CHITTAGONG INDEPENDENT UNIVERSITY (CIU)
UNDERGRADUATE CURRICULUM
SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

B.Sc. in Electrical & Electronic Engineering In order to obtain a B.Sc. in **Electrical & Electronic Engineering**, a student must complete a minimum of **140 c**redits of coursework. This includes **32** credits of Foundation Studies. The minimum requirement for the major is **93** credit hours including **6** credit hours of internship / senior project and minor **15** credits hours.

Foundation Courses		**32 Credits**
Communication Skills		**6**
ENG 101	Listening and Speaking Skills	3
ENG 105	Business English	3
ENG 106	Advanced English Skills	3
Computer Skills		**3**
CSC 101	Introduction to Computer Science	3
Numeracy		**6**
MAT 102	Linear Algebra & Coordinate Geometry	3
MAT 212	Probability & Statistics for Sc. & Engr.	3
Natural Sciences		**8**
PHY 101	Physics-I	3
PHY 101L	Physics-I Lab	1
CHEM 101	Chemistry	3
CHEM 101L	Chemistry Lab	1
PHY 102	Physics-II	3
PHY 102L	Physics-II Lab	1
Social Sciences		**3**
SOC 101	Introduction to Sociology	3
HEA 101	Health and Society	3
ECN 200	Introduction to Economics	3
Humanities		**3**
FRN 101	Elementary French	3
HST 103	History and Civilization	3
ACN 201	Principles of Accounting	3
Live-in-Field Experience		
LFE 201	Live-in-Field Experience	3

Course Descriptions of Foundation Courses

ENG 101 Listening and Speaking Skills (3 credits)
Listening for main ideas and specific information, getting meaning from context, identifying stressed words and reductions, listening for advice, directions, understanding instructions, guessing meaning, inferring, predicting, listening to lectures and note taking, listening to narratives and amusing anecdotes. Speaking as social interaction, to obtain and give information, telephone conversations, introductions, greetings, partings, giving instructions, making complaints, apologies, giving directions, opinions and suggestions, expressing feelings and moods, attitudes and opinions. Classroom interaction, asking for clarification and giving explanations, descriptions, comparisons, analysis, and evaluations. Speeches, presentations, debates and discussions at seminars and conferences. Pronunciation with emphasis on intonation, stress patterns, paralinguistic, features.

ENG 105 Business English (3 credits)
The role of communication in business organization, a model of the communication process, perception and reality, the filter of the mind, some malfunctions of communication, principles of clear business writing, qualities of effective business correspondence, the direct approach letters, the indirect approach, persuasive requests and collection letters, sales letters, job applications and resume writing, office memorandums, the problems and organization of a report, determination of a report make-up, techniques of writing a report, visual aspects in a report, public speaking and oral communication.

ENG 106 Advanced English Skills (3 credits)
Advanced skills in reading- Critical reading and responding, analysis and evaluation of texts styles, comparing different purposes and registers, writing critiques of articles, text books and reviews, reading scientific and technical articles, journals and research papers. Writing in response to reading, notes, summaries, term papers, seminar and workshop presentations, collaborative writing on wider topics. Speeches and debates. Writing in narrative and expository modes. Writing research papers, abstracts, formulating thesis questions and statements, making bibliographic surveys, writing research questions for surveys and interviews, gathering and presentation of data, drawing conclusions, abbreviations and numbers, quotations, footnotes and references, bibliographies, tables, illustrations, editing and proofreading. Term paper mandatory.

CSC 101 Introduction to Computer Science (3 credits)
Introduction to Desktop personal computers. Hardware and software. Basic idea of the working of microprocessors. Storage devices. System components: Variation. Basic concepts of BIOS. Diskette Operating System. Internal and external commands. Function keys. Line editors and screen editors. Batch files. BASIC programming language Variable and constants. Mathematical operations. Conditional branching.

Looping and arrays. Dimensioning arrays. Subprograms. ho operations. Word Processing: On-and practice wit one of the word processors: Word, WordPerfect or WordStar. Will cover: Basic editing, formatting, pagination, margin control, spell checking, searching and sorting.

MAT 102 Linear Algebra & Coordinate Geometry (3 credits)

Linear algebra:

Introduction to systems of linear equations. Gaussian elimination. Definition of matrices. Algebra of matrices. Transpose of a matrix. Factorization, Determinants. Quadratic forms. Matrix polynomials. Euclidean n-space. Linear transformation from IR^n to IR^m. Real vector spaces and subspaces. Basis and dimension. Rank and nullity. Inner product spaces Gram-Schmidt process and QR-decomposition. Eigen values and Eigen vectors. Diagonalization. Linear transformations, Kernel and range. Application of linear algebra to electric networks.

Coordinate Geometry:

Coordinate Geometry of 2-dimension-change of axis, Transformation of coordinates. Simplification of equations of curves, Coordinate geometry of 3-dimension system of coordinates, distance between two points, section formula, projection, direction cosines, equations of planes and lines.

MAT 212 Probability & Statistics for Sc. & Engr. (3 credits)

Discrete and continuous random variables; probability concepts; discrete and continuous distributions; Binominal, Poisson, Normal, Exponential distributions; moments and moment generating functions; joint probability distributions; sampling distributions; confidence intervals; least-square regression; hypothesis testing; analysis of variance; Markov process, Monte-Carlo simulation.

PHY 101 Physics - 1 (3 credits)

Waves and Oscillations: Simple harmonic motion, Differential equation of simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillation, spring mass system, torsion pendulum, two body oscillation, reduced mass, damped oscillation, forced oscillation, resonance, vibrations of membranes and columns, progressive and stationary wave, group and phase velocities, sound waves-Doppler effect, Sabine's formula, architected acoustics.

Optics: Defects of images: Spherical aberration, astigmatism, coma, distortion, curvature, chromatic aberration, theories of light, Haygen's principle; Interference of light: young's double slit experiment, displacement of fringes and its uses, Fresnel bi-prism, interference in thin film, Newton's rings, interferometers, Differentiation: Diffraction by single slit, Diffraction from a circular aperture, resolving power of optical instruments, diffraction at double slit and N-slits, diffraction grating, Polarization: production and analysis of polarized light, Brewster's law, Malu's law, polarization by double refraction, Nicol prism, optical activity, polarimeters, optics of crystal optical effect in crystal, laser, nonlinear optics.

Thermal Physics: Heat and work, Zeroth law of thermodynamics, thermometer, thermocouple, the first law of thermodynamics and its applications, Kinetic theory of

gases- kinetic interpretation of temperature, specific heats of ideal gases, equipartition of energy, mean free path, work done by gas, isothermal and adiabatic relations, vandarwaal's equation of state, Maxwell's distribution of molecular speeds, reversible and irreversible processes, Carnot's cycle, second law thermodynamics, Carnot's theorem, entropy, thermodynamics functions, Maxwell relations, Clausius and Clapeyron equation.

PHY 101L Lab work based on PHY1 (1 credit)

PHY 102 Physics II (3 credits)

Atomic Structure: Rutherford scattering, atomic structure (Bohr model, Thomson model, Rutherford model), Zeeman Effect.

Structure of Matter: Classification of solids, crystal structure of solids, Bragg's law, Distinction between metal, insulator and semiconductor.

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.

Nuclear Physics: Constituent of atomic nucleus, nuclear binding energy, different types of radioactivity, radioactive decay law, Nuclear reactions, nuclear fission, nuclear fusion.

Mechanics: Linear momentum of a particle, linear momentum of a system of particles, conservation of linear momentum, some applications of a system particles, Kepler's law of planetary motion, the law of Universal Gravitation, the motion of planets and satellites.

Introductory Quantum Mechanics: Wave function, uncertainty principle, postulates, Schrodinger time independent equation, expectation value, probability, particle in a Zero potential, calculation of energy.

PHY102L Lab work based on PHY2 (1 credit)

CHEM 101 Chemistry (3 credits)

Matter and energy. Modern concept of the structure of atom. Concept of the Periodic Table of elements. Concept of chemical bonds. Concept of mole, chemical reactions and ideal gas laws. Modern concept of acids and bases. Energetic and chemical equilibrium. Chemical kinetics: rate, order, rate constant and Arrhenius equation. Concepts of catalysis and photochemical reactions. Organic chemistry: concepts of saturated hydrocarbons, unsaturated hydrocarbons, alcohols, fatty acids and aromatic hydrocarbons. Concept of chemical industries in Bangladesh: case studies: chemical fertilizer, paper, sugar and leather.

CHEM 101L Lab work based on CHEM1 (1 credit)

SOC 101 Introduction to Sociology (3 credits)

Introductory Sociology is designed to acquaint the beginning students with the major concepts and theories. With a brief discussion of its history and contributions of the

major sociologists the course introduces the students to the methodology of social research. The course then looks at the major concepts, like culture, groups, socialization, deviance and social control. The next section deals with social inequality in terms of social stratification, global inequality, and inequalities among ethnic groups, gender and of age. It then moves to the different institutions like, family, religion, education, economy, and government and politics. The next section deals with population, environment, urbanization and finally with collective behavior and social movements and social change.

HEA 101 Health and Society (3 credits)
This course aims to introduce students to an understanding of key sociological approaches to the analysis and understanding of health and society. The course covers concepts of health and disease, patterns of health and the social construction of disease. Special attention is given to develop knowledge on theories central to the notion of health, including the social, cultural and institutional forces and context that play a role on health and health related practices. The purpose is to help establish a perspective that will enable the students to better understand the relationship between health and society as well as to provide skills and knowledge for research experiences. The course also provides an overview of the basic concepts of population studies that will help students develop their own demographic perspective, enabling them to understand some of the most important issues confronting the world. The course will use a combination of methods, such as lectures, debates, preparation of assignments by reviewing journal articles and presentation.

ECN 200 Introduction to Economics (3 credits)
Basic concepts of economics. Distinction between Micro and Macro Economics. General view of price system: Demand and Supply. Elasticity of demand and supply. Consumer's behavior: Utility analysis, Inferior good and Giffen good. Market structures: Perfect competition, Monopoly, Monopolistic competition and Oligopoly. Factors of production: labor, land, capital and entrepreneur. Basic concepts of Macroeconomics. Circular flow of income, mixed economy, private and public sector economic interactions. Measuring domestic output: national income and the price level. Aggregate Expenditures Model. The Multiplier, net exports, and government. Aggregate demand and aggregate supply of money. Money market equilibrium.

Credit creation by banking system. Monetary policy. Some concepts of international Trade, exchange rate determination and economic development.

HST 103 History & Civilization (3 credits)
Meaning, Growth and Spread of civilization The Ancient Near East: Mesopotamia- Egypt- The Hebrews- The Hittites Canaanites - Philistine - Phoenicians - Crete - Mycenae _ The Classical World the Greeks and the Romans - The Medieval Age: Christianity, Barbarian invasions, Feudalism, Manorial System, Growth of towns and Universities - Byzantine civilization and the formation of Russia - Early Culture in America: The Mayas, the Aztecs, the Incas - The Renaissance and the Reformation -

Government and Societies in the Age of Absolutism - The Age of Explorations – The formation of Latin American - the Scientific and Industrial Revolutions – Consolidation of Europe's Global dominance - World War I - The Bolshevik Revolution in Russia.

FRN 101 Elementary French I (3 credits)
Letters of alphabet. Accents and their pronunciation. Definite and indefinite articles (feminine/masculine, singular/plural). Personal pronouns. Auxiliaries "to be" and "to have", verbs ending with '-er', in the present tense. Interrogative, negative form. Simple adjectives (descriptive, colors). Presenting onself.

ACN 201 Principles of Accounting (3 credits)
An introduction. The recording Process. Adjusting the Accounting and Preparing the Statements. Completion of the Accounting Cycle. Accounting for Merchandizing operation. Special journals. Preparation of Income Statement and Balance sheet for companies. (According to Company Act 1994). Introduction to Accounting Principles.

Live-in-Field Experience
LFE 201: Live-in-Field Experience (3 credits)

The course is intended to expose CIU students to experience life in the cross-cultural situation obtained in the country, and to the practice of the field survey method. It is usually offered during the semester break in the winter.

Core Courses		40 Credits
CCR 205	Programming Concepts	3
CCR 205L	Lab work based on CCR 205	1
ECR 101	Introduction to Electrical Engineering	3
ECR 101L	Lab work based on ECR 101	1
ECR 205	Digital Circuits	3
ECR 205L	Lab work based on ECR 205	1
ECR 206	Electrical Circuits	3
ECR 206L	Lab work based on ECR 206	1
ECR 207	Electronics I	3
ECR 207L	Lab work based on ECR 207	1
ECR 209	Microprocessors and Interfacing	3
ECR 209L	Lab work based on ECR 209	1
ECR 250	Numerical Methods for Engineering	3
ECR 250L	Lab work based on EEE 250	1
ECR 301	Telecommunication Systems I	3
ECR 301L	Lab work based on ECR 301	1
ECR 305	Introduction to Digital Signal Processing	3
ECR 305L	Lab work based on ECR 305	1
ECR 407	Electronics II	3
ECR 407L	Lab work based on ECR 407	1
Concentration		**38 Credits**
EEE 302	Electrical Machines I	3
EEE 302L	Lab work based on EEE 302	1
EEE 303	Electrical Machines II	3
EEE 303L	Lab work based on EEE 303	1
EEE 304	Electromagnetic Theory & Applications	3
EEE 308	Systems & Control	3
EEE 308L	Lab work based on EEE 308	1
EEE 340	Measurement and Instrumentation	3
EEE 340L	Lab work based on EEE 340	1
EEE 350	Optoelectronics	3
EEE 402	Power System I	3
EEE 402L	Lab work based on EEE 402	1
EEE 403	Power System II	3
EEE 403L	Lab work based on EEE 403	1
EEE 413	Solid State Electronics	3
EEE 413L	Lab work based on EEE 413	1
EEE 450	Power System protection	3

EEE 450L	Lab work based on EEE 450	1
Optional Courses (Any three)		**9 Credits**
EEE 404	Optical Communication	3
EEE 405	Digital Modulation & Coding	3
EEE 406	Telecommunication Systems II	3
EEE 409	Computer Systems Engineering	3
EEE 410	Wireless Data Communication Systems	3
EEE 412	Mobile & Satellite Communication Systems	3
EEE 414	Electrical Drive Systems	3
EEE 416	Microwave Engineering	3
EEE 418	Embedded Systems	3
EEE 430	Semiconductor Devices	3
EEE 431	Microelectronics	3
ECR 433	Engineering Economics & Finance	3
EEE 435	Robotics	3
EEE 440	Engineering and Technology Management	3
EEE 445	Energy & Environment	3
EEE 490	Special Topics in Electrical & Electronic Engineering	3
Internship Program or Senior Project		**6 Credits**
EEE 498	Senior project	6
EEE 499	Internship Program	6

Course Description of Major in **Electrical & Electronic Engineering**

Core Courses

CCR 205 Programming Concepts: (3 credits)
Introduction to digital computers.
Programming languages, algorithms and flow charts.
Structured programming using C:
Variables and constants, operators, expressions, control statements, functions, array, pointer, structure union, user defined data types, Input-Output files.
Object Oriented Programming using C++:
Introduction, Classes and Objects, Polymorphism, Function and Operator Overloading, Inheritance.

CCR 205L Lab work based on CCR 205 (1 credit)

ECR 101Introduction to Electrical Engineering: (3 credits)
Electrical Circuit Concepts & Units- Voltage, Current, Power & Energy, Resistance & Conductance, Ohms Law, KVL, KCL, Series & Parallel dc Circuits & networks.
Methods of Analysis- Branch-Current Analysis, Node & Mesh Analysis, Bridge Networks, Y-Δ transformation.
Network Theorems- Superposition, Thevenin's, Norton's, Maximum Power Transfer Theorem & Reciprocity Theorem.
Energy Storage Elements- Inductors & Capacitors & Their Characteristics, Series-Parallel Combination of Inductors & Capacitors.
Responses of RL & RC Circuits- Natural & Step Responses.
Magnetic Quantities & Variables- Flux Permeability & Reluctance, Magnetic Field Strength, Magnetic Potential, Flux Density Magnetization Curve.
Laws in Magnetic Circuits- Ohm's Law, Ampere's Circuit Law, Series & Parallel Magnetic Circuits.

ECR 101L Lab work based on ECR 101 (1 credit)

ECR 205: Digital Circuits (3 credits)
Realizations of combinational circuit: MSI devices, ROM's. PLA's. Synchronous. Sequential logic circuits: latches, flip flops, counters, registers. Algorithmic state machines: systematic design applications. PLD's, VHDL.

ECR 205L Lab work based on ECR 101 (1 credit)

ECR 206 Electrical Circuits (3 credits)
Analysis of Single Phase AC circuits:

Series and Parallel RL, RC and RLC circuits, Resonance in AC circuits, Series and Parallel resonance. Q of a circuit, nodal and mesh analysis, application of network theorems in AC circuits, Circuits with non-sinusoidal excitations, transient in AC circuits,

Analysis of poly phase Circuits:

Poly phase supply, 3-phase conditions, balanced and unbalanced circuits, power calculation.

Magnetically couple circuits:

Self and mutual inductances, coupling co-efficient, reflected impedance, transfer impedance.

Two port networks (TPN):

Two port networks (symmetrical & asymmetrical), determination of two port parameters, relationship between two port parameters, equivalent. π and T equivalent networks.

Filter:

Passive filters, fundamental equations of an ideal filter, theorem connecting characteristics impedance and attenuation, impedance matching of filters, composite filters, band pass and band stop filters.

ECR 206L Lab work based on CCR 206 (1 credit)

ECR 207 Electronics I (3 credits)

P-N Junction as a Circuit Element:

Intrinsic and extrinsic semiconductors, operational principles of p-n junction diode, contact potential, biasing of diode, current-voltage characteristics of a diode, simplified DC and AC diode models, dynamic resistance and capacitance.

Diode Circuits:

Half wave and full wave rectifiers with filter capacitor, characteristics of a Zener diode, Zener shunt regulator, clamping and clipping circuits.

Bipolar Junction Transistor (BJT):

Voltage and current gain, input output impedance of common base, common emitter and common collector amplifier circuits, multistage amplifiers.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET):

Structure and physical operation of an enhancement MOSFET, threshold voltage, body effect, current-voltage characteristics of an enhancement MOSFET, biasing discrete and integrated amplifier circuits, single-stage MOS amplifier, MOSFET as switch, introduction to VMOS and CMOS inverter, Differential and multistage amplifiers, small-signal operation, differential and common mode gains.

Junction Field-Effect-Transistor (JFET):

Structure and physical operation of JFET, transfer characteristics, pinch-off voltage.

ECR 207L Lab work based on ECR 207 (1 credit)

ECR 209 Microprocessors and Interfacing (3 credits)

The programmer's model of a microprocessor: writing assembly language programs. The hardware model of a microprocessor: synchronous and asynchronous busses. Interfacing concepts: I/O Organization, address decoding, static and dynamic memory interfacing. Direct I/O for simple peripherals. I/O support devices: PIAs, ACIS. Interrupt-driven I/O: interrupt vectors, interrupt handlers, DMA controllers, Standard microcomputer busses: VME, EISE, SCSI and

others. Laboratory interfacing experiments using 8-bit and 16-bit hardware, assembly language software, real-time kernels and operating systems.

ECR 209L Lab work based on ECR 209 (1 credit)

ECR 250 Numerical Methods for Engineering (3 credits)
Introduction:
Motivation and errors in numerical techniques, Taylor series.
Finite Difference Calculus:
Forward, backward, divided, and central difference and difference of polynomial.
Interpolation and Extrapolation:
Iteration, bisection, false position. Raphson, Secant and Muller's methods.
Simultaneous Linear Algebra Equations:
Cramer's rule, Inversion of matrices, Gauss elimination, Gauss-Jordon method, factorization and Gauss-Siedel iteration methods.
Curve fitting:
Linear and polynomial regression, fitting power, exponential and trigonometric functions, ordinary differential equations, initial value problem, Taylor's series method, Picard's methods of successive approximation, Euler's method and RungeKutta method, Boundary value problems.
Numerical Integration:
General quadratic formula, trapezoidal rule and Simpson's rule, numerical differentiation.

ECR 250L Numerical Methods for Engineering Lab: (1 credit)
Laboratory experiments based on theory and concepts learnt in EEE340

ECR 301 Telecommunication Systems I (3 credits): To present a general introduction to telecommunications aspects such as signal acquisition, transmission and processing in communication systems. This subject is intended for telecommunication engineering students as a necessary background, and also for electrical or computer engineering students not specializing in telecommunications as a general knowledge. Including: Characteristics of typical communication channels; Typical signals (speech, audio, video, data) and their characteristics; Basic analogue and digital techniques; Key techniques in handling transmission system issues (modulation, coding, multiplexing, etc); System performance and evaluation (channel noise, inters symbol interference, bit error rate, etc.); Major communication systems including telephony, radio, TV, satellite, mobile phone, optical fiber, radar and networks.

ECR 301L Lab work based on ECR 301 (1 credit)

ECR 305 Introduction to Digital Signal Processing (3 credits): The mathematics of signals and linear systems. Fourier and Laplace transforms, discrete Fourier and Z transforms. Analogue filters: approximation theory, Butterworth, Bessel, Chebyshev and elliptic filters. Filter impulse

and frequency responses, stability, and sensitivity. Sampling continuous signals: the sampling theorem, reconstruction, and aliasing. The discrete Fourier transform (DFT) and the fast Fourier transform (FFT). Fundamentals of the design and realization of finite impulse response (FIR) and infinite impulse response (IIR) digital filters. Digital processing of analog signals, including applications of digital signal processing (DSP) and programmable DSP chips. The representation and modeling of non-deterministic (random) signals, correlation functions, and power density spectra.

ECR 305L Lab work based on ECR 305 (1 credit)

ECR 407 Electronics II (3 credits)

Frequency Response of Amplifier:

Poles, Zeros, and Bode plots, amplifier transfer function, techniques of determining 3 dB frequencies of amplifier circuits, frequency response of single-state and cascade amplifiers, frequency response of differential amplifiers.

Operational Amplifiers (Op-Amp): Properties of ideal Op-Amps, non-inverting and inverting amplifiers, inverting integrators, differentiator, weighted summer and other applications of Op-Amp circuits, Electronic Analog computation Schmitt trigger, Differential Amp, Differential and common gain, comparators, effects of finite open loop gain and bandwidth on circuit performance, logic operation of Op-Amp

Feedback Amplifiers:

Properties, basic topologies, feedback amplifiers with different topologies, stability, frequency compensation.

Active Filters:

Different types of filters and specifications, transfer functions, realization of first and second order law, high and band pass filters using Op-Amps.

Oscillators and Timing Circuits:

Sinusoidal oscillators, Phase shift oscillator, resonant circuit oscillator, general form of oscillator circuit, wein-bridge oscillator, crystal oscillators, Bi-stable, mono-stable, Astablemultivirators, IC555 and its applications. VCO, PLL and Blocking oscillator.

ECR 407L Lab work based on ECR 407 (1 credit)

Concentration

EEE 302 Electrical Machines I (3 credits)

DC Generator:

Types, no-load voltage characteristics, buildup of a self-excited shunt generator, critical field resistance, load-voltage characteristics, effect of speed on no-load and load characteristics and voltage regulation. Armature reaction, losses and efficiency, Parallel operation of DC generators.

DC Motor:

Torque, counter EMF, speed, torque-speed characteristics, starting and speed regulation.

Speed control by converter and chopper, Crane, Traction and hoist application of DC motor, Choice of DC motors for different applications.

Transformer:

Ideal transformers- transformation ratio, no-load and load vector diagrams, actual transformer-equivalent circuit, regulation, short circuit and open circuit tests. Three phase transformers and its V-connection, Scott connections, three phase operation of single-phase transformers, Induction voltage regulators, Autotransformers: three phase and single phase, power transformers: bushing, Cooling. Tap changing and parallel operation.

EEE 302L Lab work based on EEE 302 (1 credit)

EEE 303 Electrical Machines II (3 credits)

Three phase Induction Motor:

Rotating magnetic field, equivalent circuit, vector diagrams, torque-speed characteristics, effect of changing rotor resistance and reactance on torque-speed curves, motor torque and developed rotor power, no-load test, blocked rotor test, starting and breaking and speed control.

Single Phase Induction Motor:

Theory of operation, equivalent circuit and starting.

Synchronous Generator:

Windings, excitation systems, equivalent circuit, vector diagrams at different loads, factors affecting voltage regulation, synchronous impedance methods of predicting voltage regulation and its limitations, Parallel operation: necessary conditions, synchronizing, circulating current and vector diagram.

Synchronous Motor:

Operation, effect of loading under different excitation condition, effect of changing excitation V-curves and starting.

EEE 303L Lab work based on EEE 303 (1 credit)

EEE 304 Electromagnetic Theory & Applications (3 credits): General field properties. Electric and magnetic fields. Inductance and capacitance. Dielectric and magnetic materials and their applications. Electrodynamics forces. Transformer and motor action: rotating magnetic fields. Dielectric and induction heating. Applications of Maxwell's equation. Transmission lines from circuit and electromagnetic viewpoints. Electromagnetic radiation. Some health and regulatory considerations.

EEE 308 System & Control (3 credits): History of feedback control, Differential equations, Laplace transforms, Transfer functions, Poles & Zeros, State space models, Computer model of 2nd order system, Modeling mechanical systems, Gears, DC servo motor and load, First and second order systems, Underdamped systems, Block diagram algebra, Signal flow graphs, Mason's rule, Stability, Routh-Hurwitz criterion, Steady state errors, Static error constants and system type number, Steady state errors for disturbances, Root locus theory, rules for sketching root locus, Generalized root locus, Transient response design via gain adjustment, Pole sensitivity, Design via root locus, Ideal integral control, Lag compensation, PD control, PID control, Lag-lead ompensation, Feedback compensation, Bode plots, Nyquist plots, Nyquist stability criterion, Gain margin and phase margin, Time delay, Stability via Bode plots, Closed-loop transient vs open-loop frequency response, M&N circles, Nichols chart, Introduction to design via frequency response ,Gain adjustment, Lag compensation, Lead compensation.

Practical classes include Matlab tutorials linked to lectures and construction and testing of DC servo motor feedback control systems.

EEE 308L Lab work based on EEE 308 (1 credit)

EEE 340 Measurement and Instrumentation (3 credits)

Introduction:

Applications, functional elements of a measurement system and classification of instruments.

Measurement of Electrical Quantities:

Current and Voltage, power and energy measurement, Current and potential transformer.

Transducers:

Mechanical, electrical and optical transducers.

Measurement of Non-Electrical Quantities:

Temperature, pressure, flow, level, strain, force and torque, earthquake, speed, frequency, phase difference.

Basic Elements of DC and AC signal Conditioning:

Instrumentation amplifier, noise and source of noise, noise elimination compensation, function generation and linearization, A/D and D/A converters, sample and hold circuits.

Data Transmission and Telemetry:

Methods of data transmission, DC/AC telemetry system and digital data transmission. Recording and display devices. Data acquisition system and microprocessor applications in instrumentation.

EEE 340L Lab work based on ECR 250L (1 credit)

EEE 350 Optoelectronics

Optical Properties of Semiconductor

Direct and indirect band-gap materials, radiative and non-radiative recombination, optical absorption, photo-generated excess carriers, minority carrier life time, luminescence and quantum efficiency in radiation.

Properties of Light:

Particle and wave nature of light, polarization, interference, diffraction and black body radiation.

Light Emitting Diode (LED):

Principles, materials for visible and infrared LED, internal and external efficiency, loss mechanism, structure and coupling to optical fibers.

Simulated Emission and Light Amplification:

Spontaneous and simulated emission, Einstein relations, population inversion, absorption of radiation, optical feedback and threshold conditions,

Semiconductor Lasers:

Population inversion in degenerate semiconductors, laser cavity, operating wavelength, threshold current density, power output, hetero-junction lasers, optical and electrical confinement. Introduction to quantum well lasers.

Photo Detectors:

Photoconductors, junction photo-detectors, PIN detectors, avalanche photodiodes and phototransistors.

Solar Cells:
Solar energy and spectrum, silicon and Schottkey solar cells.

Modulation of Light:
Phase and amplitude modulation, electro-optic effect, acousto-optic effect and magneto-optic devices, introduction to integrated optics.

EEE 402 Power system I (3 Credits)

Inductance and Capacitance of overhead power line:
Flux, Linkages, inductance due to external flux, inductance of single-phase two-wire line, composite conductor lines, G.M.D. 3-phase line with equilateral and with unsymmetrical spacing, parallel circuit of 3-phase line, and use of tables, Electric field, capacitance of two wire line, three-phase lines with symmetrical & with equilateral spacing, effect of earth.
Line representation: equivalent circuit of long transmission line, Underground and overhead line,
Generalized line constants:
General line equations in term of ABCD constants, relations between constants, charts of line constants, constants of combined networks measurement of line constants.
Insulators for Overhead line:
Types of insulators, their constructions and performance, potential distribution in a string of insulators, string efficiency, methods by equalizing potential distribution, special types of insulators, testing of insulator.
Insulated Cables:
Underground cables VS overhead lines, insulating materials, electro static stress grading, three core cable-dielectric losses and heating, modern developments oil filled and gas filled cables, measurements of capacitance, cable testing, corona and corona power loss.
Mechanical Characteristics of transmission line:
Sag and stress analysis, effect of wind and ice loading, supports at different elevation, condition of erection, effects of temperature changes.
Power distribution:
DC and AC distribution calculation for different network configuration, typical layout of a substation.

EEE 402L Lab work based on EEE 402. (1 credit)

EEE 403 Power system II (3 credits)
System modeling: Review of synchronous machine, the effect of synchronous machine excitation, per unit quantities, changing the base of per unit quantities, per unit impedance in single phase transformer and three phase transformer circuits, per unit impedance of three winding transformers, one-line diagram, impedance and reactance diagram, per unit and percentage method of calculations, advantages and disadvantages of per unit computations.
Network calculations: Node equation, matrix partitioning, node elimination by matrix algebra, bus admittance and impedance matrices, modification of an existing bus impedance matrix, direct determination of bus impedance matrix.

Load flow solution and control: Classification of buses, specification of bus voltage-power etc, Gauss-Seidel method and Newton-Raphson method of load flow solutions, some principles of load flow control.
Symmetrical components: Symmetrical components of unsymmetrical phasors, sequence impedance and sequence networks, sequence network of unloaded generators, positive and negative sequence networks, zero-sequence networks.
Unsymmetrical faults: Unsymmetrical short-circuits on an unloaded generator, single line-to-ground fault, line-to-line fault, double line-to-ground fault, unsymmetrical faults of power systems, faults through impedance, unsymmetrical open circuits and series impedances.
Power system stability: The stability problem of power system, swing equation, power-angle equation, equal area criterion of stability.
Multi-machine stability studies: Classical representation, step-by-step solution of the swing curve, factors affecting stability, techniques for improving stability.

EEE 403L Lab work based on EEE 403. (1 credit)

EEE 413 Solid State Electronics (3 credits): Modern power semiconductor devices e.g., diodes, thyristors, MOSFETs, and other insulated gate devices such as the IGBT, MCT and the FCT; Static and switching characteristics, gate drive and protection techniques; Various DC-DC, AC-DC, DC-AC and AC-AC converter circuit topologies, their characteristics and control techniques; Application considerations for remote and uninterruptible power supplies, and for computer systems, telecommunications, automobiles, traction and other industrial processes; Utility interaction, harmonic distortion, and power factor; EMI and EMC considerations.

EEE 413L Lab work based on EEE 413 (1 credit)

EEE 450 Power System protection (3 credit)
Purpose of power system protection, Criteria for detecting faults:
Over current, differential current, difference of phase angles, over and under voltages, power direction, symmetrical components of current and voltages, impedance, frequency and temperature.
Electromechanical, electronic and digital relays:
Basic modules, over current, differential, distance and directional, Trip circuits, Different protection scheme for generator, transformer, motor, bus bar, transmission lines, Protection of ring mains and radial feeders, Miniature circuit breakers and fuses.
Fuse:
Commercially available fuses, their constructions, characteristics and applications.
Circuit breakers:
Principle of arc excitation, selection criteria and ratings of circuit breakers, types-air, oil,SF6, vacuum, ACB, MCCB.

EEE 450L Lab work based on EEE 450. (1 credit)
Optional Courses (any three)

EEE 404 Optical Communication (3 credits): Wave propagation in single mode and multimode optical fibers. Step-index and graded index fibers. Gaussian approximation of fields in single mode fiber, spot size, equivalent step index of single mode fiber. Material, waveguide and internodes dispersions. Polarization and birefringent fibers. Ray theory, optimal profile, mode coupling in multimode fiber. Optical fiber measurement and characterization. Launching efficiencies in multimode and single mode fibers.

EEE 405 Digital Modulation & Coding (3 credits): Provides detailed understanding of techniques used to process digital information in order to ensure its reliable delivery over noisy channels. Examines the fundamental resources available to telecommunication systems and develops techniques for understanding the implications of different modulation and coding techniques on these fundamental quantities. The course also provides a general understanding of the role of digital modulation and coding in practical digital communication systems. Brief review of key concepts from signal processing, linear systems, sampling theory and source coding. Digital transmission through AWGN channels. Base band signaling and pulse shaping. Carrier amplitude, phase and frequency modulation techniques. Spread spectrum modulation. Carrier and clock synchronization. Channel capacity. Forward error correction coding. Applications of these techniques in typical digital communications systems.

EEE 406 Telecommunication Systems II (3 credits): This subject provides a fundamental coverage of important communication systems, their basic components, as well as legal and commercial aspects affecting the design and operation of these systems. This subject is intended for students who wish to major in telecommunications or to strengthen their knowledge of modern communication systems. Basic principles of guided and unguided wave propagation. Transmission aspects of voice telephony, digital networks signaling, CCITT signaling system, Asynchronous Transfer Mode (ATM), Advanced Broadband Digital Transport Formats. Broadcast radio and TV systems. Cable systems. Introduction to mobile and satellite communications.

EEE 409 Computer System Engineering (3 credits): Computer system: computer structures, components, functions, memory, I/O devices, modules, programmed and interrupt driven I/I, I/O channels and processors, interfaces; Computer peripherals: Displays, mass storage systems, printers, touch screens, digitizers, etc.; Computer network: network requirements, architecture, protocol stack models, Ethernet, Token Ring, Wireless, and FDDI networks, bridges, switching and routing in IP and ATM networks, and Internetworking.

EEE 410 Wireless Data Communication Systems (3 credits): The subject will introduce the participants to the state of the art in the area of wireless data communications. It will focus on principles, technologies, system architectures, and standards for wireless access networks, including both fixed and mobile services. In particular: Introduction to Wireless Technologies; First, Second, and Third Generation Wireless Networks; MAC Technologies for Wireless, Packet Switching, Circuit Switching, Burst Switching; Radio Resource ; Allocation and Cellular Systems; Cellular Digital Packet Data network; GSM Architecture: Routing and Flow Control Protocols, Mobility Management; High-Speed Circuit-Switched Data Services General Packet Radio Service; Enhanced Data for Global Evolution and Global Third Generation; Wireless

Local Area Network and Hyperlan Standards, Their Architecture; Broadband Wireless Access Standards; Applications of Wireless Services; Future Wireless Services and Software Radios.

EEE 412 Mobile & Satellite Communication Systems (3 credits): A specialized subject, aimed to provide a fundamental understanding of the system architecture and system design, and the effect of the channel on the performance of two of the most important digital telecommunications systems, i.e. digital cellular mobile communication and digital satellite communication. It shows how digital modulation and coding techniques taught in ETE405 Digital Modulation and Coding may be used to improve the reliability of each system. It also provides a general understanding of these systems from the network perspective. Modern communication systems from a systems point of view. Cellular mobile communication systems. Propagation-loss model. The mobile fading channel. Multiple access techniques. The GSM. Digital satellite communication systems. Satellite orbits. Station keeping. Multiple access techniques. System synchronization. DAMA. Satellite packet communication. Mobile satellite networks.

EEE 414 Electrical Drive Systems (3 credits): Electrical Drive systems. Elements of Drive systems and their requirements for servo and industrial drive applications. Drive representation, quadrant operation, dynamic and regenerative braking. Transfer function representations of dc motor and converter and drive performance analysis. Performance analysis of induction motor drives with variable voltage, voltage source, current source and variable frequency supply. Performance analysis of synchronous and reluctance motors with variable frequency supply. Transducers in electric drive systems. The analysis of asymmetrically connected induction motors. Unified machine theory. Computer aided design and analysis.

EEE 416 Microwave Engineering (3 credits): Microwave amplifiers, oscillators, mixer and detectors, and electronic switches are basic components of microwave systems. The performance of these components is critical to system performance. This module therefore teaches the design of these components to satisfy performance specifications. Topics covered: Amplifiers: theory, LNA and multistage design; Oscillator theory: nonlinear negative resistance, startup, stability, power generation; Gunn and IMPATT diode oscillators; Design of planar passive components and their application; PIN diode switch and phase shifter analysis and design; Mixers and detectors: theory, mixer and detector diodes, diode detectors and mixers.

EEE 418 Embedded Systems (3 credits): Provides a detailed overview of the important topics in the field. Typical examples of embedded systems; real time and safety critical issues; constraint driven design; systems integration; hardware-software partitioning and time-to-market considerations will be addressed. The subject will examine programmable devices, micro-controllers, application specific standard processors: importance of interrupts; re-configurable logic; system-on-a-chip; finite state machines; dataflow architectures; and distributed embedded systems. Software for embedded systems, including: programming languages and software architectures; interrupt servicing; multi-tasking; task communications and scheduling;

verification: hardware-software co-simulation; and real-time operating systems will be introduced.

EEE 430 Semiconductor Devices (3 credits): The module provides a state-of-the-art overview of devices, development and basic understanding of the physics of power semiconductors. The module covers: Carrier physics in power devices: mobility, resistively, life-time, high-level injection; Breakdown voltage and junction termination: avalanche breakdown, punch-through breakdown; Power devices: power MOSFET for synchronous rectifiers, power diode and recovery phenomena, power transistor and quasi-saturation effects, gate turn-off thyristor, MOS-controlled bipolar device; Smart power ICs: evolution, high-voltage power MOSFETs in integrated circuits, technological limitations in power ICs, protection techniques in power ICs.

EEE 431 Microelectronics (3 credits): Design techniques for hybrid microelectronics, analog integrated electronic circuits, materials and processing, design of monolithic integrated circuits, and hybrid integrated circuits; thick film circuits, thin film circuits, multichip modules, interconnects, electronic packaging, processing and fabrication of IC technologies.

ECR 433 Engineering Economics & Finance (3 credits): Introduction and review of basic concepts of engineering economics and engineering finance; marginal analysis; money and its management; debt management ; project worth analysis; rate of return analysis; project risk and uncertainty; theory and applications of engineering finance; designing, structuring, pricing and financing of engineering products, options, futures, swaps and other securities; financial & investment risk management; tools of mathematical finance, stochastic processes; stochastic interest rates; derivative trading & arbitrage; multivariate stochastic methods in finance; Black–Scholes theory; discrete-time Markov chain, Monte–Carlo simulation.

EEE 435 Robotics (3 credits): Rigid Motions and Homogeneous Transformation; Forward Kinematics: Common robot configurations; Denavit-Hartenberg convention; A-matrices; T-matrices; Inverse kinematics: Planar mechanisms; geometric approaches; spherical wrist; Velocity kinematics: Angular velocity and acceleration; Motions planning: Configuration space; artificial potential fields; randomized methods; collision detection; Trajectory generation: Joint space interpolation; polynomial splines; trapezoidal velocity profiles; minimum time trajectories; Feedback control: Actuators and sensors; transfer functions; tracking and disturbance rejection; PID control; feed forward control; resolved motion rate control; Vision-based control: The geometry of image formation; feature extraction; feature tracking; the image Jacobian; visual servo control Advanced Topics (one or more of the following depending on the instructor): Lagrangian dynamics; parallel robots; mobile robots; force sensing and force control; machine learning; advanced topics in vision; student projects; other.

EEE 440 Engineering and Technology Management (3 credits): Concepts of engineering and technology management, innovation process, technological change, technological organizations, motivation and leadership theories applicable to engineers and scientists, engineering and R&D projects, resource management in current and emerging technologies, and strategic management of technological system interfaces, communication and team building for engineering driven

organization, engineering economic analysis and economics of technology innovation, project management, productivity analysis, technology forecasting, assessment, acquisition and transfer, technopreneurship, venture financing, corporate governance and organizational transformation management.

EEE 445 Energy & Environment (3 credits): Energy conversion and the laws of Thermodynamics; chemistry of fossil fuel conversion; reaction, kinetics, entropy; availability; Gibbs function; heat engines; atmospheric & hydrologic pollution and energy conversion; nuclear energy; principles of conversion; fuel cycle; environmental issues; renewable energy resources; solar, wind, biomass and other sources of renewable energies; thermodynamics of renewable energy resources; economics of energy conversion and environmental effects.

EEE 490 Special Topics in Electrical & Electronics Engineering (3 credits): Special topics, whose contents are approved by the Academic Council, will be covered in this course.

EEE 498 Senior Project (6 credits): Students have to take either EEE 498 or EEE 499.

EEE 499 Internship (6 credits): Students have to take either EEE 498 or EEE 499. Course

Minor in Engineering Mathematics		15 Credits
Students majoring in Electrical & Electronics Engineering must take engineering mathematics as their minor. Students taking this minor will be adequately trained in mathematics to understand its application in fields of Electrical and Electronics Engineering.		
Compulsory Courses		**12 Credits**
MAT 201	Calculus	3
MAT 251	Complex Variables & Vector Analysis	3
MAT 303	Differential Equations	3
MAT 305	Boundary Value Problems	3
Optional Courses – Anyone from the following		**3 Credits**
MAT 403	Introduction to Mathematical Modeling	3
MAT 405	Optimization Techniques	3

Description of Minor in Engineering **Mathematics**

MAT 201 Calculus (3 credits)
(Differential Calculus & Integral Calculus)
Differential Calculus:
Limits, continuity and differentiability, Successive differentiation of various types of functions, Leibnitz's theorem, Rolle's Theorem, Mean value theorem, Taylor's and Maclaurin's theorems in finite and infinite forms, Lagrange's form of reminders, Cauchy's form of reminders, Expansion of functions, evaluations of indeterminate forms of L'Hospital's rule, Partial differentiation, Euler's theorem, Tangent and normal, Subtangent and subnormal in Cartesian and polar co-ordinates, Determination of maximum and minimum values of functions, Curvature, Asymptotes, curve, tracing.
Integral Calculus:
Definition, integration by the method of substitution, integration by parts, Standard Integrals. Integration by successive reduction. Definite Integrals, its properties and use in summing series. Walli's formulae. Improper integrals. Beta function and Gamma function, Area under a plane, curve and area of a region enclosed by two curves in Cartesian and polar co-ordinates, Trapezoidal and Simpson's rule, Volumes and surface areas of solids of revolution.

MAT 251 Complex Variables and Vector Analysis (3 credits)
Complex Variables:

Complex number system. General functions of a complex variable. Limits and continuity of a function of complex variable and related theorems. Complex differentiation and the Cauchy-Riemann equations. Mapping by elementary functions. Infinite series. Convergence and uniform convergence. Line integral of a complex function. Cauchy's integral formula. Liouville's theorem. Taylor's and Laurent's theorem. Singular points, Residue, Cauchy's residue theorem. Contour integration, conformal mapping.

Vector Analysis:

Scalar and vectors, equality of vectors, addition and subtraction of vectors, geometrical interpretation. Multiple product of vectors. Linear dependence and independence of vectors. Differentiation and Integration of vectors together with elementary applications. Line, Surface and volume integrals. Gradient of a scalar functions, divergence and curl of a vector function, Various formulae. Integrals form of gradient, divergence and curl. Divergence theorem, Stoke's theorem, Green's theorem and Gauss's theorem.

MAT 303 Differential Equations (3 credits)

Ordinary differential equations:

Degree and order of ordinary differential equations, formation of differential equations by various method, solution of first order differential equations. Solution of general linear equations of second and higher order with constant coefficients, applications. Solution of homogeneous linear equation of the higher order when the dependent or independent variables are absent. Solution of differential equations by the method based on the factorization of the operators. Frobenious method. Legendre and Bessel's function.

Partial Differential Equations:

Introduction linear and on-linear first order equations. Standard forms. Linear equations of higher order. Equations of the second order with variable coefficients. Wave equations. Particular solution with boundary and initial conditions.

MAT 305 Boundary Value Problems (3 credits): Bessel's functions; Legendre polynomials; Fourier series; half wave and full wave expansions; solutions of Laplace equation, Poisson's equation, wave equation and diffusion equation in orthogonal and non-orthogonal coordinate systems; Sturm-Liouville problem. Fourier and Laplace Transform in details.

MAT 403 Introduction to Mathematical Modeling (3 credits): An introduction to techniques of mathematical modeling involved in the analysis of meaningful and practical problems in many disciplines including mathematical sciences, operations research, engineering and the management and life sciences. Students will be encouraged to recognize and formulate problems in mathematical terms, solve the resulting mathematical problems and interpret the solution in real terms.

MAT 405 Optimization Techniques (3 credits): Discrete, deterministic models of interest to social sciences. Linear programming, duality, simplex method, sensitivity analysis, convex sets. Selections from assignment, transportation, network flow, nonlinear programming problems.