Systems I**
3 Credit Hours, 3 Contact Hours per Week

Overview of communication systems: Basic principles, fundamental elements, system limitations, message source, bandwidth requirements, transmission media types, bandwidth and transmission capacity.

Noise: Sources of noise, characteristics of various types of noise and signal to noise ratio.

Communication systems: Analog and digital. Continuous wave modulation: Transmission types- base-band transmission, carrier transmission; amplitude modulation- introduction, double side band, single side band, vestigial side band, quadrature; spectral analysis of each type, envelope and synchronous detection; angle modulation- instantaneous frequency, frequency modulation (FM) and phase modulation (PM), spectral analysis, demodulation of FM and PM. Sampling- sampling theorem, Nyquist criterion, aliasing, instantaneous and natural sampling, flat-topped sampling; pulse amplitude modulation- principle, bandwidth requirements; pulse code modulation (PCM)- quantization principle, quantization noise, non-uniform quantization, signal to quantization error ratio, differential PCM, demodulation of PCM; delta modulation (DM)- principle, adaptive DM; line coding-formats and bandwidths.

Digital modulation and demodulation: Amplitude-shift keying- principle, ON-OFF keying, bandwidth requirements, detection, noise performance; phase-shift keying (PSK)- principle, bandwidth requirements, detection, differential PSK, quadrature PSK, noise performance; frequency-shift keying (FSK)- principle, continuous and discontinuous phase FSK, minimum-shift keying, bandwidth requirements, detection of FSK, Multilevel signalling.
Multiplexing: Time-division multiplexing (TDM)- principle, receiver synchronization, frame synchronization, TDM of multiple bit rate systems; frequency-division multiplexing (FDM)- principle, de-multiplexing. PDH, SONET/SDH.

Multiple-access techniques: Time-division multiple-access (TDMA), frequency-division multiple access (FDMA); code-division multiple-access (CDMA) - spread spectrum multiplexing, coding techniques and constraints of CDMA.

EEE 310 Communication Systems I Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 309. In the second part, students will design simple systems using the principles learned in EEE 309.

EEE 311 Digital Signal Processing I
3 Credit Hours, 3 Contact Hours per Week


EEE 312 Digital Signal Processing I Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 311. In the second part, students will design simple systems using the principles learned in EEE 311.

EEE 313 Solid State Devices
3 Credit Hours, 3 Contact Hours per Week

Semiconductors in equilibrium: Energy bands, intrinsic and extrinsic semiconductors, Fermi levels, electron and hole concentrations, temperature dependence of carrier concentrations and invariance of Fermi level.

Carrier transport processes and excess carriers: Drift and diffusion, generation and recombination of excess carriers, built-in-field, recombination-generation SRH formula, surface recombination, Einstein relations, continuity and diffusion equations for holes and electrons and quasi-Fermi level.

PN junction: Basic structure, equilibrium conditions, contact potential, equilibrium Fermi level, space charge, non-equilibrium condition, forward and reverse bias, carrier injection, minority and majority carrier currents, transient and AC conditions, time variation of stored charge, reverse recovery transient and capacitance.

Bipolar Junction Transistor: Basic principle of pnp and npn transistors, emitter efficiency, base transport factor and current gain, diffusion equation in the base, terminal currents, coupled-diode model and charge control analysis, Ebers-Moll model and circuit synthesis. BJT non-ideal effects; Hetero-junction transistors.

Metal-semiconductor junction: Energy band diagram of metal semiconductor junctions, rectifying and ohmic contacts.

MOS structure: MOS capacitor, energy band diagrams and flat band voltage, threshold voltage and control of threshold voltage, static C-V characteristics, qualitative theory of MOSFET operation, body effect and current-voltage relationship of a MOSFET. Non-ideal characteristics of MOSFET: channel-length modulation and short-channel effects in MOSFETs. MOS scaling.

Introduction to Multigate FET architecture: Double gate MOSFET. FinFET. Surrounding gate FET. high-K
dielectric FETs.

EEE 315 Power Electronics
3 Credit Hours, 3 Contact Hours per Week

Fundamental of power electronics, characteristics of static power semiconductor devices (BJT, MOSFET, IGBT, Thyristors). AC/DC power converters: uncontrolled rectifiers (single phase and three phase), controlled rectifiers (single phase and three phase), dual converter. AC/AC power converters: phase controlled converters (single phase and three phase), AC switch, cycloconverter. DC/DC converters: choppers (step down and step up), switching regulators (buck, boost, buck-boost). DC/AC converters: types, single phase and three phase inverters. Various applications of converters.

EEE 316 Power Electronics Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 315. In the second part, students will design simple systems using the principles learned in EEE 315.

EEE 317 Control System I
3 Credit Hours, 3 Contact Hours per Week

EEE 318 Control System I Laboratory
1.5 Credit Hours 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 317. In the second part, students will design simple systems using the principles learned in EEE 317.

EEE 414 Electrical Services Design
1.5 Credit Hours, 3 Contact Hours per Week

Familiarization with CAD tools for building services design. Introduction to building regulations, codes and standards: BNBC, NFPA etc. Terminology and definitions: fuses, circuit breakers, distribution boxes, cables, bus-bars and conduits. Familiarization with symbols and legends used for electrical services design. Classification of wiring. Design for illumination and lighting: lux, lumen, choice of luminaries for various applications- domestic building, office building and industry. Wattage rating of common electrical equipment.

Designing electrical distribution system for low and high rise domestic, office and academic buildings, for multipurpose buildings. Size selection of conductors and breakers, bus-bar trunking (BBT) system for various applications. Single line diagram (SLD) of a typical 11kV/0.415kV, 500kVA sub-station and a 200kVA pole-mounted transformer.

Earthing requirements, various earthing methods. Earthing and lightning protection system design. Familiarization with indoor and underground telephone and fiber optic cables, UTP and CAT5/6 data cables. Designing routing layout and installation of intercom, PABX, telephone, public address (PA) systems, cable TV distribution, LAN and wireless data systems for a building. Safety regulations, design of security systems including CCTV, burglar alarm. Concept of fire prevention and its importance. Fire detection (smoke, heat etc.) and alarm system (with voice evacuation), firefighting system (sprinkler system, hose). Installation of air conditioning, heating, lifts and fire hydrants.
evacuation), firefighting system (sprinkler system, hose). Installation of air-conditioning, heating, lifts and elevators.

EEE 415 Microprocessors and Embedded Systems
3 Credit Hours, 3 Contact Hours per Week

Basic components of a computer system. Simple-As-Possible (SAP) computer: SAP-1, selected concepts from SAP-2 and SAP-3 (jump, call, return, stack, push and pop). Evolution of microprocessors.

Introduction to Intel 8086 microprocessor: features, architecture, Minimum mode operation of 8086 microprocessor: system timing diagrams of read and write cycles, memory banks, design of decoders for RAM, ROM and PORT.

Introduction to Intel 8086 Assembly Language Programming: basic instructions, logic, shift and rotate instructions, addressing modes, stack management and procedures, advanced arithmetic instructions for multiplication and division, instructions for BCD and double precision numbers, introduction to 8086 programming with C language. Hardware Interfacing with Intel 8086 microprocessor: programmable peripheral interface, programmable interrupt controller, programmable timer, serial communication interface, keyboard and display interface (LED, 7 segment, dot matrix and LCD).

EEE 416 Microprocessors and Embedded Systems Laboratory
1.6 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 415. In the second part, students will design simple systems using the principles learned in EEE 415.

EEE 439 Communication Systems II
3 Credit Hours. 3 Contact Hours per Week
Baseband digital transmission, Limitations, Pulse shaping, Repeaters, Pulse equalization techniques, AWGN channel model, bit error rate of a baseband transmission system, channel capacity theorem.

Digital modulation techniques, detection and demodulation techniques, digital receivers, matched filter and correlator receiver, bit error rate calculation of a digital link, digital link design.

Error correction coding: block codes, cyclic codes, systematic and nonsystematic cyclic codes, decoding techniques.

Wireless digital communication system, wireless channel model, non-cellular and cellular communication, cellular concept, frequency reuse techniques.
Multiple access techniques: FDMA, TDMA, CDMA and SDMA. Introduction to 2G and 3G mobile communication systems.

Introduction to optical fiber communication and Satellite communication. Local area network, OSI model, random access techniques, Aloha, slotted Aloha.

**EEE 400 Thesis/Project**
3 Credit Hours, 6 Contact Hours per Week Level-4, Term-I
3 Credit Hours, 6 Contact Hours per Week Level-4, Term-II

Study of practical problems in the fields of electrical and electronic engineering.

**ELECTIVE COURSES**

**Interdisciplinary**

**EEE 421 Control System II**
3 Credit Hours, 3 Contact Hours per Week

EEE 422 Control System II Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 421. In the second part, students will design simple systems using the principles learned in EEE 421.

EEE 425 Biomedical Signals, Instrumentation and Measurements
3 Credit Hours, 3 Contact Hours per Week

EEE 426 Biomedical Signals, Instrumentation and Measurement Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 425. In the second part, students will design simple systems using the principles learned in EEE 425.

EEE 427 Measurement and Instrumentation
3 Credit Hours, 3 Contact Hours per Week


EEE 428 Measurement and Instrumentation Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 427. In the second part, students will design simple systems using the principles learned in EEE 427.

CSE 451 Computer Networks
3 Credit Hours, 3 Contact Hours per Week
3 Credit Hours, 3 Contact Hours per Week


CSE452 Computer Networks Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in CSE 451. In the second part, students will design systems using the principles learned in CSE 451.

Communication and Signal Processing Group

EEE 331 Random Signals and Processes
3 Credit Hours, 3 Contact Hours per Week


Estimation Techniques (ML, MMSE, MAP) and power spectrum. Cross spectral densities. Response of linear systems to random inputs. Statistical Estimation Techniques (ML, MMSE, MAP).

EEE 431 Digital Signal Processing II
3 Credit Hours, 3 Contact Hours per Week

Spectral estimation of random processes: classical methods, minimum variance method, parametric methods: AR and ARMA spectral estimation, Levinson-Durbin algorithm, super resolution techniques: Pisarenko, and MUSIC.


EEE 433 Microwave Engineering
3 Credit Hours, 3 Contact Hours per Week

EEE 434 Microwave Engineering Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 433. In the second part, students will design simple systems using the principles learned in EEE 433.

EEE 435 Optical Communications
3 Credit Hours, 3 Contact Hours per Week


EEE 437 Wireless Communication
3 Credit Hours, 3 Contact Hours per Week

EEE 438 Wireless Communication Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

Laboratory experiments and design of wireless communication systems based on the syllabus of EEE 437 Wireless Communications.

EEE 441 Telecommunication Engineering
3 Credit Hours, 3 Contact Hours per Week

ISDN, architecture of ISDN, B-ISDN implementation. Digital subscriber loop (DSL), Wireless local loop (WLL), FTTx, SONET/SDH, WDM Network, IP telephony and VoIP, ATM network and Next Generation Network (NGN).

EEE 443 Radar and Satellite Communications
3 Credit Hours, 3 Contact Hours per Week

Introduction to Satellite Communication, Satellite frequency bands, satellite orbits, satellite types, regulation of the spectrum and interference, propagation channel, air interfaces, link budget analysis, Digital Modulation, Error Correction Codes, Multiple Access, receiver synchronization, baseband processing, fixed and mobile applications, basics of satellite networking.

Radar equation, radar cross section, information contents in radar signals, noise and clutter, radar detectors, Doppler and MTI radar, pulse compression, CW and FM-CW radar, radar transmitter and receivers, introduction to polarimetric radar and synthetic aperture radar.

EEE 445 Multimedia Communications
3 Credit Hours, 3 Contact Hours per Week

EEE 447 Introduction to Digital Image Processing
3 Credit Hours, 3 Contact Hours per Week

History and background of digital image processing, image processing system and applications, visual perception, sensors for image acquisition, sampling and quantization, intensity transformation and enhancement of images in spatial domain, histogram equalization, Fuzzy techniques for image processing, 2D discrete Fourier transform, image restoration, Wiener and constraint least-square filters for images, homomorphic filters, image reconstruction from projections, multi-resolution image processing, sub-band coding and image compression.

EEE 449 Information and Coding Theory
3 Credit Hours, 3 Contact Hours per Week

Entropy and Mutual Information: Entropy, joint entropy and conditional entropy, Relative entropy and mutual information, chain rules for entropy, relative entropy and mutual information, Jensen's inequality and log-sum inequality.


Source Coding: Kraft inequality, optimal codes, Huffman code and its optimality, Shannon-Fano-Elias coding, arithmetic coding.

Channel Capacity: Binary symmetric channels and properties of channel capacity, channel coding theorems, joint source and channel coding theorem.

Block coding and decoding, BCH, RS codes, Convolutional coding, Viterbi Decoder, Turbo codes, decoding techniques STBC, SFBC, STFBC.

Gaussian Channel: Introduction to Gaussian Channel, Band limited channel, Parallel Gaussian Channel, Gaussian Channel with feedback.
EEE 491 Introduction to Medical Imaging
3 Credit Hours, 3 Contact Hours per Week

Introduction to imaging, medical imaging modalities, Medical imaging before x-rays, Hippocratic thermography, dissection, laparoscopy, X-radiography, Computed tomography (CT), evolution of CT scanner design, image reconstruction algorithms, filtered back-projection method, iterative method, low dose computed tomography, Ultrasound, Sonar and other early applications of acoustics, basic principles of ultrasound imaging, Evolution of ultrasound technology and clinical applications, Magnetic resonance imaging, Early use of nuclear magnetic resonance (NMR) spectroscopy, Principles of NMR and MRI, Evolution of magnetic resonance imaging (MRI) technology and clinical applications, development and applications of functional MRI, Introduction to Nuclear imaging.

EEE 493 Digital Filter Design
3 Credit Hours, 3 Contact Hours per Week

Application of digital filters, analog filters, linear phase FIR filters, optimal filter design, Remez exchange algorithm, multiband filters, approximately linear phase IIR filter, all pass filter, design of IIR filter using optimization methods: Newton's method, Quasi-Newton algorithms, Minimax algorithms, improved Minimax algorithms, filter design in time-frequency domain, design of special filters: Hilbert transformer, narrowband filter, fractional delay filter, Wiener filter, filter design using Kalman filter/parallel Kalman filter, Wavelet filter.

EEE 495 Speech Communication
3 Credit Hours, 3 Contact Hours per Week

Speech production and phonetics: articulatory and acoustic features; Speech analysis: formant, pitch, time and frequency domain analysis techniques, spectrogram; Speech coding: linear predictive coding, vocoders, vector quantization; Speech enhancement: spectral subtraction based techniques; Speech synthesis: formant synthesizers; Speech and speaker recognition: feature extraction and conventional recognition methods.
EEE 497 Telecommunication Networks
3 Credit Hours, 3 Contact Hours per Week


(Note: For total credit hour fulfillment of the degree of B. Sc. Engg (EEE), credits of either EEE 497 or EEE 499 will be counted but not both.)

EEE 498 Telecommunication Networks Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

Laboratory experiments and designs based on the course EEE 497 Telecommunication Networks.

EEE 499 Wireless and Mobile Networks
3 Credit Hours, 3 Contact Hours per Week

(Note: For total credit hour fulfillment of the degree of B. Sc. Engg (EEE), credits of either EEE 497 or EEE 499 will be counted but not both.)

Electronics Group

EEE 351 Analog Integrated Circuits
3 Credit Hours, 3 Contact Hours per Week

Analog IC Design: Bipolar, MOS and BiCMOS IC technology and its impact, eggshell analogy, application areas and the future of analog IC design.

Review of transistors: Large and small signal models, compact models for Bipolar, FET, and BiCMOS. Amplifiers with passive and active loads, cascode stages.

Constant current or voltage references: Supply voltage and temperature independent biasing, band-gap references; constant-Gm biasing. Widlar band-gap voltage reference.

Differential pairs: Differential vs. single-ended operations of simple amplifiers, differential and common mode voltages, common mode rejection ratio (CMRR), input common mode range (ICMR), transfer characteristics, small signal analysis, and frequency response of differential pairs.

High-gain amplifiers: Design and analysis of operational amplifiers (Op Amps) using BJTs and FETs, hierarchy in analog integrated circuits for an Op-Amps, internal structure of IC Op-Amps, high-performance Op-Amps.

Switch capacitor circuits: Equivalent resistance of a switched capacitor, unity gain buffers, charge amplifiers and integrators. Sampling switches: Charge injection, clock feed-through, charge feed-through; quantized model and remedy of charge injection. Switched capacitor filters.

Origin of internally developed noises in ICs; shot, thermal, flicker, burst and avalanche noises in a device. Representation of noises in circuits, noises in single stage and differential amplifiers, noise bandwidth.

EEE 451 Processing and Fabrication Technology
3 Credit Hours, 3 Contact Hours per Week

Substrate materials: Crystal growth and wafer preparation, epitaxial growth technique, molecular beam epitaxy, chemical vapor phase epitaxy and chemical vapor deposition (CVD).

Doping techniques: Diffusion and ion implantation. Growth and deposition of dielectric layers: Thermal oxidation, CVD, plasma CVD, sputtering and silicon-nitride growth.

Introduction to Semiconductor Characterization Tools.

Etching: Wet chemical etching, silicon and GaAs etching, anisotropic etching, selective etching, dry physical etching, ion beam etching, sputtering etching and reactive ion etching. Cleaning: Surface cleaning, organic cleaning and RCA cleaning. Lithography: Photo-reactive materials, pattern generation, pattern transfer and metalization. Steps of lithography. Non-optical lithography.
Discrete device fabrication: Diode, transistor, resistor and capacitor. Integrated circuit fabrication: Isolation - pn junction isolation, mesa isolation and oxide isolation. BJT based microcircuits, p-channel and n-channel MOSFETs, complimentary MOSFETs and silicon on insulator devices. Testing, bonding and packaging.

EEE 453 VLSI Circuits and Design I
3 Credit Hours, 3 Contact Hours per Week

IC trends, technology and design approaches. MOS device: structure, operation, threshold voltage and characteristics.

Ratioed circuits: NMOS inverter with resistive and transistor load, Pseudo NMOS inverter.

Ratioless circuits: CMOS inverters: operation, transfer characteristics, design for equal rise and fall time, propagation delay, rise time, fall time and power consumption estimation. NMOS pass transistor and CMOS pass gate circuits. Buffer chain design to drive large capacitive load.


Basic logic gates in CMOS. Synthesis of arbitrary combinational logic in CMOS, pseudo-NMOS, dynamic CMOS, clocked CMOS and CMOS domino logic. Structured design: Parity generator, bus arbitration logic, multiplexers based design, programmable logic array (PLA) design. Clocked sequential circuit design: two phase clocking, dynamic shift register. CMOS latches and flip flops.

Subsystem design: 4-bit arithmetic processor: bus architectures, shifter, design of a general purpose ALU. Memory elements design: System timing consideration, three transistor and one transistor dynamic memory cell. Pseudo-static RAM/register cell. 4 transistor dynamic and 6 transistor static CMOS memory cell. 4x4 bit register array and 16 bit static CMOS memory array.

Finite State Machine design: Design of Moore Type and Mealy type FSM using Verilog. Testing VLSI circuits.
EEE 454 VLSI Circuits and Design I Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 453. In the second part, students will design simple systems using the principles learned in EEE 453.

EEE 455 Compound Semiconductor Devices
3 Credit Hours, 3 Contact Hours per Week

Reviews of Compound semiconductor: Zinc-blend crystal structures, growth techniques, alloys, band gap, basic opto-electronic properties, density of carriers in intrinsic and doped compound semiconductors.
Introduction to Physics of Hetero-Junctions: Band alignment, band offset, Anderson's rule, single and double sided hetero-junctions, quantum wells and quantization effects, lattice mismatch and strain and common hetero-structure material systems.


Hetero-structure bipolar transistor (HBT): Structure and operating principle, quasi-static analysis, extended Gummel-Poon model, Ebers-Moll model, secondary effects and band diagram of a graded alloy base HBT.

Resonant Tunneling diodes: physics and operation. Resonant Tunneling Transistors: device physics, operation and characteristics.

EEE 457 VLSI Circuits and Design II
3 Credit Hours, 3 Contact Hours per Week
Scaling of MOS transistor and interconnect: RC delay modeling, repeaters and cascaded drives. Advanced CMOS nanometer process flow and enhancement of CMOS process, technology related CAD issues and manufacturing issues, design margin and PVT corners.


Sequential circuit design: sequencing methods, maximum and minimum delay constrains, clock skew. Design of latches and flip-flops, clock Generation and synchronization, High-speed clock generation and distribution.

ASIC Cell based design, standard cell place and route design, timing directed placement design, mixed signal design. Interchange formats: LEF, DEF, SDF, DSPF, SPEF, ALF PDEF, CIF and GDS2. Floor planning, power distribution and I/O design.

Algorithm and architecture for digital processors in verilog, system verilog and system-C: building block for signal processors, digital filters and signal processors, pipelined architecture.

Architecture for arithmetic processors: addition, subtraction, multiplication and division. Complete design of a simple RISC processor. Post-synthesis design validation: timing verification, fault simulation and testing, design for test. High speed and low power memory circuit design: advanced topics in DRAM and SRAM.

**EEE 458 VLSI Circuits and Design II Laboratory**  
1.5 Credit Hours, 3 Contact Hours per Week  
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 457. In the second part, students will design simple systems using the principles learned in EEE 457.

**EEE 459 Optoelectronics**  
3 Credit Hours, 3 Contact Hours per Week
Optical properties in semiconductor: Direct and indirect band-gap materials, basic transitions in semiconductors, radiative and non-radiative recombination, optical absorption, photo-generated excess carriers, minority carrier lifetime, luminescence and quantum efficiency in radiation.

Properties of light: Particle and wave nature of light, polarization, interference, diffraction and blackbody radiation.

Light emitting diode (LED): Principles, materials for visible and infrared LED, internal and external efficiency, loss mechanism, structure and coupling to optical fibers. Double-Hetero-structure (DH) LEDs, Characteristics, Surface and Edge emitting LEDs.

Stimulated emission and light amplification: Spontaneous and stimulated emission, Einstein relations, population inversion, absorption of radiation, optical feedback and threshold conditions.


EEE 460 Optoelectronics Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

Laboratory based on EEE 459
EEE 461 Semiconductor and Nano Device
3 Credit Hours, 3 Contact Hours per Week


EEE 463 Introduction to Nanotechnology and Nanoelectronics
3 Credit Hours, 3 Contact Hours per Week


Power Group

EEE 371 Power System II
3 Credit Hours, 3 Contact Hours per Week

Economic Operation within and among plants, transmission-loss equation, dispatch with losses.

Flexible AC transmission system (FACTS) - introduction, shunt compensation (SVC, STATCOM), series compensation (SSSC, TCSC, TCSR, TCPST), series-shunt compensation (UPFC).

Power quality - voltage sag and swell, surges, harmonics, flicker, grounding problems; IEEE/IEC standards, mitigation techniques.

**EEE 372 Power System II Laboratory**  
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments and do simulations to verify practically the theories and concepts learned in EEE 371. In the second part, students will design simple systems using the principles learned in EEE 371.

**EEE 471 Energy Conversion III**  
3 Credit Hours, 3 Contact Hours per Week

Basic principles of energy conversion: electromagnetic, electrostatic, thermoelectric, electrochemical, and electromechanical.

Acyclic machines: generators, conduction pump and induction pump.  
Nonconventional energy conversion: solar-photovoltaic, solar-thermal, wind, geothermal, wave and tidal energy, MHD (Magneto Hydrodynamic) systems.

**EEE 473 Renewable Energy**  
3 Credit Hours, 3 Contact Hours per Week

Renewable energy sources: Solar, wind, mini-hydro, geothermal, biomass, wave and tides.

Solar Photovoltaic: Characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, sun tracking systems, Maximum Power Point Tracking (MPPT): chopper, inverter. Sizing the PV panel and battery pack in stand-alone PV applications. Modern solar energy applications (residential, electric vehicle, naval, and space). Solar power plants connected to grid.

Solar thermal: principles of concentration, solar tower, parabolic dish, receiver, storage, steam turbine and generator.

Wind turbines: Wind turbine types and their comparison, power limitation, Betz's law; Control mechanism: pitch, yaw, speed. Couplings between the turbine and the electric generator, Wind turbine generator - DC, synchronous, self excited induction generator and doubly fed induction generator. Grid interconnection: active and reactive power control.

Biomass and biogas electricity generation.

**EEE 475 Power Plant Engineering**  
3 Credit Hours, 3 Contact Hours per Week

EEE 477 Power System Protection
3 Credit Hours, 3 Contact Hours per Week

Electric arcs, arc extinction mechanism, transient recovery voltage. Circuit Breakers: operating mechanisms, construction and operation of Miniature Circuit Breaker (MCB), Molded Case Circuit Breaker (MCCB), Air Circuit Breaker (ACB), Air Blast Circuit Breaker (ABC), Vacuum Circuit Breaker (VCB), Oil Circuit Breaker (OCB), Minimum Oil Circuit Breaker (MOCB) and Sulfur Hexafluoride (SF6) circuit breaker. High Rupturing Capacity (HRC) Fuse, Drop Out Fuse (DOF), Load Break Switches, Contactors. Bus bar layout, isolators, earthing switch; lightning arresters, CT, PT: wound type and CCVT (Capacitor Coupled Voltage Transformer), MOCT (Magneto Optical Current Transducer).

Fundamental of protective relaying. Classical relays (electromagnetic attraction type, induction type); numerical relays. Inverse Definite Minimum Time (IDMT) relays, directional relays, differential and percentage differential relays, distance relays, pilot relays (wire pilot, carrier).

Protection of generators, motors, transformers, transmission lines, HVDC system and feeders.

EEE 478 Power System Protection Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 477. In the second part, students will design simple systems using the principles learned in EEE 477.

EEE 479 Power System Reliability
3 Credit Hours, 3 Contact Hours per Week
EEE 481 Power System Operation and Control
3 Credit Hours, 3 Contact Hours per Week

Overview: vertically integrated vs. deregulated power system. Real-time operation: SCADA; EMS (energy management system); various data acquisition devices - RTU, IED, PMU, DFDR, WAMPAC (wide area monitoring, protection and control).

Application functions: state estimation; short term load forecasting; unit commitment (UC); economic dispatch (ED); optimal power flow (OPF). Frequency control: generation and turbine governors, droop, frequency sensitivity of loads, ACE (area control error), AGC (Automatic Generation Control) and coordination with UC and ED; frequency collapse and emergency load shed.

Power system security: static and dynamic; security constrained OPF.

Electricity market operation: GenCos, ISO, DisCos, bidding, spot market, social welfare, market clearing price (MCP), locational marginal price (LMP), bilateral contracts and forward market, hedging.

Demand side control: DMS (distribution management system), DSM (demand side management), smart grid concept.

EEE 483 High Voltage Engineering
3 Credit Hours, 3 Contact Hours per Week
High voltage DC generation: rectifier circuits, ripple minimization, voltage multipliers, Van-de-Graaf and electrostatic generators; applications.

High voltage AC generation: Tesla coils, cascaded transformers and resonance transformers.

Impulse voltage generation: Shapes, mathematical analysis, codes and standards, single and multi-stage impulse generators, tripping and control of impulse generators.

Breakdown in gas, liquid and solid dielectric materials, applications of gas and solid dielectrics in transformer. Corona.

High voltage measurements and testing: IEC and IEEE standards, sphere gap, electrostatic voltmeter, potential divider, Schering bridge, Megohm meter, HV current and voltage transducers: contact and noncontact.

Over-voltage phenomenon and insulation coordination. Lightning and switching surges, basic insulation level (EV, EHV and UHV systems), surge diverters and arresters.

EEE 484 High Voltage Engineering Laboratory
1.5 Credit Hours, 3 Contact Hours per Week

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 483. In the second part, students will design simple systems using the principles learned in EEE 483.

EEE 485 Power Transmission and Distribution
3 Credit Hours, 3 Contact Hours per Week

Transmission line parameters: Inductance - inductance due to internal flux, flux linkages between points external to an isolated conductor, flux linkages of one conductor in a group, single-phase two-wire line, composite-conductor lines, three-phase lines with equilateral/unsymmetrical spacing, double circuits, bundled conductors;
Capacitance - electric field of a long straight conductor, potential difference between points due to a charge, capacitance of a two-wire line, capacitance of three-phase line with equilateral/unsymmetrical spacing, effect of Earth on transmission line capacitance, bundled conductor, parallel-circuit three-phase lines.

Sag of overhead lines, Types of insulators and electrical stress analysis.

Underground cables: Types and construction; oil filled, gas insulated and XLPE cables; electrical characteristics - electrical stress, capacitance, charging current, insulation resistance, dielectric power factor and dielectric loss, skin effect, proximity effect; identification of fault location.

HVDC transmission: Comparison of AC and DC transmission, HVDC transmission system components, monopolar and bipolar HVDC transmission, power converters: CSC (Current source converter) and VSC (Voltage source converter), operation and control of HVDC transmission link.

Substations: Substation equipment, bus bar arrangements, substation earthing, neutral grounding, substation automation, GIS substation.

Distribution systems: Primary and secondary distribution - radial, ring main, and interconnected system, distribution losses and feeder reconfiguration.

EEE 487 Nuclear Power Engineering
3 Credit Hours, 3 Contact Hours per Week

**EEE 489 Smart Grid**  
3 Credit Hours, 3 Contact Hours per Week

Smart grid: two way communication; distributed energy resources (DERs) - DG (distributed generation) and ES (energy storage); high power density batteries, EV (electric vehicles) and PHEV (plug-in hybrid electric vehicles); smart sensors, meters and appliances at demand side.

Data communication channels; protocols; TCP/IP; IEEE 802 series wireless LANs: bluetooth, Zigbee, WiMax; wired LANs- Ethernet, PSTN, PLC (Power Line Carrier); cyber security.

Smart meters and AMI (advanced metering infrastructure): construction; standards for information exchange-Modbus, DNP3 and IEC61850; interfacing with HAN, NAN, WAN.

Power electronic interfaces between grid and DERs.

Demand side integration (DSI): DSM; real time pricing; ancillary markets; DR (demand response) for load shaping, frequency and voltage control, energy efficiency.

Microgrids, self healing and restoration.

**4.5 COURSES OFFERED BY OTHER DEPARTMENTS TO EEE STUDENTS**

**4.5.1 Computer Science and Engineering**

**CSE 109 Computer Programming**  
3 Credit Hours, 3 Contact Hours per Week

Introduction to digital computers. Programming languages, algorithms and flow charts. Structured Programming using C: Variables and constants, operators, expressions, control statements, functions, arrays, pointers, structure unions, user defined data types, input-output and files. Object-oriented Programming using C++: introduction, classes and objects; polyorphism; function and operator overloading; inheritance.
CSE 110 Computer Programming Sessional  
1.5 Credit Hours, 3 Contact Hours per Week  

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in CSE 109. In the second part, students will learn program design.

CSE 451 Computer Networks  
3 Credit Hours, 3 Contact Hours per Week  


CSE 452 Computer Networks Sessional  
3 Credit Hours, 3 Contact Hours per Week  

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in CSE 451. In the second part, students will design systems using the principles learned in CSE 451.
4.5.2 Civil Engineering

CE 106 Engineering Drawing
1.5 Credit Hours, 3 Contact Hours per Week

Introduction- lettering, numbering and heading; instrument and their use; sectional views and isometric views of solid geometrical figures. Plan, elevation and section of multistoried building; building services drawings; detailed drawing of lattice towers.

4.5.3 Mechanical Engineering

ME 267 Mechanical Engineering Fundamentals
3 Credit Hours, 3 Contact Hours per Week

Introduction to sources of energy: Steam generating units with accessories and mountings; steam turbines. Introduction to internal combustion engines and their cycles, gas turbines.

Refrigeration and air conditioning: applications; refrigerants, different refrigeration methods.

Fluid machinery: impulse and reaction turbines; centrifugal pumps, fans, blowers and compressors. Basics of conduction and convection: critical thickness of insulation.

ME 268 Mechanical Engineering Fundamentals Sessional
1.5 Credit Hours, 3 Contact Hours per Week

Sessional based on ME 267.

4.5.4 Industrial and Production Engineering

IPE 493 Industrial Management
3 Credit Hours, 3 Contact Hours per Week

Management Functions and Organization: Evolution, management function: organization, theory and structure, span of control, authority delegation, manpower planning.

Personal Management: Importance, need hierarchy, motivation, leadership, wage incentives, performance appraisal, participative management.

Operation Management: Production planning and control (PPC) functions, quantitative methods applied in production, quality management, location and layout planning, safety and loss management.

Cost and Financial Management: Elements of cost products, cost analysis, investment analysis, benefit cost analysis, risk analysis.

Management Accounting: Cost planning and control, budget and budgetary control.

Marketing Management: Concepts, strategy, sales promotion, patent laws.

Technology Management: Management of innovation and changes, technology life cycle. Case studies.
4.5.5 Physics

PHY 121 Waves and Oscillations, Optics and Thermal Physics
3 Credit Hours, 3 Contact Hours per Week

Waves and oscillations: Differential equation of simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillations, spring mass system, torsional pendulum; two body oscillation, reduced mass, damped oscillation, forced oscillation, resonance, progressive wave, power and intensity of wave, stationary wave, group and phase velocities.


PHY 102 Physics Sessional
1.5 Credit Hours, 3 Contact Hours per Week

Laboratory experiments based on PHY 121.
PHY 165 Electricity and Magnetism, Modern Physics and Mechanics
3 Credit Hours, 3 Contact Hours per Week

Electricity and magnetism: Electric charge and Coulomb's Law, Electric field, Concept of electric flux and the gauss's Law - some applications of gauss's Law, Gauss's Law in vector form, Electric potential, Relation between electric field and electric potential, Capacitance and dielectrics, Gradient, Laplace's and Poisson's equations, Current, Current density, Resistivity, The magnetic field, Ampere’s Law, Biot-savart Law and their applications, Laws of electromagnetic induction- Maxwell's equations.

Modern Physics: Galilean relativity and Einstein's special theory of relativity; Lorentz transformation equations, Length contraction, Time dilation and mass-energy relation, Photoelectric effect, Compton effect; de Broglie matter waves and its success in explaining Bohr's theory, Pauli's exclusion principle, Constituent of atomic nucleus, Nuclear binding energy, Different types of radioactivity, Radioactive decay Law; Nuclear reactions, Nuclear fission, Nuclear fusion, Atomic power plant.


4.5.6 Chemistry

CHEM 101 Chemistry I
3 Credit Hours, 3 Contact Hours per Week


CHEM 114 Inorganic, Quantitative Analysis Sessional
1.5 Credit Hours, 3 Contact Hours per Week

Volumetric analysis: acid-base titration, oxidation-reduction titrations, determination of Fe, Cu and Ca volumetrically.

4.5.7 Mathematics

MATH 157 Calculus I
3 Credit Hours, 3 Contact Hours per Week


**MATH 159 Calculus II**  
3 Credit Hours, 3 Contact Hours per Week


**MATH 257 Ordinary and Partial Differential Equations**  
3 Credit Hours, 3 Contact Hours per Week

Ordinary Differential Equations: Degree and order of ordinary differential equations, formation of differential equations. Solution of first order differential equations by various methods. Solution of general linear equations of second and higher orders with constant coefficients. Solution of homogeneous linear equations. Solution of differential equations of the higher order when the dependent or independent variables are absent. Solution of differential equation by the method based on the factorization of the operators. Frobenius method.

MATH 259 Linear Algebra
3 Credit Hours, 3 Contact Hours per Week


MATH 357 Probability and Statistics
3 Credit Hours, 3 Contact Hours per Week


4.5.8 Humanities

HUM 127 Sociology
3 Credit Hours, 3 Contact Hours per Week

Introduction: Society, Science and Technology- an overview; Scientific Study of Society; Social Elements, Society, Community, Association and Institution; Mode of Production and Society; Industrial Revolution.
Society, Community, Association and Institution, Mode of Production and Society; Industrial Revolution, Development of Capitalism.

Culture and Socialization: Culture; Elements of Culture; Technology and Culture; Cultural Lag; Socialization and Personality; Family; Crime and Deviance; Social Control. Technology, Society and Development; Industrialization and Development; Development and Dependency Theory; Sustainable Development; Development and Foreign Borrowing; Technology Transfer and Globalization, Modernity and Environment; Problem and Prospects.

Pre-industrial, Industrial and Post-industrial Society: Common Features of Industrial Society; Development and Types of Social Inequality in Industrial Society; Poverty, Technology and Society; Social Stratification and Social Mobility; Rural and Urban Life, and their Evaluation.

Population and Society: Society and Population; Fertility, Mortality and Migration; Science, Technology and Human Migration; Theories of Population Growth-Demographic Transition Theory, Malthusian Population Theory; Optimum Population Theory; Population Policy.

**HUM 135 English**
3 Credit Hours, 3 Contact Hours per Week

General discussion: Introduction, various approaches to learning English.

Grammatical Problems: Construction of sentences, grammatical errors, sentence variety and style, conditionals, vocabulary and diction.

Reading Skill: Discussion readability, scan and skin reading, generating ideas through purposive reading, reading of selected stories.

Writing Skill: Principles of effective writing; Organization, planning and development of writing; Composition, precis writing, amplification.

General strategies for the writing process: Generating ideas, identifying audiences and purposes, construction arguments, stating problems, drafting and finalizing.
Approaches to Communication: Communication today, business communication, different types of business communication.

Listening Skill: The phonemic systems and correct English pronunciation.

Speaking Skill: Practicing dialogue; Story telling; Effective oral presentation.


**HUM 137 Professional Ethics**  
3 Credit Hours, 3 Contact Hours per Week


Human qualities of an engineer. Obligation of an engineer to the clients. Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession.

Ethical Expectations: Employers and Employees; inter-professional relationship: Professional Organization- maintaining a commitment of Ethical standards. Desired characteristics of a professional code. Institutionalization of Ethical conduct.

**HUM 272 Developing English Skills Laboratory**  
1.5 Credit Hours, 3 Contact Hours per Week

Grammar: Tense, article, preposition, subject-verb agreement, clause, conditional and sentence structure.  
Vocabulary building: correct and precise diction, affixes, level of appropriateness. Colloquial and standard, informal and formal.
Developing reading skill: Strategies of reading- skimming, scanning, predicting, inferencing; Analyzing and interpreting variety of texts; Practicing comprehension from literary and nonliterary texts.

Developing writing skill: Sentences, sentence variety, generating sentences; Clarity and correctness of sentences, linking sentences to form paragraphs, writing paragraphs, essays, reports, formal and informal letters.

Listening skill and note taking: Listening to recorded texts and class lectures and learning to take useful notes based on listening.

Developing speaking skill: Oral skills including communicative expressions for personal identification, life at home, giving advice and opinion, instruction and directions, requests, complains, apologies, describing people and places, narrating events.

**HUM 277 Fundamentals of Economics**  
3 Credit Hours, 3 Contact Hours per Week


Introducing macroeconomics. National income accounting, the simple Keynesian analysis of national income, employment and inflation. Savings, investment and decision making. Fiscal policy and monetary policy- money and interest rate, income and spending.

Economics of development and planning.

**HUM 279 Financial and Managerial Accounting**  
3 Credit Hours, 3 Contact Hours per Week

Financial Accounting: Objectives and importance of accounting, branches of accounting, accounting as an


**EEE COURSES FOR OTHER DEPARTMENTS**

The courses offered by the Department of Electrical and Electronic Engineering for undergraduate students of other departments of BUET are following.

**5.1 Computer Science and Engineering**

**EEE 163 Introduction to Electrical Engineering**
3 Credit Hours, 3 Contact Hours per Week

of sinusoidal quantities, balanced three phase circuits. Ideal operational amplifier circuits.

EEE 164 Introduction to Electrical Engineering Sessional
1.5 Credit Hours, 3 Contact Hours per Week

Experiments based on EEE 163.

EEE 263 Electronic Circuits
4 Credit Hours, 4 Contact Hours per Week

Ideal device characteristics of diode, bipolar junction transistor (BJT), metal oxide semiconductor field effect transistor (MOSFET).

Wave shaping circuits, diode wave shaping techniques, clipping and clamping circuits, comparator circuits, switching circuits.

Amplifiers: BJT and MOSFET amplifiers.

Linear Integrated Circuits: Op-Amps, Oscillators, Timers (555), Function generators, Phase Locked Loop (PLL), analogue switches.

Digital Circuits: Logic gates, Logic families; TTL and CMOS Logics; Flip Flops, counters and registers, memory systems; A/D and D/A converters, S/H circuits.

EEE 264 Electronic Circuits Sessional
1.5 Credit Hours, 3 Contact Hours per Week

Experiments based on EEE 263.
EEE 269 Electrical Drives and Instrumentation
3 Credit Hours, 3 Contact Hours per Week

Introduction to three phase circuits, alternators and transformers; Principles of operation of DC, synchronous, induction, universal and stepper motors; Thyristor and microprocessor based speed control of motors.

Instrumentation amplifiers: differential, logarithmic, and chopper amplifiers; frequency and voltage measurements using digital techniques; recorders and display devices, spectrum analyzers and logic analyzers; data acquisition and interfacing to microprocessor based systems; Transducers: terminology, types, principles and application of photovoltaic, piezoelectric, thermoelectric, variable resistance and optoelectronic transducers; Noise reduction in instrumentation.

EEE 270 Electrical Drives and Instrumentation Sessional
3 Credit Hour, 3 Contact Hours per Week

Experiments based on EEE 269

EEE 463 Optical Communications
3 credit Hours, 3 Contact Hour per week

EEE 465 Telecommunication Systems
3 Credit Hour, 3 Contact hours per week

Introduction: Principle, evolution and telecommunication networks, National and International regulatory bodies. Basic elements of telecommunication, message source and bandwidth, Transmission medium: twisted pair cable, coaxial cable, wireless channel and electromagnetic spectrum, satellite channel and fibre optic cable, transmission impairment, noise and noise to signal ratio, transmission capacity. Analogue and digital transmission, telephone apparatus, telephone exchanges, subscriber loop, supervisory tones, PSTN. Switching systems. Introduction to analogue system, strowger and crossbar switching system, stored program controlled system (SPC), Digital switching system, space division switching, time division switching. Traffic analysis, traffic characterization, grade of service, network blocking probabilities, delay system and queuing. Integrated service digital network (ISDN); N-ISDN and B-ISDN, architecture of ISDN, B-ISDN implementation. Digital subscriber loop (DSL), Wireless local loop (WLL), FTTx, PDH and SONNET/SDH, WDM network, IP telephony and VoIP, ATM network and next generation network (NGN).

5.2 Biomedical Engineering

EEE 171 Electrical Circuits
3 Credit Hours, 3 Contact Hour per week

Introduction to electric circuit: laws and theorems for dc circuit; AC circuit; AC circuit: circuit analysis techniques with phasors for single phase sinusoidal circuits (RL, RC and RLC), transient response of capacitor and inductor circuits, sinusoidal steady state response, resonance, four wire system of generated emfs, balanced poly phase circuits, three phase three wire system, power in balanced three phase systems; Filter circuits: active and passive; ideal operational amplifier circuits; magnetic circuits; Transformers.

EEE 172 Electrical Circuits Sessional
1.5 Credit Hours, 3 Contact Hour per week

Experiment based on EEE 171.

**EEE 273 Basic Electronic Devices and Circuits**
3 Credit Hours, 3 Contact Hour per week

Introduction to semiconductors; p-type and n-type semiconductors; p-n junction diode characteristics; Diode applications; half and full wave rectifiers; clipping and clamping circuits; regulated power supply using zener diode, Bipolar Junction Transistor (BJT); principle of operation; I-V characteristics; Transistor circuit configurations (CE, CB, CC), BJT biasing; load lines; BJTs at low frequencies, Hybrid model, h parameters, simplified hybrid model; Small signal analysis of signal analysis of single and multi-stage amplifiers; frequency response of BJT amplifiers; Field Effect Transistors (FET); principle of operation of JFET and MOSMET; Depletion and enhancement type NMOS and PMOS; biasing FETs; Low and high frequency models of FETs, Switching circuits using FETs; Introduction to CMOS. Operational Amplifiers (OpAmp); linear applications of OpAmps, gain input and output impedances; active filters; frequency response and noise.

**EEE 274 Basic Electronic Devices and Circuits Sessional**
1.5 Credit Hours, 3 Contact Hour per week

Experiments Based on EEE 273.

**EEE 375 Digital Signal Processing**
3 Credit Hours, 3 Contact Hour per week


**EEE 376 Digital Signal Processing Sessional**  
3 Credit Hours, 3 Contact Hour per week

Experiments Based on EEE 375.

**EEE 377 Random Signals and Process**  
3 Credit Hours, 3 Contact Hour per week


5.3 Civil Engineering

**EEE 165 Basic Electrical Technology**  
3 Credit Hours, 3 Contact Hours per week

Electrical units and standards. Electrical networks and circuit solution: series, parallel, node and mesh analysis. Instantaneous current, voltage and power, effective current and voltage, average power. Sinusoidal single phase RLC circuits: phasor algebra, balanced three phase circuits. Electrical wiring for residential and commercial
5.4 Water Resources Engineering

**EEE 165 Basic Electrical Technology**
3 Credit Hours, 3 Contact Hours per week


**EEE 166 Basic Electrical Technology Sessional**
1.5 Credit Hours, 3 Contact Hours per week

Laboratory experiments based on EEE 165.

5.5 Mechanical Engineering

**EEE 159 Fundamentals of Electrical Engineering**
3 Credit Hours, 3 Contact Hours per week

Laws of Electric Circuit: Ohm's law, Kirchhoff's voltage and current laws, delta wye transformation. Electrical networks: network analysis methods of branch and loop currents, method of node pair voltages, Thevenin's and Norton's theorems, magnetic concepts and units: magnetic field, right hand rule, magnetic flux density, Biot-Savart law, magnetic field intensity, measurement of magnetic flux, energy of magnetic field, characteristic of ferromagnetic materials, theory of ferromagnetism, B-H curve, hysteresis loss, eddy current and eddy current loss, total core loss, introduction to magnetic circuits. Electromagnetic forces: forces upon a current carrying conductor and charges particle moving in a magnetic field. Electromagnetic torque; electric motor.
conductor and charges particle moving in a magnetic field. Electromagnetic torque, electric motor. Electromagnetic induction and emf; Lenz's law, Bτv rule, elementary ac generator.


**EEE 160 Fundamentals of Electrical Engineering Sessional**
0.75 Credit Hours, 3 Contact Hours per alternate week

Laboratory experiments based on EEE 159.

**EEE 259 Electrical and Electronic Technology**
4 Credit Hours, 4 Contact Hours per week

Balanced three phase circuit analysis and power measurement. Single phase transformer- equivalent circuit and laboratory testing, introduction to three phase transformers. DC generator principle, types, performances and characteristics. DC Motor: principles, types of motor, performances, speed control, starters and characteristics. AC Machines: three phase induction motor principles, equivalent circuit. Introduction to synchronous machines and fractional horse power motors.

Semiconductor diode, transistor characteristics, equivalent circuits, self biasing circuits, emitter follower amplifiers, push pull amplifier. Introduction to silicon controlled rectifier and its application. Oscilloscope. Transducers: strain, temperature, pressure, speed and torque measurement.

**EEE 260 Electrical and Electronic Technology Sessional**
1.5 Credit Hours, 3 Contact Hours per week
Laboratory experiments based on EEE 259.

5.6 Chemical Engineering

EEE 155 Electrical Engineering Fundamentals
3 Credit Hours, 3 Contact Hours per week
Electrical units and standards, electrical networks and circuit theorems, introduction to measurement and instrumentations.
Alternating current, RLC series, parallel circuits, magnetic concepts and magnetic circuits.

EEE156 Electrical Engineering Fundamentals Sessional
1.5 Credit Hours, 3 Contact Hours per week
Laboratory experiments based on EEE 155.

EEE 267 Electrical and Electronic Technology
3 Credit Hours, 3 Contact Hours per week
EEE 268 Electrical and Electronic Technology Sessional
1.5 Credit Hours, 3 Contact Hours per week

Laboratory experiments based on EEE 267.

5.7 Materials and Metallurgical Engineering

EEE 155 Electrical Engineering Fundamentals
3 Credit Hours, 3 Contact Hours per week

Electrical units and standards, electrical networks and circuit theorems, introduction to measurement and instrumentations.

Alternating current, RLC series, parallel circuits, magnetic concepts and magnetic circuits.

EEE 156 Electrical Engineering Fundamentals Sessional
1.5 Credit Hours, 3 Contact Hours per week

Laboratory experiments based on EEE 155.

EEE 267 Electrical and Electronic Technology
3 Credit Hours, 3 Contact Hours per week

Balanced three phase circuits. Introduction to single phase and three phase transformers. Principles of construction, operation and applications of DC generator, DC motor, synchronous generator, synchronous motor and induction motor. Semiconductor diode, transistors, operational amplifiers (Op-Amps), silicon controlled rectifiers (SCRs); principles of operation and applications. Oscilloscope, Transducers; temperature, pressure
rectifiers (SCRs): principles of operation and applications. Oscilloscope. Transducers: temperature, pressure, flow rate, speed and torque measurements.

5.8 Naval Architecture Marine Engineering

EEE 161 Electrical Engineering Principles
3 Credit Hours, 3 Contact Hours per week


Fundamentals of DC generators, DC motors: principle and operation.

EEE 261 Electrical and Electronic Technology for Marine Engineers
3 Credit Hours, 3 Contact Hours per week

Three phase induction motors. AC generators, synchronous motor, speed control of three phase motors. Diodes, BJTs, diode and BJT circuits, BJT, MOSFET and SCR as power switching devices, controlled rectifiers and inverters.

Radar and wireless equipment, electronic navigation aids, LORAN, RDF and Decca Chain.

EEE 262 Electrical and Electronic Technology for Marine Engineers Sessional
1.5 Credit Hours, 3 Contact Hours per week

Laboratory experiments based on EEE 261.
5.9 Industrial Production Engineering

EEE 167 Basic Electrical and Electronic Circuits
4 Credit Hours, 4 Contact Hours per week

Direct Current Circuits: laws and theorems, DC network analysis.

Alternating current: AC quantities and sinusoidal waveforms, phasors, AC circuit analysis: series and parallel branches RL, RC and RLC. Balanced three phase circuits.

Semiconductor diode: operation, characteristics and applications. Introduction to bipolar transistor (BJTs): characteristics, common emitter (CE), common base (CB) and common collector (CC) amplifier configurations.

EEE 168 Basic Electrical and Electronic Circuits Sessional
1.5 Credit Hours, 3 Contact Hours per week

Laboratory experiments based on EEE 167.

EEE 271 Electrical Machines and Electronics
3 Credit Hours, 3 Contact Hours per Week

Single phase transformer. DC motor: principle and applications. Three phase induction motor: principle and applications. Introduction to synchronous motors and fractional horse power motors.

Introduction to operational amplifiers (Op-Amps) and applications. Silicon controlled rectifier (SCR): operation and characteristics. Power control using SCR. Transducers: strain, temperature, pressure, speed and torque measurements.
EEE272 Electrical Machines and Electronics Sessional
1.5 Credit Hours, 3 Contact Hours per week

Laboratory experiments based on EEE 271.

5.10 Architecture

EEE 373 Basic Electrical Engineering For Architects
2 Credit Hour, 2 Contact Hour per week

Introduction to electricity; Basic principles, electrical circuit theorems for DC and AC. Illumination: Lighting fundamentals, various light sources, lighting for various applications, Introduction to electrical distribution wiring layout, substation layout and renewable energy system in a building.