Premier University
Chittagong

Program:
B.Sc. in Electrical and Electronic Engineering
Syllabus: V1 (EEE 1st to 3rd Batch)

Introduction:
The B.Sc. in Electrical and Electronic Engineering (EEE) Program extends over a period of four years divided into eight semesters. Each semester is of 6 months duration. Each theory course is assigned 3 credits and the corresponding laboratory course is of 1.5. There are also credits for industrial training, project & thesis. Thus, a total of 161.5 credit hours are required for a B.Sc. in EEE degree.

Objectives of the EEE Program:
This curriculum has been designed carefully for imparting scientific knowledge in Electrical and Electronic Engineering to the student so as to enable them to become future professionals. The program will also focus on their personal development as socially and environmentally aware citizens and lifelong learners.

Design of the Program:
The EEE curriculum consists of foundation, core, pre-engineering and elective courses. The foundation and core courses are designed to equip the students with the basic knowledge and skills in the major Electrical and Electronic Engineering areas. The pre-engineering courses provide the basic knowledge of science and humanities. The Elective courses allow each student to select advanced courses according to his / her particular interest in a given area of concentration.

Assignment of Credits:
1. Theoretical Courses: Three lectures per week per semester will equivalent to three credits (Total forty five lectures for a 3-credit course, the rest of the time of the semester is allowed for preparatory leave, examinations, results preparation, etc). For theory courses, odd numbers are assigned for the course number.

2. Laboratory (Lab) Courses: Credits of the laboratory courses will be half of the class hours per week per semester. For laboratory courses even numbers are assigned for the course number.

Credits are also assigned to industrial training, project and thesis works taken by the students. For project & thesis course, even number has been assigned for the course number.

Project &Thesis and Industrial training:
The students will choose the Project & thesis topic have to conduct with the respected teacher assigned by the department.

The main objective of industrial training is to provide practical exposure to the student in a working environment. Students will be placed in the Electrical/ Electronic products industry or power plant so that they get an opportunity for translating their theoretical conception in real life situation. The training will cover 3-4 weeks in a semester. The students have to submit individual report on their training within the specified time.

The project & thesis/ report will be graded as per normal grade of the institute. Failure to obtain a passing grade will call for either revision or resubmission of the project & thesis/ report or retake the training program as may be determined by the Chairman of the Department or Examination committee of the institute. However, resubmission or retaking will be allowed once only.

The Laboratory Facilities:
1. Electrical, Electronics and Communications Laboratories:
There are Electrical, Electronics and Communications Laboratories well-decorated and equipped with electrical and electronic materials, communications and Microprocessor based equipments. These are also stuffed by lab teachers, pre-experienced lab assistants and foreman.

2. Computer laboratory:
The computer laboratory is well equipped with modern computers and connected under a local area network and Internet staffed by a professional systems manager and lab assistants. The students can utilize computer as part of supervised classes by the instructors and on their own to complete assignments in computer and other related courses.

Degree Requirements:
The EEE degree requirements are
i). Completion of minimum 161.5 credit hours;
ii). Passing of all courses individually and maintaining a CGPA of 2.50;
iii). Completion of project & thesis/ industrial training with a minimum grade of 'B^-'.

Entry Requirement:
For admission into the EEE program, candidates must have obtained (SSC GPA) + (HSC GPA) = 5.0 or 2nd division in both SSC & HSC or equivalent examinations in science. Students who have passed at least 6 papers in G.C.E 'O' level and 6 papers of 'A' level may also apply provided the student must have completed at least 2 papers of Physics, 2 papers of Chemistry and 2 papers of Mathematics. Minimum average of GPA of combined 'O' level and 'A' level shall be 'C'. An applicant must submit his results during the application. Provisional admission for appeared students are not allowed.. 'O' level and 'A' level points are calculated on a 4 point scale (A = 4, B = 3, C = 2, D = 1). For applicants from foreign countries, similar standard will be maintained by the Premier University. The applicants must have completed Physics, Chemistry and Mathematics in the 12^{th} level.

The Premier University Admission Committee of the EEE program uses the following as basis for evaluating each applicant:

i). A complete application for admission
ii). Official transcript of records,
iii). Non-refundable application fee,
iv). Test scores of the admission test administered by the Premier University
v). Performance in the interview.

SUMMARY OF COURSES

1st Semester

Course No.	Course Title	Credit
PHY101	Physics I	3.0
CSE101	Computer Fundamentals	2.0
CSE102	Computer Fundamentals Lab	1.0
MAT101	Calculus	3.0
CE101	Civil Engineering Drawing	1.0
EEE101	Electrical Circuits I	3.0
EEE102	Electrical Circuits I Lab	1.5
CHE101	Chemistry	3.0
CHE102	Chemistry Lab	1.5
	Total	19.0

2nd Semester

Course No.	Course Title	Credit
PHY103	Physics II	3.0
PHY104	Physics Lab	1.5
ENG101	English II	3.0
MAT103	Mathematics I	3.0
MAT105	Mathematics II	3.0
EEE103	Electrical Circuits II	3.0
EEE104	Electrical Circuits II Lab	1.5
ME101	Mechanical Engineering Drawing & CAD	1.0
	Total	19.0

3rd Semester

Course No.	Course Title	Credit
ECO201	Basic Economics	3.0
MAT201	Statistics	3.0
MAT203	Mathematics III	3.0
EEE 201	Electrical Machines I	3.0
EEE 202	Electrical Machines I Lab	1.5
EEE 203	Electronics I	3.0
EEE 204	Electronics I Lab	1.5
EEE 205	Signals & Systems	3.0
	Total	21.0

4th Semester

Course No.	Course Title	Credit
ME201	Basic Mechanical Engineering	3.0
EEE 207	Electrical Machines II	3.0
EEE 208	Electrical Machines II Lab	1.5
EEE 209	Electronics II	3.0
EEE 210	Electronics II Lab	1.5
ACC201	Accounting & Database Management Systems	3.0
EEE211	Computational Methods for Engineering Problems	2.0
EEE212	Computational Methods for Engineering Problems Lab	1.0
EEE213	Electromagnetic Fields and Waves	3.0
	Total	21.0

5th Semester

Course No.	Course Title	Credit
EEE 301	Electronic Appliances Laboratory	1.5
EEE 303	Electrical Power Transmission & Distribution	3.0
EEE 305	Measurement & Instrumentation	3.0
EEE 306	Measurement & Instrumentation Lab	1.5
EEE 307	Digital Electronics	3.0
EEE 308	Digital Electronics Lab.	1.5
EEE 309	Telecommunications Engineering I	3.0
EEE 310	Telecommunications Engineering I Lab.	1.5
EEE311	Electrical Machine Design	1.0
MAN301	Industrial Management	2.0
	Total	21.0

6th Semester

Course No.	Course Title	Credit
EEE 313	Control Systems	3.0
EEE 314	Control Systems Lab	1.5
EEE 315	Power System Analysis	3.0
EEE 316	Power System Analysis Lab	1.5
EEE 317	Switchgear and Protection	3.0
EEE 318	Switchgear and Protection Lab	1.5
EEE 319	Telecommunications Engineering II	3.0
EEE 320	Telecommunications Engineering II Lab	1.5
EEE 321	Electrical and Electronic Engineering Services for Buildings.	1.5
EEE 322	Industrial Training/ Project Work	1.0
	Total	20.5

7th Semester

Course No.	Course Title	Credit
EEE401	Semiconductor Physics & Devices	3.0
EEE403	Microwave Engineering	3.0
EEE404	Microwave Engineering Lab	1.5
EEE405	Microprocessor & Interfacing	3.0
EEE406	Microprocessor & Interfacing Lab	1.5
EEE407	Data Communications	3.0
EEE408	Data Communications Lab	1.5
EEE*	Elective I	3.0
EEE410	Project & Thesis	0.0
	Total	19.5

*Elective I Courses

EEE 409: Biomedical Engineering

EEE 411: Energy Conversion and Generalized Machine Theory

EEE 413: Cellular Mobile Communications

EEE 415: Science of Materials

EEE 417: Optoelectronics

EEE 419: Renewable Energy Conversion

8th Semester

Course No.	Course Title	Credit
EEE 421	Power Stations	3.0
EEE 423	Industrial Power Electronics	3.0
EEE 424	Industrial Power Electronics Lab	1.5
EEE 425	VLSI Technology	3.0
EEE 426	VLSI Technology Lab	1.5
EEE**	Elective II	3.0
EEE**	Elective II Lab	1.5
EEE 410	Project & Thesis	4.0
	Total	20.5

**Elective II Courses

EEE 427: Digital Signal Processing

EEE 428: Digital Signal Processing Lab

EEE 429: High Voltage Engineering

EEE 430: High Voltage Engineering Lab

EEE 431: Microwave Devices, Amplifiers and Sources

EEE 432: Microwave Devices, Amplifiers and Sources Lab

EEE 433: Optical Fiber Communications

EEE 434: Optical Fiber Communications Lab

EEE 435: VHDL

EEE 436: VHDL Lab.

DETAILED SYLLABI

First Semester

PHY 101: Physics I
(3 credits)

1. Mechanics:
   Kinematics

   Graphical representations of displacement-time, velocity-time and acceleration-time.

   Motion in two and three dimensions-projectile motion.

   Application of Newton's laws of motion, Free body diagrams, Analysis of frames of trusses, Friction, Equilibrium forces.

   Work-kinetic energy theorem. Power, Conservative forces. Conservation of energy.

   Conservation of linear momentum for a system of particles. Center-of-mass motion.

   Elastic and inelastic collision in one dimension.

   Rotational kinematics. Angular momentum of a single particle. Conservation of angular momentum. Moment of Inertia, Balancing of rotating masses.

   Gravitation: Gravitational field. Kepler's laws.

   Robotics: Introduction to robotics, essential components of a robot & their kinematics, links, frames, spatial motions, programming robots, clocks, sensors, actuators and control.

2. Waves & Oscillations:
   Oscillations:

Simple Harmonic motion, damped simple harmonic oscillation, forced oscillations, Combination and Composition of simple harmonic motions, Lissajous figures, Transverse and Longitudinal nature of waves, traveling and standing waves, intensity of waves, energy calculation of progressive & stationary waves, Phase velocity, group velocity.

3. Sound waves:
Velocity of Longitudinal wave in a gaseous medium, Doppler effect.

4.Thermodynamics:

Zeroth, 1st and 2nd law of thermodynamics.
Reversible and irreversible processes, Carnot cycle, Auto cycle, Diesel cycle and their efficiency.
Clausius theorem. Entropy. Absolute scale of temperature. Clausius Clapeyron equation.
Thermodynamic functions.
Maxwell's thermodynamic relations. Problem involving thermodynamic relations and functions. Gibb's phase rule.

Books:
Halliday & Resnick: *Physics I*

Brizlal: *Waves and Oscillations*

Brizlal: *Heat and Thermodynamics*

T. Hossain: *A Text book of Heat*

Theraja: *Engineering Physics*

CSE 101: Computer Fundamentals
(2 credits)

1. Introduction:
   Brief history and types of computers, application area, working principles of computer systems, single and multi user systems.

2. Number Systems Codes and Computer Logic:
   Binary, octal, decimal, hexadecimal number systems, arithmetic operations, ASCII, BCD, EBCDIC, gray, weighted codes, Boolean functions, Data representations, representation of integer, real, floating point numbers and characters.

3. Hardware:
   Organization and Architecture, Motherboard and Microprocessors, Memory units, I/O devices, Peripheral Devices.

4. Software:
   Classification, Application Software: Database spreadsheet and word processing software. System software, and Operating Systems, importance, Component and basic functions of DOS, Windows & UNIX operating System.

5. Interfacing
   Bus Architecture, Firmware, POST and BIOS.

6. Programming Languages:
   Classifications, assembler, compiler, interpreter, source and object programming.

7. Applications:
   Multimedia systems, Computer Network, Basic conception of LAN, MAN, WAN, Internet and intranet system, selection of computers: hardware, software and cost consideration

Books:
C.S. Frence: *Computer Science.*

War ford: *Computer Science.*

Norton: *Inside PC.*

Norton: *Introduction to Computer.*

Ron White: *How Computer Works.*

CSE 102: Computer Fundamentals Lab
(1 credit)

Experiments/ Tasks based on CSE 101.

MAT 101: Calculus
(3credits)

1. Differential Calculus:

(a) Introduction

Function, Domain, and range. Graphical representation of a function. Limit, continuity and differentiability, Differentiation of explicit and implicit functions and parametric equations, Significance of derivatives, Differentials,

(b) Successive differentiation:

Successive differentiation of various types of functions, Leibnitz's theorem, Rolle's Theorem, Mean value theorem, Taylor's theorem in finite and infinite forms, LaGrange's form of remainders, Cauche's form of remainders, Expansion of functions by differentiation and integration, partial differentiation, Euler's theorem, Tangent Normal, subtangent and subnormal in Cartesian and Polar co-ordinates, differentiation of maximum and minimum values of function and point of inflection, Application, Evaluation of indeterminate forms by L'Hospital's rule, Curvature, center of curvature, Evaluate and inviolate, Asymptotes, Envelopes, Curve tracing.

2. Integral Calculus:

(a) Introduction:

Definitions of integration, Integration by methods of substitution, Integration by parts, Standard integrals, Integration by methods of successive reduction.

(b) Definite Integrals:

Definite Integrals, its properties and use in summing series, Wallis's formulae, Improper Integrals, Beta function and Gamma function.

(c) Area under a plain curve:

Area under a plain curve in Cartesian and polar co-ordinates, area of the region enclosed by two carves in Cartesian and polar co-ordinates, Trapezoidal rule, Simpson's rule, length of curves in Cartesian and polar co-ordinates, parametric and pedal equations, Intrinsic equation, Volumes of solids of revolutions, Volume of hollow solid of revolution. Volume of hollow solid of revolution by shell method, Area of structure of revolution.

Books:

Joshep Edward: *Differential Calculus*

Joshep Edward: *Integral Calculus*

Mohammed & Bhattacharja: *Differential Calculus*

Mohammed & Bhattacharjee: *Integral Calculas*

P.K.Das & Mokherjee: *Differential Calculus*

P.K.Das & Mokhajji: *Integral Calculas*

CE101: Civil Engineering Drawing
(1 credit)

Isometric drawing and birds eye view of simple buildings, Plan, elevation and section of one storied and two storied building. Plan, elevation and section of staircase, Detail drawing of roof truss, Project on building drawing, Drawing by AUTOCAD.

EEE101: Electrical Circuits I
(3 credits)

Circuit variables and elements: Voltage, current, power, energy, independent and dependent sources, resistance.

Basic laws: Ohm's law, Kirchoff's current and voltage laws.

Simple resistive circuits: Series and parallel circuits, voltage and current division, wye-delta transformation.

Techniques of circuit analysis: Branch current method, Nodal and mesh analysis including supernode and supermesh. Independent and dependent sources.

Network theorems: Source transformation, Thevenin's, Norton's and superposition theorems with applications in circuits having independent and dependent sources, maximum power transfer condition and Reciprocity theorem.

Energy storage elements: Inductors and capacitors, series parallel combination of inductors and capacitors.

Responses of RL,RC and RLC circuits: Natural and step responses. Introduction to Alternating Current (AC), sinusoidal variation, frequency and wavelength. Instantaneous voltage, current and power, impedance of AC quantities, RMS value & average value, RLC series and parallel circuits.

Magnetic quantities and variables: Flux, permeability and reluctance, magnetic field strength, magnetic potential, flux density, magnetization curve. Laws in magnetic circuits: Ohm's law and Ampere's circuital law. Magnetic circuits: series, parallel and series-parallel circuits.

Books:
Robert L. Boylestad, *Introductory Circuit Analysis*, Prentice Hall.

Robert P Ward, *Electrical Engineering*.

B. L. Thereja, *A text book of electrical technology*

R.M. Kerchner and G.F. Corcoran, *Alternating Current Circuits*, Wiley.

EEE102 Electrical Circuits I Lab
(1.5 credit)

Experiments on switches, varieties of DC circuits- current measurement, voltage measurement, power measurement. Measurement of Voltage and current wave-shapes of simple RLC circuits fed with AC 50Hz supply.

Simulations of the above mentioned circuits used for experiments and other circuits by PSPICE.

CHE 101: Chemistry
(3 credits)

Structure of Atom: Atomic structure, quantum numbers, electronic configuration, periodic table. Properties and uses of noble gases. Wave nature and particle nature of electrons. Schrodinger's wave equation, Particle in one dimensional box, normalization and orthogonalization of wave functions. Mason theory of nuclear forces, Mass defect, Properties and uses of radioactive elements.

Chemical Bonding: Different types of chemical bonds, covalent and coordinate compounds, Valence bond theory.

Classification of Elements: Structure and properties of Boron, Silicon, Germanium, Gallium, Arsenic and Antimony, Preparation of pure silicon, Intrinsic and extrinsic semiconductors, p-n junction and Application of semiconductors.

Instrumental Analysis: Radiation and matter interaction, Electromagnetic radiation, UV- VIS and IR spectroscopy, Beer-Lambert's law, Basic components of a spectrometer, Radiation sources, Wavelength selectors, Different types of radiation detectors, Signal processor, Sensitivity and noise reduction.

Reaction Dynamics: Thermo Chemistry, Chemical kinetics, chemical equilibrium, Ionization of water and pH concept.

Electrochemistry: Types of conductors of electricity, Electrolytes and non-electrolytes, Phenomena of electrolysis, Faraday’s law of electrolysis, Theories of electrolytic conduction, Electrical properties of solution.

Organic Chemistry: Aliphatic and aromatic hydrocarbons, Selective organic reactions.
Polymers: Synthetic and natural polymers, Thermosetting and thermoplastic polymers, natural and synthetic rubber, Insulation properties of PVC, rubber and plastics.

Water Treatment: Specification of water, Treatment of drinking water, Iron removing plant, Distillation of water, Contamination of water caused by As, Pd, Hg and other toxicants, Removal of toxicity from polluted water, Thermal and radioactive pollution of water.

Fuel: Types of fuel, Origin of fuel, Refining of crude fuels, Characteristics of different fuels, Calorific value, Octane number, Antiknock compounds, Cracking of fuels, Nuclear fuels and Aviation fuels.

Books:
B.S. Bahl, G.D.Tuli and Arun Bahl, *Essentials of Physical Chemistry*.
R.D. Madan, *Modern Inorganic Chemistry*.

CHE 102: Chemistry Lab
(1.5 credits)

Oxidation reduction titration, Iodometric titration, Complexometric titration Determination of Fe, Ni, Cu and Ca, Analysis of Brass, Determination of saponification value, iodine value and acid value, Analysis of unknown salts.

Second Semester

PHY 103: Physics II
(*3 credits)*

1.Electricity and Magnetism

Electromagnetism:
Magnetic fields, Maxwell's equations, Ampere's law, Faraday's law, Lenz's law.

Inductance:
Self inductance, Mutual inductance.

Magnetic properties of matter:
Magnetomotive force, magnetic field intensity, permeability and susceptibility, classification of magnetic materials, magnetization curve of ferromagnetic materials, magnetic circuits, magnetostriction.

2. Optics
Theories of light:
Huygen's principles and constructions.

Interference of light:
Young's double slit experiment, Fresnel bi-prism, Newton's ring, interferometers.

Diffraction and Polarization of light:
Diffraction, diffraction by single slit, diffraction by double slit, diffraction gratings, polarization of electromagnetic waves, optics of crystals.

Lasers and their Applications: Laser, introduction, stimulated and spontaneous radiation's coherence, resonators Ruby, He, Ne, CO_2, N_2 and dye laser. Material processing with lasers, welding, material removal and material shaping.

3. Modern physics:
Relativity, Michelson-Morley experiment, Lorenz-Einstein transformation, mass energy relation, quantum effect, photoelectric effect, Compton effect.

4. Atomic Physics:

De-Broglie wave, correspondence principles, uncertainty principle, The Rutherford-Bohr model of the atom, Energy levels and spectra, atomic excitation, the Laser, Quantum theory of hydrogen atom, the Zeeman effect, electron spin, many electron atoms and the exclusion principle.

5. Nuclear Physics:
Introduction , nuclear constituents, nuclear binding and nuclear structure, radioactivity, radioactive decay, half-life, law of successive disintegration, radioactive equilibrium, the nucleus, properties of nucleus, binding energy, nuclear reactions, nuclear fission and fusion, nuclear reactors.

Books:
Halliday & Resnick: *Physics II*

Brizlal: *Optics*

Jenkine & White: *Fundamentals of Optics*

Beiser: *Modern Physics*

Kaplan: *Nuclear Physics*

Theraja: *Engineering Physics*

PHY 104: Physics Lab
(1.5 credits)

Experiments based on PHY 101 and PHY 103.

ENG 101: English II
(3 credits)

Technical Reading &Writing:
The purpose of this course is to develop the reading comprehension skills in English. Students will be required to study reading selected materials from technical/scientific publications and presenting the topics before the class as well as taking active part in discussions in English. In addition to that each student will have to write a report on an assigned topic.

1. Beginning to Write
   a) Making sensible sentences.
   b) Joining and expanding sentences.
   c) Contracting sentences.
   d) Logical development of sentences in context using an idea.
   e) Clear and effective communication of information.

2. Reading for Writing
   Students will be required to comprehend modern prose-passages drawn from different disciplines with attention to their (a) context, (b) vocabulary, and (c) syntax, and deliver feedback in the form of précis, summaries, and comprehension answers. They will also be required to present their writings before the class for discussion and reactions by the peers.

3. Expanding Writing
   a) Writing paragraphs on technical aspects.
   b) Writing short, free and guided compositions.
   c) Developing essays on technical issues.
   d) Writing reports, memos and business letters.
   e) Editing compositions for clarity and effectiveness.

Books.
Raymond, Murphy, *English Grammar in Use*
A. J. Glover: *Build Up Your English* (ELBS)
L.G. Alexander: *Fluency in English*
E. Frank Candlin: *General English for Technical Students.*
Hans P. Guth: *Words and Ideas*
Maurice Imhoof and Herman Hudson : *From Paragraph to Essay*

MAT 103: Mathematics I
(3 credits)

1. Geometry:
   (a) Co-ordinate geometry of two dimensions:
   Change of axes, transformation of co-ordinates, simplification of equations of curves, General equation of second degree, Straight line, Circle, Parabola, Ellipse, Hyperbola.

   (b) Co-ordinate geometry of three dimensions:
   Systems of co-ordinate, distance of two points, Section formula, projection, direction cosines, Equations of planes and lines, sphere, Cone, Central conicoid.

2. Vector Analysis
   (a) Vector algebra:
   Addition and multiplication of vectors, Application to geometry and mechanics, triple product and multiple products, linear dependencies and independence of vectors, Definition of line, surface, and volume integrals, Vector spaces.

   (b) Vector Calculus:
   Differentiation of vectors with application, Gradient of a scalar function, Divergence and curl of a vector function, Physical significance of gradient, divergence and curl, Vector integration, divergence theorem, Stock's theorem, Green's Theorem and their application. Curvilinear coordinate.

3. Complex Variables:
   Complex number system, General functions of complex variable limits and continuity of function of complex variable and related theorems, Complex differentiation and the Cauchy Riemann equation, Infinite series, Convergence and uniform convergence, Line integral of a complex function, Cauchy integral formula, Liouville's theorem, Taylor's and Lorenz's theorem, Singular points, Residue, Cauchy's residue theorem.

Books:
Askwith, J.M. Kur: *Two dimensional Geometry/ analytical geometry*
J.T. Bell: *A treatise on three dimensional Geometry*
Rahman & Bhattacharjee: *A text book of co-ordinate geometry and vector analysis*
M.R.Spigel: *Vector analysis*
M.R. Spigel: *Complex Variables*

MAT 105: Mathematics II
(3 credits)

1. Differential Equations:
Definition and solution of ordinary differential equation, first order ordinary differential equation, first order ordinary differential equation with constant co-efficient. Initial value problems and their application. Bessel's equations, and function series solutions.

2. Laplace transform:
Definition of Laplace transform, Laplace transform of different functions, First shift theorem, inverse transform, Linearity, use of first shift theorem and partial functions. Transform of derivatives, Transform of an integral, The Heaviside unit function, the unit impulse function. The second shift theorem, Periodic functions, Convolution, solution of ordinary differential equations by Laplace transform.

3. Fourier Series:
Fourier series, convergence of Fourier series, Fourier analysis, Fourier transforms.

Books:

M.R. Spigel: *Laplace Transform*

Churchill: *Fourier Series and Boundary Value Problems*

Dr. S.M. Farid: *Differential Equations.*

Erinu Kresgige: *Differential Equations.*

EEE103: Electrical Circuits II
(3 credits)

Effective values of AC current and voltage. Average power, phasors and complex quantities, impedance, real and reactive power, power factor with sinusoidal excitatory for RLC circuits. Analysis of non-sinusoidal waves. Analysis of single phase AC circuits: series and parallel RL, RC and RLC circuits, nodal and mesh analysis, application of network theorems in AC circuits, circuits with non-sinusoidal excitations, transients in AC circuits, passive filters. Resonance in AC circuits: series and parallel resonance.

Magnetically coupled circuits. Analysis of three phase circuits: Three phase supply, analysis of balanced and unbalanced circuits, power calculation, Phase sequence and its effects. Measurement of 3-phase power by 3-wattmeter method as well as two wattmeter method. Application of Matrix in circuit analysis. Transients in AC circuits.

Books:

R.M. Kerchner and G.F. Corcoran, *Alternating Current Circuits*, Wiley.

Robert L Boylestad, *Introductory Circuit Analysis*, PrenticeHall.

B. L. Thereja, *A text book of electrical technology*.

EEE104: Electrical Circuits II Lab
(1.5 credits)

Experiments on various types of AC circuits, Measurement of branch voltage, branch current in single phase and three phase circuits. Measurement of single phase power, Measurement of three phase Power. Experiment on measurement in a coupled circuit.
Simulation of the circuits used for the above mentioned experiments and other circuits by PSPICE.

ME101: Mechanical Engineering Drawing & CAD
(1 credit)

This course brings into focus the Introduction, scale drawing, sectional view, isometric views, missing line, auxiliary view, detail and assembly drawing, project on engineering drawing and CAD using AutoCAD or contemporary packages instructed by the teachers.

Recommended Books:
Goerge Omura & B. Robert Colloria: *AutoCAD – 2002 instant reference*

Goerge Omura: *Mastering AutoCAD*

B. Robert Colloria: *Introduction to AutoCAD*

Third Semester

ECO 201: Basic Economics
(*3 credits)*

1. Introduction:
   The nature of economic problems and their sources. Economic goals of a society. Alternative economic systems.

2. Circular flow of income.
3. Demand and Supply Theory
   Supply, demand and market – elementary theory of supply and demand – relationship between goods and factor markets.

4. Elasticity:
   Demand and supply elasticity - Measurement, importance and applications.

5. Consumer behavior and market demand
   Utility approach vs. the indifference user approach – Individual and market demand curves - the consumer's surplus, application.

6. Production and Costs Theory
   The production function- technical efficiency - short run and long run - choice of inputs in the short and the long run – total fixed and variable costs – average and managerial costs

7. The perfectly competitive market and its characteristics
   Conditions of profit maximization - A firms short run optimal output level – firm's short run supply curve - the short run industry supply – interaction of market demand and industry supply - the equilibrium price - The long run industry supply curve.

8. Imperfectly competitive markets
   Monopoly – optimal price – output combination - inefficiency of monopoly-Price discrimination- natural monopoly - important features of monopolistic competitive and oligopoly – cartels in oligopoly.

9. Basic principles of factor pricing
   Derived demand for an input – income distribution - factor price differentials – causes and implications - economic rents.

10. Resource allocation and the market
    Concepts of equity and efficiency - strength and weakness of the market mechanism in terms of equity and efficiency - the need for government intervention – tools of intervention – regulation - public ownership and taxation.

11. International trade
    Gains from international specialization - free trade vs. protection – the World Trade Organization (WTO) and globalization - regional economic integration SAARC, EU.

12. Non – Renewable resources
    Pricing and optimal rate of extraction.

13. Key macroeconomics phenomena
    Output - employment- inflation - exchange rates - growth etc. – major macroeconomics ills – unemployment – inflation - slow growth.

14. National output – concepts and measurements - interpretation of national income measures – inter temporal and international comparisons – the pitfall.

15. Income determination
    Aggregate expenditure and equilibrium national income – a simple model. Changes in autonomous expenditures and national income – the multiplier. Government spending and taxes. Net exports – a more comprehensive measure of aggregate expenditure – equilibrium income in this context.

16. Aggregate demand and aggregate supply – short run and long run. Determination of national income and the price level. Demand and supply stocks. Fiscal and monetary policies – Government budget – controlling deficits – various proposals.

17. The trade off between inflation and unemployment – stagflation, short run and the long run Philips curves.

18. Balance of payments and the exchange rates
    Policy changes to correct dis-equilibrium in the balance of payments.

Books:

A. Koutsoyiannis, Modern Microeconomics

R.G. Lipsey, An introduction to positive economics

P. A. Samuelson, Economics

R.A. Bilas, Microeconomics theory

R. Dornbusch and S.Fischer, Macroeconomics.

William H. Branson, Macroeconomic Theory and Policy.

H.L. Ahuja, Modern Economics

M. Chacholiades, International Trade: Theory and Policy.

MAT 201: Statistics
(3 credits)

Measures of central tendency, Standard deviation, variance and measures of dispersion, correlation and regression. Definition and rules of combination, elementary probability theory, Random variable and probability density functions, discontinuous probability distributions like binomial, Poisson, continuous distribution like normal and exponential, characteristics of distributions, Test of hypothesis like T-test, Chi-square test, Z-test, standard deviation and measure of dispersion, regression analysis. Random variables and processes.

Books:
R.E.Walpole & R.H.Myres: *Probability and Statistics for engineer's and scientists.*

S.K. Gupta: *Basic statistics and Probability.*

M. Spiegel: *Statistics*

MAT 203: Mathematics III
(3 credits)

1. Linear Algebra:
Basic concept and technique of liner algebra, Cauchy-Schwarz Theorem, Minkowski's inequality, linear equations, system of linear equations and their solution, solution of homogenous system of linear equations.

2. Matrices:
Definition of matrix, various Types of Matrices: Transpose and conjugate transpose of a matrix, Sub matrices, addition, subtraction, multiplication, and division of matrices, Transverse of a matrix, Adjoins and inverse of a square matrix, Rank and elementary transformation of a matrix, addition, subtraction, multiplication of complex matrices, Inverse of a complex matrix, linear dependence and independence of vectors and matrices, Solution of linear equation by matrix method, Quadratic forms, Matrix polynomials, Determination of characteristics roots and vectors, Vector space, Null space and nullity of a matrix, characteristic subspace of matrices. Eigenvalues and eigenvectors.

3. Numerical analysis:

a. Error:

Definitions, sources, examples. Propagation of Error. A general error formula.

b. Root finding:

The bisection method and the iteration method, the method of false position. Newton-Raphson method. Methods of approximation theory: Polynomial interpolation: Lagrange form, divided formula. Solution of polynomials with complex variables.

Books:

Curtis F.Gerald, *Applied Numerical Analysis*, Addison-Wesley Publishing Company.

Ranics Scheild, *Numerical Analysis*.

M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation.*

EEE 201: Electrical Machines I
(3 credits)

DC generator: construction, principle of operation classification, armature winding, voltage build up, armature reactions and commutation, performance evaluation and testing.

DC motor: Operation, types, speed-torque characteristics, starting, speed control, braking.

Single phase transformers: construction and principle of operation, equivalent circuit, PU systems, phasor diagram, efficiency, regulation, testing of short-circuit test and open circuit test, parallel operation.

Three-phase transformer: Vector group, parallel operation and testing, autotransformer.

Books:

A.F. Puchstein and T.E. Lloyed, *Alternating Current Mechines*.

Jack Rosenblatt and M. Harold Friedman, *Direct and Alternating Current Machinery.*

EEE 202: Electrical Machine I Lab
(1.5 credits)

Experiments based on syllabus of EEE 201.

EEE203: Electronics I
(3.0 credits)

P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode, simplified dc and ac diode models, dynamic resistance and capacitance. Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a zener diode, zener shunt regulator, clamping and clipping circuits. Bipolar junction transistor (BJT) as a circuit element: Bipolar junction transistor: current components, BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch. Single stage mid-band frequency BJT amplifier circuits: Voltage and current gain, input and output impedance of common base, common emitter and common collector amplifier circuits. Metal-oxide-semiconductor field-effect-transistor (MOSFET) as circuit element: structure and physical operation of an enhancement

MOSFET, threshold voltage, Body effect, current- voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter. Junction field-effect-transistor (JFET): Structure and physical operation of JFET, transistor characteristics, pinch-off voltage. Differential and multistage amplifiers: Description of differential amplifiers, small-signal operation, differential and common mode gains, RC coupled mid-band frequency amplifier.

Books:
Bernard Grob, *Basic Electronics*.

Albert Paul Malvino, *Electronic Principles*.

EEE204: Electronics I Lab
(1.5 credits)
Experiments based on syllabus of EEE 203.

EEE 205: Signals & Systems
(3 credits)

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, inevitability.

Time domain analysis of LTI systems: analogues system 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, sampling theorem 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, poles and zeroes of a network. Distance signals and z-transform methods.

Introduction to Random signals: Stationery, Ergodicity, Noise models, Correlation and power spectrum, Distribution and density functions.

Books:

Haykin, *Signals and Systems*

D.K. Cheng, *Linear System Analysis.*

Fourth Semester

ME 201: Basic Mechanical Engineering
(3 credits)

Fundamental concepts of thermodynamic systems, introduction to thermodynamic properties, processes and cycles, ideal and real gas laws, first and second laws of thermodynamics, reversibility and irreversibility, performance of heat engines and heat pump, steady flow energy equation, its derivation and application to various real systems.

Fluid statics: forces on submerged planes-impulse momentum principles, flow measuring instruments, losses in fluid flow through pipes, continuity equation, Bernauli's law.

Pumps: Types, working principle, centrifugal pump, power calculation, priming, working principles of submersible pump and turbine pump.

Water turbines: Types, description and working principles, water turbines used in hydroelectric power plants. Properties of steam, brief introduction to steam power plants, its heat and energy balance, cycle description and calculation of efficiency. Introduction to vapor compression, refrigeration system, cycle description and efficiency calculation.

Books:
P.L. Nag, *Engineering Thermodynamics*.

V.P. Vasandani and D.S. Kumar, *Heat Engineering.*

EEE 207: Electrical Machines II
(3 Credits)

Three phase induction motor: Rotating magnetic field, equivalent circuit, vector diagram, 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, V curves, starting, braking and speed control.

Single phase induction motor: Theory of operation, equivalent circuit, starting techniques..
Synchronous Generator: excitation systems, equivalent circuit, vector diagrams at different loads, factors affecting voltage regulation, synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations. Introduction to wind turbine generators.

Parallel operation of two or more generators: Necessary conditions, synchronization, circulating current and vector diagram.

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

Books:
Jack Rosenblatt and M. Harold Friedman, *Direct and Alternating Current Machinery*.

A.F. Puchstein and T.E. Loyed, *Alternating Current Machines.*

EEE 208: Electrical Machines II Lab
(1.5 Credits)

Experiments based on syllabus of EEE 207.

EEE 209: Electronics II
(3 Credits)

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.

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, effects of finite open loop gain and bandwidth on circuit performance, logic signal operation of Op-Amp, dc imperfections.

General purpose Op-Amp: DC analysis, small-signal analysis of different stages, gain and frequency response of 741 Op-Amp. Negative feedback: 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 low, high and band pass filters using Op-Amps.

Signal generators: Basic principle of sinusoidal oscillation, Op-Amp RC oscillators, LC and crystal oscillators.

Power Amplifiers: Classification of output stages, class A, B and AB output stages. RF amplifiers, waveform generations using 555 and 8038 ICs, Multivibrators, schmitt trigger, pulse generator, VCO.

Books:
Albert Paul Malvino, *Electronic Principles.*

C. Halkias and Jacob Millman, *Electronics Devices & Circuits*.

EEE 210: Electronics II Lab
(1.5 Credits)

Experiments based on syllabus of EEE 209.

ACC 201: Accounting & Database Management Systems
(3 credits)

Accounting: Accounting its origin and development, Definition of Accounting and book Keeping, used and users of financial information, transaction, assets, liabilities, the accounting cycle. Journal, Ledger, Cash book, Trial balance, income statement, Retained earnings, statement and balance sheet. Interpretation of financial statements, use of accounting information in project evaluation and other decision making.

Database Management Systems: Concepts and methods in data base systems. File organization and retrieval. Data Base models. Data description languages, data base integrity and security. Data dictionary/directory systems, data base administration. Data base design. Survey of some existing data base management systems. Development of computerized information systems in supporting the decision making responsibilities of management.

Books:
Meijs Williams, *Accounting*.

T. Hargren and George Foster, *Cost Accounting*.

EEE 211: Computational Methods for Engineering Problems
(2 credits)

Review of computer & its application. Principles of programming, Flow Charts, The C and C^{++} programming languages, Numerical solution of algebraic and transcendental equations, Matrices, Solution of system of linear equations by matrix method, Interpolation, Extrapolation. Solution of differential equation, Integration.

Books:
H. Schildet: *C/C++ The complete reference*.

L. Balagurshamy : *Programming in C++*.

H. Schildet: *Teach yourself C++*.

Curtis F. Gerald, *Applied Numerical Analysis*, Addison- Wesley Publishing Company.

EEE 212: Computational Methods for Engineering Problems Lab
(1 credit)

Tasks on Computer Programming and applications related to the syllabus of EEE 211.

EEE 213: Electromagnetic Fields and Waves
(3 credits)

Review of Vector Analysis.
Electrostatics:
(a) Electrostatics: Coulomb's law, force, electric field intensity, electrical flux density. Gauss's theorem with application, Electrostatic potential, boundary conditions, method of images, Laplace's and Poisson's equations, energy of an electrostatic system, conductors and dielectrics.

Magnetostatics:
Concept of magnetic field, Ampere's Law, Biot-Savart law, vector magnetic potential, energy of magnetostatic system, Mechanical forces and torque's in Electric and Magnetic fields, Curvilinear co-ordinates, rectangular, cylindrical and spherical co-ordinates, solutions to static field problems. Graphical field mapping with applications, solution to Laplace equations, rectangular, cylindrical and spherical harmonics with applications.

Maxwell's equations:
Their derivations, continuity of charges, concepts of displacement current, Boundary conditions for time-varying system, Potentials used with varying charge and currents, Retarded potentials, Maxwell's equations in different coordinate systems.

Relation between circuit theory and field theory:
Circuit concepts and the derivation from the field equations, High frequency circuit concepts, circuit radiation resistance, Skin effect and circuit impedance, Concept of good and perfect conductors and dielectrics, Current distribution in various types of conductors, depth of penetration, internal impedance, power loss, calculation of inductance and capacitance.

Propagation and reflection of electromagnetic waves in unbounded media:
Plane wave propagation, polarization, power flow and Poynting's theorem. Transmission line analogy, reflection from conducting and dielectric boundary display lines ion in dielectrics, liquids and solids, plane wave propagation through the ionosphere. Introduction to radiation.

Books:

Simon Ramo, John R. Whinnery, Theodore Van Duzer, *Fields and Waves in Communication Electronics.*

David K. Cheng, *Field and Wave Electromagnetics*.

Willium H. Hayt. Jr., *Engineering Electromagnetics*.

Fifth Semester

EEE 301: Electronic Appliances Laboratory
(1.5 credits)

Principle of operation of Electronic Appliances used in domestic places, commercial places and offices: AM & FM Radio Receiver, Television receiver, Flat Screen TV, 100HZ Digital TV, Big screen LED TV, big screen Plasma TV, Audio Cassette and CD player, VCR, VCP, VCD player, DVD player, satellite TV receiver system. Study of Practical circuit diagrams the above mentioned appliances and possible troubles in these appliances.

Basic principle of operation of an AM radio transmitter, FM Radio transmitter, TV transmitter and the transmitting antennas used in these cases.

Books:
Arvind M Dhake, *Television Engineering*, McGraw-Hill, ISBN: 0070963894

Jan Axelson , *Making Printed Circuit Boards*, McGraw-Hill Professional Publishing, ISBN: 0830639519

Gulati, Colour Television

Frank Baylin, *Home Satellite TV installation & troubleshooting manual*, 3rd edition, BPB Publishing B-14, Connaught Place, New Delhi-110001.

Bernard Grob, *Basic Television & Video Systems*, 5th ed. (International Student Edition), McGraw-Hill Book Company, Singapore.

EEE 303 Electrical Power Transmission & Distribution
(3 credits)

Inductance of transmission lines: Flux linkage, Inductance due to internal flux, Inductance of single phase two wire lines, Flux linkage of one conductor in a group, Inductance of composite conductor lines. GMD examples; 3 phase lines with equilateral spacing and unsymmetrical spacing. Parallel circuit 3 phase lines. Use of tables. Electrical field; potential difference between points due to a charge, capacitance of a two-wire line. Group of charged conductors. Capacitances of 3 phase lines with equilateral and with unsymmetrical spacing. Effect of earth, parallel circuit lines. Resistance and skin effect: Resistance and temperature, skin effects, influence on resistance, use of table, Current and voltage relation on a transmission line, T- and pi-representation, exact solution. Equivalent circuit of a long line. Mechanical characteristics of transmission line: Sag and stress analysis; Wind and ice loading, supports at different elevation conditions at erection; effect of temperature changes. Generalized line constant: General line equation in terms of A, B, C, D constants. Relation between constants, charts of line constants, constants of combined networks, measurement of line constants. Circle diagrams: Receiving end and sending end power circle diagrams. Voltage and power factor control in transmission systems. Tap changing Transformers; on load tap changing. Inductance regulators. Moving coil regulators; Boosting transformers. Power factor control; static condensers; synchronous condenser. Insulators for overhead lines; types of insulators, their construction and performance. Potential distribution in a string of insulators, string efficiency. Methods of equalizing potential distribution; special types of insulators, testing of insulators. Insulated cables, cables versus overhead lines, insulating materials. Electrostatic stress grading. Three core cables; dielectric losses and heating. Modern development; oil filled and gas filled cables. Measurement of capacitance. Cable testing. Introduction to transmission line protection: over current relay and time grading, reverse power relays. Differential protection. Distant relays. Distribution: Distributor calculation, ring mains and interconnections.

Books:

H.W. Cotton and H. Barber, *The transmission and Distribution of Electrical Energy*.

A.T. Starr, *Generation, Transmission and Utilization of Electrical Power*.

W.D. Stevenson, *Elements of Power System Analysis,* McGrawHill.

EEE 305: 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. Measurement of non-electrical quantities: Temperature, pressure, flow, level, strain, force and torque. 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.

Books:

E.W. Golding and F.C. Widdis, *Electrical Measurements & Measuring Instruments*.

A.K. Sawhney and Puneet Sawhney, *Electrical & Electronics Measurement and Measuring Insruments.*

F.K. Harris, *Electrical Measurements*, Wiley Eastern.

A.D.Helfrick & W.D.Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, Prentice–Hall India.

D V S Murty, *Transducers and Instrumentation*, Prentice- Hall India.

EEE 306: Measurement and Instrumentation Lab
(1.5 credits)

Experiment based on syllabus of EEE 305

EEE 307: Digital Electronics
(3 credits)

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. Implementation of basic static logic gates in TTL, ECL, IIL and CMOS and BiCMOS: DC characteristics, noise margin and power dissipation. Power optimization of basic gates and combinational logic circuits. Modular combinational circuit design: pass transistor, pass gates, multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements and ALU design. Programmable logic devices: logic arrays, field programmable logic arrays and programmable read only memory. 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.

Books:

Robert L. Boylestad, *Electronic Devices and Circuits*.

Albert Paul Malvino, *Electronic Principles.*

Adel S. Sedra and Kenneth E. Smith, *Microelectronic Circuits*.

EEE 308: Digital Electronics Lab
(1.5 credits)

Experiments based on syllabus of EEE 307.

EEE 309: Telecommunications Engineering I
(3.0 credits)

Amplitude modulation and demodulation: DSB-SC, SSB, VSB.

Frequency modulation and demodulation: NBFM, WBFM and phase modulation (PM).

Pulse modulation: PAM, PCM, DPCM,ADPCM, Delta modulation.
Performance of AM, FM, PAM in presence of noise.

Multiplexing : Necessity of multiplexing, FDM and TDM and their applications.

Digital Modulation Schemes: ASK,FSK, PSK, QPSK, MSK and their spectral properties, Coherent and non-coherent detection, Correlation and matched filter receivers.

Propagation of Radio Waves : Ground wave, Sky wave, (Ionospheric Propagation), Troposphere scattering, Line of sight propagation.

RADAR : Principles RADAR and its applications.

Satellite Communication : Principle of satellite communication, Geo-stationary satellite, Frequency bands, Application of satellite communication, VSAT, uplink, downlink & transponder models, multiple access techniques.

Books:
B.P. Lathi, *Modern Digital & Analog Communication Systems*.

George Kennedy, *Electronic Communication System*..

Simon Haykin, *Communication System*.

Herbert Taub and Donald L. Schilling, *Principles of Communication Systems*.

Mischa Schwartz, *Information Transmission, Modulation and Noise*, 4th edition. (1990).

EEE 310: Telecommunications Engineering I Lab
(1.5 credits)

Experiments based on syllabus of EEE 309.

EEE311:Electrical Machine Design (2hrs. per week)
(1 credit)

Design principles of Electrical Machines, Equipment, Device involving electric and magnetic circuit. Design of Electric Power Transformers, Transformers for Electronics (AF & RF) circuits. Design of Electric Ceiling Fan, Pedestal Fan and table fan. Design of Electric motors for small pumps. Design of Electric Autotransformers. Design of Electric Welding Transformer.

Books:

M.G. Say, *Machine Design*.

A.K. Sawhney, *Electrical Machine Design*.

MAN 301: Industrial Management
(2 credits)

Scope of industrial management, functions of management, duties and responsibilities of a manager, Brief discussions about Tailor's scientific management, theory and contributions of Henry Fayol-Elton- Mayo and Gilbreth, Modern concepts of management.

Organization: Growth of organization authority, responsibility, relationships, span of control, principles of organization, administration-management and organization relationship, committee.

Personnel management: Functions of personnel manager, wages and salary, wage-incentive plan, job evaluation and merit rating, moral and motivation, leadership, industrial disputes, collective bargaining agent, health and safety measures.

Financial management: Elements of costs, break-even analysis, depreciation calculation, budgets, budgetary control, introduction to time value of money and benefit/cost ratio.

Marketing: Modern concept of marketing, marketing department, sales promotion, inventory and inventory control, CPM, plant layout and location, use of computer in management and office business, management information systems.

Books:
James B. Dilworth, " Productions and Operations Management".

Ricky W. Griffin, " Management".

Heinz Weihrich & Harold Koontz, " Management".

Sixth Semester

EEE 313: Control Systems
(3 credits)

Introduction to control systems, Routh's stability criterion, block diagrams and signal flow graph, frequency response method & Bode plots, root locus method, Nyquist's stability criterion, feedback control system performance based on frequency response, cascade compensation of root locus plots, cascaded compensation of frequency response plots. State-space representation: Formation of state equations, Transfer function from state equation, stability & Eigen values of state transition matrix. Application of MATLAB for control system design. Survey of control system in Industry.

Books:
J.J.D. Azzo & C.H. Houpis, *Control System*.

R.C. Dorf and R.H. Bishop, *Modern Control Systems*, eighth edition, Addison-Wesley Longman Inc, USA, 1998, ISBN : 981-235-859-5.

Katsuhiko Ogata, *Modern Control Engineering*, November 30, 2001, Pearson Higher Education, ISBN: 0130432458.

EEE 314: Control Systems Lab
(1.5 credits)

Experiments based on syllabus of EEE 313.

EEE 315: Power System Analysis
(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 a 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 three phase faults: Short circuit currents and the reactance of synchronous machines, internal voltages of loaded machines under transient conditions, bus impedance matrix in fault calculations, bus impedance matrix equivalent network, percentage reactance and short-circuit MVA, reactor control of short-circuit currents and location of reactors and their advantages and disadvantages.

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.

Books:
William D. Stevenson Jr., *Power System Analysis.*

John J. Grainger, *Power System Analysis*.

EEE 316: Power System Analysis Lab
(1.5 credits)

Experiments based on syllabus of EEE 315.

EEE 317: Switchgear and Protection
(3 credits)
Purpose of power system protection, Introduction to circuit interruption and protection. Terminologies and general characteristics of relays and breakers. Circuit breakers: control systems, arc extinction, recovery voltage. Air, oil, air blast, vacuum, SF6 and high voltage DC circuit breakers. Selection criteria, testing of circuit breakers. Relays: overcurrent, directional, differential, distance, sequence, pilot-wire and carrier current protection. Busbar arrangement, grounding. Unit protection: generator, motor, transformer, bus and line protection.

Static Relays: Introduction to Analogue and Digital static relays. Static overcurrent, differential and distance protection.
Microprocessor based relays.

Books:
Sunil S . Rao, *Switch Gear and Protection*.

EEE 318: Switchgear and Protection Lab
(1.5 credits)
Experiments based on syllabus of EEE 317.

EEE 319: Telecommunications Engineering II
(3 credits)

Digital signaling over bandwidth constrained AWGN channels: Characterization of bandlimited channels, signal design for bandlimited channels.

Receiver design: Optimum demodulation for intersymbol interference and noise, Optimum receivers and probability of error in AWGN, equalization, synchronization.

Multiplexing and Multiple Accesses: FDMA, TDMA and CDMA, associated standard hierarchies and applications.

Telephony: Introduction to basic telephone networks, Telephone sets, Signals and tones. Necessity of Signalling in Telecommunications.

Spread Spectrum Systems: Direct sequence spread spectrum signals, frequency-hopped spread spectrum signals, processing gain and performance. Applications of spread spectrum systems.

Wireless and Mobile Communications: Introduction to wireless communication systems: fixed wireless access, cellular, paging, trunked mobile systems, Capacity considerations, Standards. Radio wave propagation in the mobile environment- fading, interference. Mobile radio link design. Introduction to GSM and IS-95.

Basics of wireless access: Overview of wireless access networks, base and subscriber stations, frequency planning, multiple access. Noise and interference in wireless communication systems.

Switching: Circuit Switching and Packet switching, Evolution of circuit switching systems Crossbar switching, Space switching, time switching, and stored program control (SPC) switching. Blocking and non-blocking switches. Packet switching with comparison to circuit switching.TS, TST, STS swithes.

Soft switch.
Teletraffic Theory: Statistical characterization of telecommunications traffic. The Erlang C formula and its applications. Circuit efficiency, grade of service and measurement of congested circuits. Dimensioning of telephone circuits and switches.

Transmission: Multiplexing hierarchies – PCM and time division multiplexing,
European and American PCM hierarchy, SONET, SDH and WDM techniques and networks.

Books:
B.P. Lathi, *Modern Digital & Analog Communication Systems*.

Leon W. Couchii, *Digital and analog communication system* .

Valaney, *Digital Communication System* .

Mischa Schwartz , *Information Transmission, Modulation & Noise* .

James Martin, *Packet Switching* .

Herbert Taub and Donald L. Schilling, *Principles of Communication Systems*.

EEE 320: Telecommunications Engineering II Lab
(1.5 credits)
Experiments based on syllabus of EEE 319.

EEE 321: Electrical and Electronic Engineering Services for Buildings.
(1.5 credits)

Designing LT Electrical distribution buildings, for low rise office buildings, for industrial buildings, for multipurpose buildings. Selection of cable size, circuit breaker size, busbar size. Typical lighting design inside a domestic building, office building and an industry. Choice of luminaries for various applications.

Introduction to modern Lifts and their installation. Installation of a PABX for domestic building, office building and industrial compound. Designing routing and layout of indoor and underground telephone and fiber optic cables. Designing routing and layout of UTP data cables and fiber optic cables for LAN.

Introduction to IEE Wiring Regulation 16th (BS7671:2001 incorporating Amendments 1& 2, 2004. Safety regulations, various types of cables for indoor wiring and electrical distribution in buildings. Distribution boards, MCB, MCCB. Earthing requirements, various earthing systems. Conductors for outdoor distribution through poles. Single line diagram of a typical 11 KV/0.4 KV 500 KVA Substation and 200 KVA pole mounted transformer. Bus-bar trunking system for various applications.

Introduction to CCTV, Fire Detection and Alarm system, Fire fighting system, Burglar Alarm system.

Books:

BS7671:2001 incorporating Amendments 1 & 2, 2004, (IEE Wiring Regulation 16th edition), IET, U.K. (Including more supporting documents from IET London, U.K.)

Plus other books.

EEE 322: Industrial Training/ Project Work
(1 credits)

3-4 weeks industrial Training/ Project Work as described before.

Seventh Semester

EEE 401: Semiconductor Physics and Devices
(3 credits)

Electron & Hole statistics in semiconductors. Transport properties, Charge carrier recombination, Diffusion of electron & hole, Equation of continuity, Carrier injection, p-n Junction, Types of p-n junction, Current-Voltage characteristics, Physical model of a p-n junction, Junction capacitance and Width, Breakdown phenomena, Bipolar junction transistors: Basic principle of pnp and npn transistors, emitter efficiency, base transport factor and current gain, diffusion equation in the base, Ebers-Moll equations and circuit synthesis. Metal- Semiconductor Junction : Energy band diagram of metal semiconductor junctions, Rectification at metal-semiconductor Junction, MOS structure: MOS capacitor, energy band diagrams and flat band voltage and control of threshold voltage. Schottky-diffusion theory, Principle of operation of FET, qualitative theory of MOSFET operation, body effect and current –voltage relationship of a MOSFET. Junction field-effect-transistor. Photovoltaic effect, LED,

Books:

Michael Shur, *Physics of Semiconductor Devices*, Prentice-Hall of India Pvt. Ltd., 1995.

S.M. Sze, *Physics of Semiconductor Devices*, 2nd edition, Jhon Willy, 1981

EEE 403: Microwave Engineering
(3 credits)

H.F transmission lines, smith chart, Impedance matching technique and applications.
Guided electromagnetic waves, Parallel plane and Rectangular waveguides, Cavity resonator. Antennas and radiation, Small current element antenna, long straight antenna, Radiation patterns and gain. Frequency Independent and Logperiodic antennas. Antennas arras: Broadside and Endfire array, Phase scanning of Antennas arrays.

Transit time effects, Velocity modulation, Microwave tubes: Klystron amplifier, Multicavity Klystron amplifier, Reflex Klystron oscillator, Magnetron Oscillator, Traveling Wave Tube Amplifier (TWTA), Backward Wave Oscillator (BWO).

Books:

Simon Ramo,John R. Whinnery, Theodore Van Duzer, *Fields and Waves in Communication Electronics.*

David M. Pozar, *Microwave Engineering*, Wiley Text Books; 2nd edition, ISBN: 0471170968.

E.C. Jordan and K.G. Balmain, *Electromagnetic Waves and Radiating Systems*, Prentice-Hall Inc.,N.Y., 1968.

S.Y. Liao, *Microwave Devices and Circuits*, Prentice-Hall Inc., New Jersey, USA.

C.T.A. Johnk, *Engineering Electromagnetic Fields and Waves,* Wiley Eastern Limited, New Delhi.

EEE 404: Microwave Engineering Lab
(1.5 credits)

Experiments based on syllabus of EEE 403.

EEE 405: Microprocessor & Interfacing
(3 credits)

Introduction to microprocessors. Intel 8086 microprocessor: Architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt. Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard and display interface. Introduction to micro-controllers.

Books:

Ramesh Gaonkar, *Architecture Programming and Application with the 8085.*

Barry B. Brey, *The Intel Microprocessos 8086/8088 : Architecture Programming and Interfacing.*

D.V. Hall, *Microprocessor and Interfacing.*

EEE 406: Microprocessor and Interfacing Lab
(1.5 credits)

Experiments based on syllabus of EEE 405.

EEE 407: Data Communications
(3 credits)

Introduction: Data and signals. Transmission media and impairments. Data encoding techniques - Analog and digital encoding of digital data .Frequency and time-division Multiplexing techniques. Flow control. Error detection and error control techniques. Standards for interfacing to media. Compression. Network classification. Network topologies;

Network architecture for data and computer communications: Circuit switching. Packet switching. ISDN, BISDN. Frame relay and ATM. SMDS .Routing in packet-switched networks -fixed, random and adaptive approaches. SS7, Congestion and its control. Quality of Service;

Local and Wide Area Networks: Common topologies. Medium access control-round-robin, reservation and contention-based strategies. ALOHA protocol and its variants. CSMA and CSMA/CD protocols. Token-ring protocol. IEEE 802 standards for local area networks. High speed LANs - Fast and Gigabit Ethernet, FDDI. baseband, broadband. Wireless LANs. Internetworking - Hubs, Bridges, Switches, Repeaters, routers and gateways. DSU/CSU. xDSL and cable modems. TCP/IP protocol suite. TCP/IP Sockets. Name Service. Application protocols over TCP/IP. Voice over IP. Bluetooth. Cellular;

Network applications: client/server concept; port de-multiplexing; socket API; server concurrency; DNS; TELNET; Web technologies including HTML, HTTP, CGI, Java; RPC and middleware; network management. HTTP. Electronic mail. WWW;

Network performance evaluation: Network simulation using CNET Network simulator; analytic modeling.

Books:

Behrouz A. Forouzan, *Data Communication and Networking.*

Wayne Tomassi, *Advanced Electronic Communication Systems*.

EEE 408: Data Communications Lab
(1.5 credits)

Experiments based on syllabus of EEE 407.

EEE 410: Project & Thesis
(0.0 credits)

Design, study, investigation or development of an electrical or electronic circuit, useful equipment, appliance involving latest state-of-art technology ending with a thesis. The thesis will contain a detailed report on the project work done.

Alternatively, it can be a theoretical study involving some analytical development and development leading to a research work leading to a publication of a research paper on a topic of current interest. A thesis write up is necessary.

The work will be carried individually of normally two students under the direct supervision of an experienced teacher of the department and will be completed within two semesters.

The thesis must be prepared following the guideline provided by the department.

Eighth Semester

EEE 421: Power Stations
(3 credits)

Energy sources: Fossil fuels, nuclear fission, renewable sources-hydro, biomes, solar, wind, geothermal; pumped storage hydro.

Power station performance: connected load, demand factor, diversity factor, load factor, plant factor, utilization factor.

Plant performance and operating characteristics: efficiency, heat rate, incremental rate method, Station performance characteristics, Station incremental rate, capacity scheduling, Base load and peak load, Load division between steam and hydro stations, choice of power station and units.

Interconnected System: Capacity savings, power sharing amongst units for economic allocation.

Private generation: industrial co-generation, capacity generation. Site selection of Power Station.

Energy Tariff: description, types and tariff in Bangladesh.

Hydro power stations: equipment, plant auxiliaries, plant operation.

Nuclear power stations: chain reactions, nuclear reactors: moderator, control rod, coolant, shielding, neutron diffusion, four factors formula, critical reactors, and operation.

Thermal power station: equipment, plant auxiliaries, and operation.

Books:
M. V. Deshpande, *Elements of Electrical Power Station Design* .

Bernhardt G.A. Skrotzki and William A. Vopat, *Power Station Engineering and Economy.*

EEE 423 :Industrial and Power Electronics
(3 credits)

Introduction to solid state devices: (i) Schottky rectifier (ii) Zener diode (iii) Diode and transistor packages. Introduction to solid state devices: (i) BJT, (ii) MOSFET, (iii) SCR and (iv) TRIAC, (v) IGBT and (vi) GTO. Introduction to triggering devices: UJT, UJT relaxation oscillator, phase control circuit; Programmable UJT (PUT), PUT relaxation oscillator, Silicon Unilateral Switch (SUS), DIAC, Silicon Bilateral Switch (SBS), Asymmetrical AC triggering devices.

Motor Control:

DC Motor Control : DC Motor braking and plugging circuits, transistor dynamic braking circuit, typical motor plugging circuit, emergency stop plugging circuit; speed control PM/ Shunt motors; electronic speed control using armature voltage control method. Solid state motor speed controller: Single transistor speed control; OP-AMP and Darlington power amplifier speed control, OP-AMP and MOSFET power amplifier control for PM/Shunt motors. SCR speed control circuits for PM/Shunt motors; simple SCR circuit, SCR plus UJT circuit variation of a pulse width modulation (PWM) speed control circuit. Speed control of series/universal motors: Series/universal motor control circuit using SCR (half wave control); TRIAC and DIAC (full wave control); TRIAC control with Hysteresis compensation.

DC motor phase control: balance bridge (reversing) drive for PM or shunt motors, phase control circuit for DC series motor.
Stepper motors: stepper motors drive circuit using transistors, Darlington transistor and MOSFETs.

AC Motor Control: AC motor braking, speed of AC motors: Variable frequency converter block diagram, simplified single phase cycloconverter. Single phase inverter, three phase six step inverter.
Voltage multipliers. Electronic timers.
Switched mode power supplies.
Magnetic Amplifiers.
Resistance welder controls. Induction heating. Dielectric heating.

Books:

Schuler and McNamee, *Industrial Electronics and Robotics*, Tata McGraw-Hill, Singapore.

P. C. Sen, *Power Electronics*, Tata McGraw-Hill publishing Company Ltd, 1987(1994) New Delhi, India.

Cyril W. Lander, *Power Electronics*, McGraw-Hill publishing Company, (UK), London,1981.

Muhammad Harunur Rashid, " *Power Electronics Handbook*.

EEE 424: Industrial and Power Electronics Lab
(1.5 credits)

Experiments based on syllabus of EEE 423.

EEE 425: VLSI Technology
(3 credits)

Introduction to MOS devices, design of inverters, static and dynamic logic circuits, Domino and zipper logic, Custom, semi-custom and cell library based design, Design of analog building backs, Effect of device scaling on circuit performance.

Overview of IC Technology and its requirements, Unit steps used in IC Technology: Wafer cleaning, photo-lithography, wet and dry etching, oxidation and diffusion, ion implantation,

CVD and LPCVD techniques for deposition of poly silicon, silicon nitride and silicon di-oxide, Metallization and passivation.

Special techniques for modern processes: self-aligned silicides, shallow junction formation, nitride oxides etc. Process flows for CMOS and bipolar IC processes.
Introduction to process, device, circuit logic and timing simulation, Hardware description languages for high level design.

Books:
N. Weste and K. Eshraghian, CMOS VLSI Design, Addison Wesley, 1993.

S.M. Sze, VLSI Technology, McGraw Hill, 1988.

EEE 426: VLSI Technology Lab
(1.5 credits)

Experiments based on syllabus of EEE 425.

EEE 410: Project & Thesis
(4 credits)
Conditions, as described for EEE 410: Project & Thesis.

Elective I

EEE 409: Biomedical Instrumentation
(3 credits)
Human body: Cells and physiological systems. Bioelectricity: genesis and characteristics. Measurement of bio-signals: Ethical issues, transducers, amplifiers and filters. Electrocardiogram: electrocardiography, phono cardiograph, vector cardiograph, analysis and interpretation of cardiac signals, cardiac pacemakers and defibrillator. Blood pressure: systolic, diastolic mean pressure, electronic manometer, detector circuits and practical problems in pressure monitoring. Blood flow measurement: Plethymography and electromagnetic flow meter. Measurement and interpretation: electroencephalogram, cerebral angiograph and cronical X-ray. Brain scans. Electromayogram (EMG). Tomograph: Positron emission tomography and computer tomography. Magnetic resonance imaging. Ultrasonogram. Patient monitoring system and medical telemetry. Effect of electromagnetic fields on human body.

EEE 411: Energy Conversion & Generalized Machine Theory
(3 credits)
Generalized energy conversion processes, general principles of electromechanical energy conversion, energy storage. Interpretation of generalized machines from field concepts. Kron's primitive machine and its adaptation in DC machines; moving to fixed-axis transformation; Park's transformation; three phase to d-q transformation; analysis of three phase synchronous and induction machines based on generalized machine theory.

EEE 413: Cellular Mobile Communication
(3.0 Credit)
Introduction to Cellular Mobile radio Background and history: Conventional Mobile Radio Versus Cellular Mobile Radio; Features of Cellular Radio; Digital Cellular Radio; Trends in the Use of Cellular Services.

The Mobile Radio Environment: Lowpass Equivalent Representation, Bandpass Signals and Linear Bandpass Systems, Multipath Propagation, Path Loss, Doppler Effect, Rayleigh Fading and Rician Fading; Statistics of Slow and fast fading;

Classification of Channels: Time Dispersion and Frequency-Selective, Fading, Frequency Dispersion and Time-Selective Fading;

Mathematical Modeling of Fading Multipath Channels: Bello Functions, Description of Random Time-Variant Channels, Discrete-Time Representation of Channels, Computational Channel Models: Gaussian, Rayleigh, Rician and Wideband Channels.

Diversity Schemes and Combining Techniques: Diversity Schemes; Space; Frequency; Polarization; Field Component; Angle; Time and Multipath Diversity; Combining Techniques: Selective, Switched, Maximal-Ratio, Equal-Gain and Baseband Combining.

Cochannel and Adjacent Channel Interference: Noise-Limited an Interference-Limited Environments; Co-channel Interference; Adjacent Channel Interference; Near-End-To-Far-End Ratio.

Cellular Traffic: Channel Assignment; Capacity of Cellular Systems; Trunking Theory; Components of Cellular Systems; Handover.

Analog FDMA Systems: The Analog Cellular Environment; Analog Modulation: Frequency Modulation; Transmission bandwidth; Signal-to-Noise Ratio; De-emphasis and Pre-emphasis; Capture Effect; Effect of Multipath fading; Modulators and Demodulators for FM; Existing Analog Cellular Radio Systems: European; American and Japanese Systems; AMPS, The NMT-900 System.

Digital TDMA Systems: The Digital Cellular Environment: Intersymbol Interference and Nyquist Filter; Nonlinear Distortion: AM/AM and AM/PM conversion; Fading Channel Issues in Digital Systems; Digital Modulation; Signal Processing and Data Formatting; Channel Coding, Security; Existing Digital Cellular Radio Systems: European; American and Japanese Systems; The GSM Systems: Overview; Mapping of Logical Channels; Speech Channel; Channel Coding and Interleaving; GSM Transmitter and Receiver; Frequency Hopping, Registration; Call Origination; Paging; Handover; Security; DCS1800, Telecommunications Services.

Digital CDMA Systems: CDMA Systems; Capacity Analysis of Multiple Access methods; IS-95 Standard for CDMA Cellular System; 3rd Generation CDMA Systems; 4th Generation Mobile Systems.

EEE 415: Science of Materials
(3 credits)
Atoms and aggregate of atoms, wave-matter concept, nature of chemical bond, crystals and their classification, Bravious lattice, atomic arrangement in solids, DC dielectric properties,

polar and non-polar dielectrics, Langevin function, Clausius-Mossotti equation, dielectrics in AC field, ferroelectricity, ferroelectric and antiferroelectric materials, magnetic properties of materials, ferromagnetic-ferrimagnetic-antiferromagnetic materials, magnetic moment, domain wall motion and coercive force in crystals, polycrystalline and permanent magnetic materials, magnetic resonance, conductivity theory, collision theory and conductivity of metals, Introduction to superconductivity and plasmas.

EEE 417: Optoelectronics
(3 credits)

Optical properties in 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 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. Stimulated emission and light amplification: Spontaneous and stimulated 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 magento-optic devices. Introduction to integrated optics.

EEE 419: Renewable Energy Conversion
(3 credits)
Renewable energy sources and their importance. Statistics regarding solar radiation and wind speed. Insulation: geographical distribution, atmospheric factors, measurements. Solar cell: Principle of operation, spectral response, factors effecting conversion efficiency, I-V characteristics, maximum power output. PV modules and arrays: stationary and tracking. PV systems: stand alone, battery storage, inverter interfaces with grid. Wind turbine generators: types, operational characteristics, cut-in and cut-out speed control, grid interfacings, AC-DC-AC link.

Elective II

EEE 427: Digital Signal Processing
(3 credits)
Discrete-time Signals and systems: signal representation, concept of filters, convolution, stability & causality, random signals (correlation, power spectrum).

DTFT: Power density spectrum, Relationship to Z transform, The Cepstrum, Concept of bandwidth, Frequency range of natural signals, Properties of DTFTThe Wiener-Khintchine theorem.

The z Transform: uses, definitions, region of convergence, inverse z transform, linearity, shift, convolution, multiplication, complex conjugation, Parseval's relation.

Input-Output Relationships: system function, poles and zeros, frequency response, filter examples, state variables.

Discrete-Time Networks: signal flow graphs, cascade & parallel networks, transpose networks, stability, linear phase, more filter examples.

Sampling of Signals: Nyquist theorem, aliasing, D/A conversion, ideal sampling/reconstruction, real-world systems (prefilters, quantization, postfilters), Discrete-time decimation and interpolation;

Interpolation & Decimation: Seen as a filter design problem, role of FIR filters.

Discrete Fourier Transform: definition, properties, zero padding, linear convolution, leakage, windows;

FFT Algorithms: decimation in time, real-valued data, radix 4 FFT, prime factor algorithms, 2-dimensional DFT, Fast Convolution, Convolution of long sequence, Overlap add and Overlap save method.

IIR Filters: mathematical structure, Impulse Invariance, Bilinear Transform, design by transformation, Butterworth, Chebyshev, Cauer designs, recursive implementations, ladder & lattice structures.

FIR Filters: mathematical structure, filter design by pole/zero placement, design by windowing, Parks-McClellan algorithm, frequency-domain design, non-recursive implementations, 2D filters.

Use of DSP in Radar: complex signals, 2-dimensional signals, matched filtering, fast convolution, side-lobe control.

Other Applications: Applications in medical imaging (CT, MRI), Speech processing.

EEE 428: Digital Signal Processing Lab
(1.5 credits)
Experiments based on syllabus of EEE 427.

EEE 429: High Voltage Engineering
(3 credits)
High voltage DC: Rectifier circuits, cascaded rectifiers, Van-de-Graff generators, electrostatic generators.

High voltage AC: cascaded transformers, tesla coils.

Impulse generators: Impulse wave shapes, mathematical analysis and design consideration of impulse generator, triggering and synchronizing of impulse generators.

Measurement and testing of high voltages, radio influence (RI) and corona, power loss calculation, break down of solid-liquid and gaseous dieletrics, Insulation testing: Standard specification, transmission line design based on direct strokes, insulation co-ordination, lightning phenomenon, lightning arrestors, surge diverter, protector tubes, high voltage

AC/DC transmission, merits and demerits of AC/DC transmission, bridge arrangement, mathematical analysis of the bridge circuits, reactive power, artificial commutation, harmonics.

EEE 430: High Voltage Engineering Lab
(1.5 credits)
Experiments based on syllabus of EEE 429.

EEE 431: Microwave Devices, Amplifiers and Sources
(3 credits)
Microwave frequency ranges, waveguides, special waveguide types, cavities and resonators, microwave networks, antennas and radiation, radiation pattern, antenna arrays and their design. Transit time effect. Microwave Tubes : Multicavity Klystron Amplifier, Reflex Klystron Oscillator, Backward Wave Oscillator, Traveling Wave Tube.
Introduction to Microwave Solid State Devices: Microwave FET amplifier, Gunn Oscillator, FET & DR Oscillator, YIG Oscillator, PIN diode modulator, MESFET amplifier.

EEE 432: Microwave Devices, Amplifiers and Sources Lab
(1.5 credits)
Experiments based on syllabus of EEE 431.

EEE 433: Optical Fiber Communications
(3 credits)
Introduction: Light propagation through optical fiber: Ray optics theory and mode theory.

Optical fiber: Types and characteristics, transmission characteristics, fiber fabrication, fiber joints, splicing, couplers, connectors.

Light sources: Light emitting diodes and laser diodes.

Detectors: PIN photo-detector and avalanche photo-detectors.

Receiver analysis: Direct detection and coherent detection, noise and limitations.

Transmission limitations: Chromatic dispersion, nonlinear refraction, four wave mixing and laser phase noises.

Optical amplifier: Laser and fiber amplifiers, applications and limitations.

Multi-channel optical system: Frequency division multiplexing, WDM,DWDM, co-channel interference, optical CDMA.

System design: Transmitter and receiver design.

Fiber optic networks: SONET, SDH, Telephone and computer networks, Cable TV.

EEE 434: Optical Fiber Communication Lab
(1.5 credits)
Experiments based on syllabus of EEE 433.