

Department of
Electrical Engineering

Syllabi for:

B. Tech. in Electrical Engineering
Effective from 2012-13



Indian School of Mines
Dhanbad-826004
Jharkhand, India

CORE COURSE SYLLABI
(Effective from 2012-2013)

I & II-SEMESTER

Sl. No.	Course No.	Course offering Department	Name of The Course	L	T	P	Total Credit Hours
THEORY							
1.	AMC11101	AM	Mathematics-I (only for 1 st Sem only)	3	1	0	7
2.	AMC12101	AM	Mathematics-II (only for 2 nd Sem only)	3	1	0	7
3.	APC11101/ ACC11101	AP/AC	Physics (Group-I)/Chemistry (Group-II)	3	0	0	6
4.	MMC11101/ MMC12102	ME & MME	Engineering Graphics (Group-I) / Manufacturing Process (Group-II)	1	4	0	6
5. a	EEC11101	EE	Electrical Technology (Group-I)	3	1	0	7
5. b	ECE11101	ECE	Electronics Engineering (Group-II)	3	0	0	6
6. a	MMC11103	ME & MME	Engineering Mechanics (Group-I)	3	1	0	7
6. b	CSE11301	CSE	Computer Programming (S) (Group-II)	3	0	0	6
7	(GLD/CMD11301) / (DMS/AP11301)	AGL & ESE/ DMS & AP	Earth System Science (S) [AGL 2-0-0 & ESE 1-0-0] (Group-I)/ Disaster Management [DMS 2-0-0] & Energy Resources [AP 1-0-0] (S) Group-II)	3	0	0	6
8.	HSC12305/ HSC11103	HSS	Value Education, Human Rights and Legislative Procedure (S) (Group-I)/ English for Science & Technology (Group-II)	3	0	0	6
9.		DSW	Co-Curricular Activities (Only for 2 nd Sem only)	0	0	0	(3)
PRACTICAL							
10.	APC12201/ ACC12201	AP/AC	Physics Practical (Group-I) / Chemistry Practical (Group-II)	0	0	3/2	1.5
11.	EEC 12201/ ECE12201	EE/ECE	Electrical Technology Practical (Group-I)/Electronics Engineering Practical (Group-II)	0	0	3/2	1.5
12.	CSE12301	CSE	Computer Programming Practical (S) (Group-II)	0	0	2	2
Total for 1st Semester (For Group-I)				19	7	3	48
Total for 1st Semester (For Group-II)				19	5	5	48
Total for 2nd Semester (For Group-II)				19	7	3	48+(3)
Total for 2nd Semester (For Group-I)				19	5	5	48+(3)

AMC 11101

MATHEMATICS- I

(3-1-0)

Calculus-I: Successive differentiation of one variable and Leibnitz theorem, Taylor's and Maclaurin's expansion of functions of single variable, Functions of several variables, partial derivatives, Euler's theorem, derivatives of composite and implicit functions, total derivatives, Jacobian's, Taylor's and Maclaurin's expansion of functions of several variables, Maxima and minima of functions of several variables, Lagrange's method of undetermined multipliers, Curvature and asymptotes, concavity, convexity and point of inflection, Curve tracing.

Calculus-II: Improper integrals, convergence of improper integrals, test of convergence, Beta and Gamma functions and its properties, Differentiation under integral sign, differentiation of integrals with constant and variable limits, Leibnitz rule.

Evaluation of double integrals, Change of order of integrations, change of coordinates, evaluation of area using double integrals, Evaluation of triple integrals, change of

coordinates, evaluation of volumes of solids and curved surfaces using double and triple integrals. Mass, center of gravity, moment of inertia and product of inertia of two and three-dimensional bodies and principal axes.

Trigonometry of Complex Number, 3D Geometry and Algebra: Function of complex arguments, Hyperbolic functions and summation of trigonometrical series.

3D Geometry: Cones, cylinders and conicoids, Central conicoids, normals and conjugate diameters.

Algebra: Convergency and divergency of Infinite series. Comparison test, D' Alembert's Ratio test, Raabe's test, logarithmic test, Cauchy's root test, Alternating series, Leibnitz test, absolute and conditional convergence, power series, uniform convergence.

AMC 12101

MATHEMATICS- II

(3-1-0)

Vector Calculus and Fourier Series:

Vector Calculus: Scalar and vector fields, Level surfaces, differentiation of vectors, Directional

derivatives, gradient, divergence and curl and their physical meaning, vector operators and expansion formulae, Line, surface and volume integrations, Theorems of Green, Stokes and Gauss, Application of vector calculus in engineering problems, orthogonal curvilinear coordinates, expressions of gradient, divergence and curl in curvilinear coordinates.

Fourier Series: Periodic functions, Euler's formulae, Dirichlet's conditions, expansion of even and odd functions, half range Fourier series, Parseval's formula, complex form of Fourier series.

Matrix Theory: Orthogonal, Hermitian, skew- Hermitian and unitary matrices, Elementary row and column transformations, rank and consistency conditions and solution of simultaneous equations, linear dependence and consistency conditions and solution of simultaneous equations, linear dependence and independence of vectors, Linear and orthogonal transformations, Eigen values and Eigen vectors, properties of Eigen values, Cayley-Hamilton theorem, reduction to normal forms, quadratic forms, reduction of quadratic forms to canonical forms, index, signature, Matrix calculus & its applications in solving differential equations.

Differential Equations: Differential Equations of first order and higher degree, Linear independence and dependence of functions. Higher order differential equations with constant coefficient, Rules of finding C.F. and P.I., Method of variation of parameter Cauchy and Legendre's linear equations, Simultaneous linear equations with constant coefficients, Linear differential equations of second order with variable coefficients; Removal of first derivative (Normal form), Change of independent variable, Applications of higher order differential equations in solution of engineering problems.

Partial Differential equations: Formation of P.D.E, Equations solvable by direct integration, Linear and non-linear equations of first order, Lagrange's equations, and Charpit's method, Homogeneous and non-homogeneous linear P.D.E. with constant coefficients, Rules for finding C.F. & P.I.

Recommended books for Mathematics I & II:

1. Higher Engineering Mathematics by B.V. Ramana, Tata McGraw-Hill.
2. Advanced Engineering Mathematics by R.K. Jain and S.R.K. Iyengar, Narosa Publishing House.
3. Calculus and Analytic Geometry by G.B. Thomas and R.L. Finney, Narosa Publishing House.

4. Advanced Engineering Mathematics by M.D. Greenberg, Pearson.
5. Higher Engineering Mathematics by B.S. Grewal, Khanna Publishers.

APC11101/APC12101

PHYSICS

(3-0-0)

Thermal Physics: Concepts of distribution of molecular velocities; Distribution laws and statistics MB, FD and BE, mean free path; Transport phenomena-viscosity, diffusion; thermal conductivity, measurement of thermal conductivity; periodic and aperiodic flow of heat; Wiedemann-Franz law. Heat radiation; black body and black body radiation; Planck's distribution law and its application to classical distribution (Rayleigh-Jeans and Wiens) and total radiation (Stefan-Boltzmann) laws.

Modern Physics: Brief idea of molecular spectra; Rigid rotator, spectra of simple molecules, rotation and rotation-vibration spectra. Brief idea of wave packet and wave function, Schrödinger equation, Particle in a Box. Free electron theory; qualitative idea of band theory of solids and Hall effect, Laser and laser systems (He-Ne and Ruby Lasers).

Electromagnetics and Electrical Phenomena in Rocks: Maxwell's field equation, Equation of electromagnetic field, Propagation of electromagnetic waves in different isotropic media, energy of electromagnetic waves, Poynting's theorem & Poynting's vector. Rocks and minerals as dielectrics, electrical conductivity and electrical phenomena in rocks, Piezo-, ferro-, tribo-, and pyro-electricity.

Recommended Books:

1. Heat And Thermodynamics; Brij Lal & Subrahmanyam; S Chand & Co Ltd; 2001
2. Thermal And Statistical Physics; R B Singh; New Age Publications; 2009
3. An Introduction To Thermal Physics; Schroeder; Dorling Kindersley India; 2007
4. Thermal Physics And Statistical Mechanics; Roy & Gupta; New Age Publications; 2001
5. Concepts Of Modern Physics; Beiser; McGraw-Hill Science; 2010
6. Modern Physics; Sivaprasath & Murugesan; S. Chand Publisher; 2009

APC11201/APC12201

PHYSICS PRACTICAL

(0-0-3/2)

Measurement of thermal conductivity of bad conductors, Optical experiments on Diffraction using diffraction grating, Experiments on Semi-conductors – Measurement of band gap and Hall Effect, experiments using He-Ne Laser - Diffraction Experiments to measure diameter of circular aperture, Polarisation Experiments to measure Brewster's angle & refractive index.

ACC11101 / ACC11102

CHEMISTRY

(3- 0- 0)

Cement: Manufacturing, composition, setting and hardening of cement.

Glass : Types of Glasses, Manufacturing & properties of Glasses.

Polymer : Classification, structure-property relationship, conductive polymers.

Solid Fuel : Structure of coal, classification of coal, Effect of heat on coal, carbonization and pyrolysis. Recovery and purification of byproducts obtained from coke ovens; Distillation of coal tar; coal.

Liquid fuel: Composition of crude oil, processing of crude oil, distillation, sweetening and cracking (basic concepts), octane number, Cetane number. Additives to improve the quality of diesel and petrol, bio-diesel.

Gaseous fuel: Characteristics of good fuel; calorific value, theoretical calculations of calorific value of a fuel, natural gas and hydrogen gas.

Phase rule & Phase equilibrium: Phase rule; degree of freedom, one and two component systems, temperature and composition diagrams, liquid-liquid and liquid-solid phase diagrams.

Lubricants: General characteristics of lubricants, chemistry of lube oil and greases. Reclamation of lubricants.

Equilibrium: Electrochemistry; Electric potentials at interfaces, electrodes, batteries. electrochemical cells and their applications.

Corrosion: Chemical and electrochemical corrosion, classification, factors affecting corrosion, Form of corrosion and general methods of corrosion prevention.

ACC12101 / ACC12102

CHEMISTRY PRACTICAL

(0- 0- 3/2)

1. Standards of HCl by Standard Sodium Carbonate solution
2. Determination of Temporary Hardness of tap water.
3. Estimation of Total Hardness of water.
4. Determination of Iron in Ferrous Ammonium Sulphate solution (Redox titration).
5. Determination of Copper in crystallized Copper-Sulphate.
6. Estimation of available Chlorine in Bleaching Powder.
7. Determination of Molecular Weight of Organic Acid by Titration method.
8. Estimation of Sodium Carbonate and bicarbonate in a mixture.
9. To determine the saponification number of an oil.
10. To determine the rate of hydrolysis of methyl /ethyl acetate.
11. To prepare Chrome Alum.

Recommended Books:

1. A Textbook of Engineering Chemistry-Sashi Chawla
2. Applied Chemistry:A Textbook for Engineers and Technologists - H.D.Gesser.
3. Engineering Chemistry - P.C.Jain & Monika Jain
4. Engineering Materials - K.G. Budinski

MMC 11101/ MMC 12101

ENGINEERING GRAPHICS

(1 – 4 – 0)

Introduction: Drawing instruments and their uses; Indian standards for drawing. Lettering and Types of lines used in engineering graphics.

Curves used in engineering practice: Conic sections, ellipse, parabola, hyperbola, cycloid, epicycloid, hypocycloid, involutes and spiral.

Projections: Orthographic projection, projection of points in different quadrants, projection of lines, projection of lines parallel to one and inclined to the other reference plane, projection of lines inclined to both the reference planes.

Multi view orthographic projections: First angle and third angle projections, conventions used, Conversion of three-dimensional views to orthographic views.

Projection of Solids and Development of surfaces

Isometric projections: Isometric views, conversion of orthographic views to isometric views.

Recommended Books:

1. Engineering Drawing - N D Bhatt
2. Engineering Graphics - S C Sharma & Naveen Kumar
3. Engineering Drawing - P S Gill
4. Engineering Drawing with Auto-CAD - Parvez, Khan & Khalique

MMC111021/MMC12102 MANUFACTURING PROCESSES (1-4-0)

Carpentry:- Classification of timber, seasoning & preservation to wood, description and application of the various tools used in carpentry, different joints and their practical uses.

Forming-Introduction to deformation and forming, types of forming processes and their applications, safety rule.

Casting: Introduction to foundry. pattern making, types of casting processes, purpose of runner and riser. application of casting, defects in casting. safety rules.

Fitting: Introduction to fitting jobs, fitting tools and their uses. safety rules.

Welding: Welding types, accessories. weldments.

Machine Tools: Types of cutting tools, types of machine tools and their specifications, safety rules.

Measurement: Use of measuring instruments etc for product measurement.

Recommended Books:

1. Workshop Technology part I, II & I IJ----- W A J Chapman
2. Workshop lechnology part I & II ----- Hazra Chowdhary
3. Workshop Technology part I & II ----- Raghuvanshi
4. Workshop Technology ----- S.K. Garg
5. Manufacturing Technology ----- P. N. Rao
6. A Text book of Workshop Technology ----- R S Khurmi & J K Gupta

EEC 11102/12102 ELECTRICAL TECHNOLOGY (3 - 1 - 0)

Concepts of circuit elements: active and passive elements; resistance, inductance, capacitance; mutual inductance and coupling. Network theorems (KCL, KVL, Thevenin, Norton, Maximum power transfer). Mesh and nodal analysis of DC circuits.

Single-phase AC circuits and concept of phasor diagram, series and parallel resonance. Three-phase AC circuits with balanced and unbalance loads. Measurement of three-phase power by two-wattmeter method.

Single-phase transformer: construction, types, e.m.f equation, equivalent circuit diagram, hysteresis and eddy current losses, efficiency, applications.

DC Machines – construction and types, e.m.f and torque equation. DC generator – operation, e.m.f. equation, OCC, losses and efficiency, applications. DC motor – operation, torque equation, starting, losses and efficiency, applications.

Three-phase induction motor: construction, types, operation, torque equation, torque slip characteristics, starting methods, applications.

Recommended Books:

1. Electrical Engineering Fundamentals - V Del Toro.
2. Basic Electrical Engineering (Special Indian Edition) - J J Cathey, S A Nasar, P Kumar.
3. Hughes Electrical and Electronic Technology - E Hughes, I M Smith, J Hiley, K Brown.
4. Basic Electrical Engineering - D P Kothari and I J Nagrath.
5. Electric Machinery - A E Fitzgerald, C Kingsley, S D Umans.

EEC11201/12201 ELECTRICAL TECHNOLOGY PRACTICAL (0 - 0- 3/2)

Experiments on Thevenin's theorem, R-L-C series circuit, Single phase power measurement, Characteristics of fluorescent lamp and incandescent lamp, OC and SC tests of single phase transformer, Open- circuit characteristics of DC separately excited generator, External Characteristics of separately excited DC generator, Three-point starter of DC shunt motor, Speed control of DC motor.

ECC 11101/12101 ELECTRONICS ENGINEERING (3-0-0)

Semiconductor Diodes and Applications – Introduction Characteristics, dc and ac resistances of a diode. Half wave and Full wave rectification. Zener Diodes and then use as regulators, Clippers and Clampers.

Bipolar Junction Transistor – Introduction, Transistor operation CB, CE and CC configuration, dc Biasing, Operating Point, Fixed Bias Circuit, Emitter – Stabilized Bias Circuit. Voltage Divider Bias.

BJT Transistor – Amplification in ac domain, Equivalent transistor model. Hybrid Equivalent model, RC coupled amplifier and its frequency response.

Operational Amplifiers – Introduction, Differential and Common Mode Operation, OPAMP Basics, Practical OPAMP Circuits.

Introduction to Field Effect Transistors and their applications.

Digital Electronics – Review of Basic Gates and Boolean Algebra, Introduction to Combinatorial Logic Design. Standard Representations of Logical Functions and their simplification. Combinatorial Logic Design, Half Adder and Full Adder.

Recommended Books:

1. Electronic Device and Circuit Theory - Boylestad & Nashelsky
2. Digital Principles & Applications - Malvino & Leach

ECC 11201/12201 ELECTRONICS ENGINEERING (LAB) (3-0-0)

1. Study of Electronic Equipment & Components.
2. Study of diode characteristics.
3. Study of regulated power supply.
4. Study of BJT characteristics.
5. Study of op-amp characteristics.
6. Implementation of Boolean algebra using logic gates.
7. Adder Circuits.

MMC 11103/MMC12103 ENGINEERING MECHANICS (3-1-0)

Fundamentals of Mechanics: Equivalent force systems, Equilibrium of rigid bodies.

Introduction to structural mechanics: Trusses, Frames, Machines, Beams, and Cables.

Friction force analysis: Sliding and Rolling friction, Screw, Belt and Collar friction

Properties of surfaces: Centroid of composite bodies, Pappus-Guldinus theorem, moment of inertia of composite bodies, parallel axis theorem, product of inertia, principal axes, Mohr's circles for moments and products of inertia.

Virtual work: Principle and applications, Stability of equilibrium.

Kinematics and kinetics of particles: Curvilinear motion, Dynamic equilibrium, Angular momentum, Revision of Conservation of Energy, Energy and Momentum methods for Single Particle and for a System of Particles, Impulsive motion.

Kinematics of rigid bodies: General plane motion, Instantaneous center of rotation, Planer motion relative to a rotating frame, Coriolis acceleration, Frame of reference in general motion.

Kinetics of rigid bodies: Application of the principle of impulse and momentum to the 3D motion of a rigid body, Kinetic energy in 3D, Euler's equations of motion, Motion of a Gyroscope, Eulerian angles.

Recommended Books:

1. Vector Mechanics for Engineers - Statics & Dynamic: Beer, Johnston.
2. Vector Mechanics - Statics & Dynamics: Nelson, Best, McLean.
3. Vector Mechanics - Statics & Dynamics: Shames. Rao, Pearson.
4. Engineering Mechanics: Timoshenko & Young.

CSC 11101/CSC 12101 COMPUTER PROGRAMMING(S) (3-0-0)

Programming in C

C Fundamentals: Introduction to C, Data types, Constants and variable declaration, Scope, Storage classes, Data input and output functions, Sample programs.

Operators & Expressions: Arithmetic, Relational, Logical, Bitwise operators, Conditional, Assignment, Library functions.

Control & Looping Statements: if, while, for, do-while, switch, break and continue statements, nested loops.

Arrays: Declaration, Initialization, Processing an array, 1D, 2D and multidimensional arrays, Strings and their Operations.

Functions: Defining functions, Function prototypes, Accessing a function, Passing arguments, Passing arrays and Recursive functions.

Pointers: Declaration, Operations on pointers, Passing pointers to a function, Pointers and arrays, Array of Pointers.

Structures & Unions: Defining a structure, Processing a structure, User defined data types, Structure and pointers, Passing structure to a function, Self referential structures, Unions.

File Management: File operations, Creating and processing a data file, Command line arguments.

Programming in JAVA

Fundamentals of Object-Oriented Programming: Basic concepts, Objects and classes, Data abstraction and encapsulation, Inheritance, Polymorphism and Dynamic binding.

JAVA Evolution: Java features, Java versus C and C++, Creating, compiling and running a Java program, Constants, Variables, Data types, Operators and Expressions, Decision making and branching, Decision making and looping, Classes, objects, and methods, Sample programs.

Recommended Book:

1. "Programming with C by Byron Gottfried" , *Second edition, Schaum's Outline Series* ,1998
2. "C programming by Kernighan and Ritchie", *Second edition, Prentice Hall*, April 1, 1988
3. "Java: The complete reference – Herbert Schildt", *Eight edition, McGraw – Hill*, 2011.

4. "The C Programming Language by Bjarne Stroustrup", Pearson Education, 2000.
5. "C: The complete reference – Herbert Schildt", Fourth edition, McGraw-Hill, 2000.
6. "Programming With Java by E Balaguruswamy", 4th Edition, Tata McGraw-Hill, 2008
7. "Let us C – by Yashwant Kanitkar", BPB publications, 2008.

CSC11201/CSC122 COMPUTER PROGRAMMING PRACTICAL (0-0-2)

Laboratory experiments will be based on the materials covered in the theory of this paper emphasizing the following topics.

1. Control statements
2. Arrays with applications
3. String Handling
4. Structure with applications
5. Pointers with applications
6. File handling in C
7. Programs on Java

(GLD/CMD)(11301/12301) EARTH SYSTEM SCIENCE (S) (3-0-0)

Part A : AGL (2-0-0)

Space Science : Solar System, Age of the Earth, Origin of Solar system. Meteors and Meteorites.

Earth Dynamics : Interior of the Earth, Composition of the Earth, Seismic waves, Seismograph, Plate Tectonics, Basics of Earthquake Engineering, Landslides, Volcanoes.

Geological Oceanography: Sea waves, Tides, Ocean currents, Geological work of seas and oceans, Tsunami and its causes, Warning system and mitigation.

Hydrogeology: Water table, Aquifer, Groundwater fluctuations and groundwater composition, Hydrologic cycle.

Glaciology: Glacier types, Different type of glaciers, Landforms formed by glacier.

Geological bodies and their structures: Rock, mineral, batholith, dyke, sill, fold fault, joint, unconformity.

Part B : ESE (1-0-0)

Earth's Atmosphere : Structure and composition of atmosphere, Atmospheric circulation, Geological work of wind, Greenhouse effect and global warming, Carbon dioxide sequestration. Steps to maintain clean and pollution free atmosphere with governing laws, precautionary measures against disasters.

Biosphere: Origin of life, Evolution of life through ages, Geological time scale, biodiversity and its conservation.

Natural Resources : Renewable and non-renewable resources, Mineral and fossil fuel resources and their geological setting, mining of minerals and conservation, effect of mining on surface environment.

Recommended Books :

1. Earth's Dynamic Systems – W. Kenneth and Eric H. Christiansen
2. Exploring Earth: An introduction to Physical Geology – John P. Davidson
3. Holmes Principles of Physical Geology – A. Holmes (Revised Ed. Doris L. Holmes)
4. A Textbook of Geology – P K Mukherjee
5. Earth System Science from biogeochemical cycles to global changes – M. Jacobson, R.J. Charlson, H. Rodhe and G.H. Orians (2002)
6. Fundamentals of Geophysics – W. Lowrie.

DISASTER MANAGEMENT & ENERGY RESOURCES

DMS11301/DMS12301	DISASTER MANAGEMENT(S)	(2-0-0)
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Concepts of Disaster, Types of Disaster and Dimensions of Natural and Anthropogenic Disasters (cyclone, flood, landslide, subsidence, fire and earthquake);
Principles and Components of Disaster Management, Organizational Structure for Disaster Management, Disaster Management Schemes;
Introduction to Natural Disasters and Mitigation Efforts: Flood Control, Drought Management, Cyclones, Terror Threats;
Pre-disaster risk and vulnerability reduction; Post disaster recovery and rehabilitation;
Disaster related Infrastructure Development;
Role of Financial Institutions in Mitigation Effort;
Psychological and Social Dimensions in Disasters;
Disaster Management Support Requirements – Training, Public Awareness.

APD11301/APD12301	ENERGY RESOURCES	(1-0-0)
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Classification of energy resources and their availability; Renewable and non-renewable energy sources; World energy prospects; Environmental impacts; Energy, power and electricity; Energy scenario in India: Availability of conventional and nonconventional energy resources and future energy demand; Indian reserves and resources of natural oil and gas, coal and nuclear minerals; Potential of hydroelectric power, solar energy, thermal, nuclear, wind, tidal wave and biomass based power in India; Introduction to hydrogen energy and fuel cells.

Books Recommended:

1. Non-Conventional Energy Sources by G.D.Rai, Khanna Publishers.
2. Fundamentals of Renewable Energy Resources by G.N. Tiwari & M.K. Ghosal, Alpha Science International.
3. Solar Energy: Fundamentals and Applications by H P Garg & J Prakash, Tata McGraw-Hill Publishing Company Ltd.
4. Solar Energy: Principles of Thermal Collection and Storage by S P Sukhatme, Tata McGraw-Hill Publishing Company Ltd.

VALUE EDUCATION, HUMAN RIGHTS AND LEGISLATIVE PROCEDURE

HSS11305/HSS 12305		(3-0-0)
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Social Values and Individual Attitudes, Work Ethics, Indian Vision of Humanism, Moral and Non-moral Valuation, Standards and Principles, Value Judgements.
Rural Development in India, Co-operative Movement and Rural Development.
Human Rights, UN declaration, Role of various agencies in protection and promotion of rights.
Indian Constitution, Philosophy of Constitution, Fundamental Rights and Fundamental Duties, Legislature, Executive and Judiciary : Their Composition, Scope and Activities.
The Legislature: Function of Parliament, Constitution of Parliament, Composition of the Council of the States, Composition of the House of People, Speaker.
Legislative Procedure: Ordinary Bills, Money Bills, Private Member Bills; Drafting Bills; Moving the Bills, Debate, Voting, Approval of the President/Governor.
Vigilance: Lokpal and Functionaries.

HSS 11101/HSS12101	ENGLISH FOR SCIENCE AND TECHNOLOGY	(3-0-0)
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Language Resource Development : Using appropriate grammatical lexical forms to express

meaning-accuracy, range and appropriacy in grammatical lexical exercises.

Reading, Interpreting and Using Written, and Graphic Information : Using (reading and writing) academic texts, articles in technical journals, instruction manuals/laboratory instruction sheets, safety manuals and regulations, and reports; Using maps, graphs, plan diagrams, flow-charts, sketches, tabulated and statistical data.

Writing Appropriately in a Range of Rhetorical Styles i.e. Formal and Informal : Writing instructions, describing objects and processes; defining, narrating, classifying exemplifying, comparing, contrasting, hypothesizing, predicting, concluding, generalizing restating, and reporting; Note making (from books/journals); Writing assignments; summarizing, expanding, paraphrasing; Answering examination questions; Correspondence skills; Interpreting, expressing and negotiating meaning; Creating coherent written tests according to the conventions.

Receiving and Interpreting the Spoken Word : Listening to lectures and speeches, listening to discussions and explanations in tutorials; Note taking (from lectures); Interacting orally in academic, professional and social situation; Understanding interlocutor, creating coherent discourse, and taking appropriate turns in conversation; Negotiating meanings with others (in class room, workshop, laboratory, seminar, conference, discussion, interview etc.).

Recommended Books:

1. Robert, E. Dewey and Robert, H. Hurlbutt III. An Introduction to Ethics, Macmillan Publishing co. int., New York, 1977.
2. Radakrishnan, S. Mahatma Gandhi: Essays and Reflections. Jaico Publishing House, Mumbai, 1957.
3. Gandhi, M K. An Autobiography; The Story of My Experiment with Truth. Navjeevan Trust, Ahmadabad, 1927.
4. Leah Levin. Human Rights: Questions and Answers, National Book Trust, New Delhi, 1998.
5. Basu, Durga Das, Introduction to Constitution of India, Prentice Hall of India Pvt. Ltd., New Delhi, 1994.

III-SEMESTER

Sl. No.	Course No.	Name of the course	L	T	P	Cr. Hrs.
1.	EEC13111	Circuit Theory	3	1	0	7
2.	EEC13112	Analog Electronics	3	1	0	7
3.	EEC13113	Signals and Systems	3	1	0	7
4.	CSR13101	Data Structures	3	0	0	6
5.	AMR13101	Methods of Applied Mathematics I	3	1	0	7
6.	EEC13311	Field Theory (S)	4	0	0	8
7.	EEC13211	Circuit Theory Practical	0	0	3/2	1.5
8.	EEC13212	Analog Electronics Practical	0	0	3/2	1.5
9.	EEC13411	Project & Seminar	0	0	2	2
Total			19	4	5	47

EEC13111

CIRCUIT THEORY

(3 - 1 - 0)

Network theorems, Formulation of network equations, Source transformation, Loop analysis, nodal analysis, Coupled circuits.

Graph of network, Tree, Incidence matrix, Loop matrix, Cut-set and cut- set matrix, Tie-set matrix, Formulation of equilibrium equation on loop and node basis.

Two port networks, short-circuit admittance parameter, open-circuit impedance parameters, Transmission parameters, hybrid parameters, series, parallel and cascade connection of two-port networks.

Laplace transformation of standard test signals, Synthesis of different waveforms using Laplace transform technique, Inverse Laplace transform, transient solution of RL, RC, LC, RLC circuits.

Network functions: Driving point impedance and Transfer functions, concept of Poles and Zeros.

Introduction to filters, Characteristic impedance, Constant-k filters, m- derived filters, Introduction to filter design.

Networks Synthesis: Positive real function, Hurwitz Polynomial, Reactance function, Foster and Cauer method of realization.

Recommended Books:

1. Introduction to modern Network Synthesis -- M. E. Van Valkenburg.
2. Network Analysis -- M. E. Van Valkenburg.
3. Fundamentals of Electric Circuits -- C. K. Alexander, M. N. O. Sadiku.
4. Network and systems -- D. Roy Choudhary.
5. Circuit Theory: Analysis and Synthesis -- A. Chakraborti

EEC13112

ANALOG ELECTRONICS

(3 - 1 - 0)

Biasing of Discrete Devices & Integrated Circuits.

Thermal Stability, Transistor heat dissipation, Significance of Q-point in thermal runaway, Junction to case thermal resistance, Conditions for thermal Stability, Selection of heat sink size.

High frequency effect in transistor, Darlington connection, h-parameter equivalent circuit for transistor, UJT, Relaxation Oscillator using UJT.

Low frequency amplifiers, Feedback amplifiers, Frequency response.
 Operational Amplifiers, Ideal and practical Op-Amp, Inverting amplifier, Noninverting amplifier, Voltage Follower, Summing amplifier, Differential Amplifier, Controlled voltage and current sources, level shifter, Comparator, Hysteresis and Schmitt Trigger.
 Instrumentation Amplifier, Log & Anti-log amplifiers, Precision Rectifier.
 Active filters, Oscillators, Power amplifiers.
 Timer, Monostable and astable operation using 555 timers.
 Voltage regulator -Series and shunt voltage regulators, Switching regulator.

Recommended Books:

1. Electronic Principles - Malvino.
2. Millman's Electronic Devices & Circuits - Millman, Halkias & Satyabratajit.
3. Electronic Devices & Circuits - Allen Mottershead.
4. OpAmps and Linear integrated Circuits - Gayakwad.
5. Electronic Devices & Circuits- Bogart, Beasley & Rico.

EEEC13113

SIGNALS AND SYSTEMS

(3 - 1 - 0)

Classification of signals and systems: Systems modeling in terms of differential equations, Periodic signal analysis, Fourier series, Aperiodic signal analysis, Fourier transform.
 Laplace transforms and their application to system analysis, impulse response, step response and convolution integral, Transfer Function, Poles and Zeroes, Concept of Stability, Routh's criteria.
 State-space representation, state-transition matrix.

Recommended Books:

1. Signals and Systems - A. V. Oppenheim, A. S. Willsky & Nawab.
2. Signals and Systems: Continuous and Discrete - R. F. Zeimer, W. H. Tranter and D. R.Fannin.
3. Discrete Time Signal Processing-A. V. Oppenheim and R. W. Schaffer.
4. Modern Control Engineering - K. Ogata.
5. Signals and Systems - K. M. Soni.

CSR13101

DATA STRUCTURES

(3 - 0 - 0)

Data structure overview, Data types, Creation and analysis of programs, Algorithm analysis; Different data structures: Arrays, Stacks, Queues, Circular queues, Priority queues, Linked lists together with algorithms for their implementation and uses; Sorting algorithms: Insertion: Selection, Bubble, Quick, Merge, Heap etc; Searching algorithms: Linear searching, Binary searching, Hashing strategy, Hashing functions and hash search Trees: Binary tree representation, Traversal, binary search tree, AVL trees, balancing, rotations, Applications, Graphs: Representation, traversals, Shortest-path problems, Applications; Recursive: Divide: and-conquer, tower of Hanoi, etc.

Recommended Books:

1. Fundamentals of data structures in C - E. Horowitz, S. Sahni, S. Anderson-Freed.
2. An Introduction of data structure with application - J.P. Tremblay, P.G. Sorenson
3. Data Structure - S. Lipschutz.
4. Data Structure using C and C++ - Y.Langsam, M.J. Augenstein, A.M. Tenenbaum.

Part-I:

Complex Variables:

Limit, continuity and differentiability of function of complex variables. Analytic functions. Cauchy-Riemann's equations, Cauchy's integral theorem, Morera's theorem, Cauchy's integral formula, Taylor's and Laurent's series, singularities, Residue theorem, contour integration.

Special Functions:

Solution of Bessel equation, recurrence relations and generating function for $J_n(x)$, orthogonal property and integral representation of $J_n(x)$. Solution for Legendre equation, Legendre polynomial, Rodrigue's formula, orthogonality property and generating function for $P_n(x)$.

Part-II:

Laplace Transform:

Laplace transform of simple functions, properties of Laplace transform, t-multiplication and t-division theorems, Laplace Transform of derivatives, integrals and periodic functions. Inverse Laplace transform and its properties, convolution theorem. Use of Laplace transform in evaluating complicated and improper integrals and solution of ordinary differential equations related to engineering problems.

Partial Differential Equations:

Classification of partial differential equations, solutions of one dimensional wave equation, one dimensional unsteady heat flow equation and two dimensional steady heat flow equation by variable separable method with reference to Fourier trigonometric series.

Recommended Books:

1. Text book of Complex Variable - Shanti Narayan.
2. Advanced Engineering Mathematics - E. Kreszyg.
3. Special Function for Scientists and Engineers - W.W.Bell.
4. Laplace Transforms - Murray R. Spiegel.
5. Higher Engineering Mathematics - B.S. Grewal.

Introduction : Physical interpretation of gradient, divergence and curl. The Laplacian operator, vector relationship in rectangular, cylindrical and spherical polar co-ordinate systems.

Electric field : Potential and potential gradient, Gauss law, Stokes theorem, Green's theorem, divergence and curl of electric field. Laplace's equation and Poisson's equation, Helmholtz theorem, field equations in different co-ordinate systems, boundary conditions, dipoles.

Magnetic field: Boit-Savart law, Ampere's law, scalar and vector potentials, divergence and curl of magnetic field, force and torque equations. Field equations in different co-ordinate systems, boundary conditions.

Electromagnetic field : Time varying field and Faraday's law, displacement current. Maxwell's wave equation, wave equations in conducting medium, skin effect, wave equations in imperfect dielectrics. Reflection, refraction and polarization of electromagnetic waves. Maxwell's field equations Vs circuit equations.

Power flow and the Poynting vector, Poynting theorem. Transmission line.

IV-SEMESTER

Sl. No.	Course No.	Name of the course	L	T	P	Cr. Hrs.
1.	EEC14111	Electrical Measurements	4	0	0	8
2.	EEC14112	Electrical Machines I	3	1	0	7
3.	EEC14113	Digital Electronics	3	1	0	7
4.	AMR14101	Numerical and Statistical Methods	3	1	0	7
5.	MMR14101	Mechanical Engineering II	3	1	0	7
6.	EEC14211	Electrical Measurements Practical	0	0	3/2	1.5
7.	EEC 14212	Electrical Machines I Practical	0	0	3/2	1.5
9.	EEC14213	Digital Electronics Practical	0	0	3/2	1.5
10.	EEC14511	Composite Viva-Voce	0	0	0	4
11.	SWC14701	Co-Curricular Activity	0	0	0	(3)
11.	EEC14411	Project & Seminar	0	0	2	2
Total			16	4	4.5	46.5 +(3)

EEC14111

ELECTRICAL MEASUREMENT

(4 - 0 - 0)

Classification of Electrical Measuring Instruments, General features of Indicating Instruments; Systematic and Random Errors, Error analysis.

Principle of Permanent Magnet Moving Coil (PMMC), D'Arsonval, Vibration and Ballistic type Galvanometers; Principles of Electrothermal, Rectifier, Moving Iron, Electrodynamical, Electrostatic and Induction type Instruments for the measurement of Voltage, Current, Power, Energy, Frequency, Phase Angle, Power Factor; Maximum Demand Indicator and Trivector Meter; Shunt and Multiplier; Instrument Transformers.

Measurement of Low, Medium and High Resistances, Cable Fault Localization; Measurement of Inductance and Capacitance by AC Bridges; Potentiometers (DC and AC), Magnetic measurements (DC and AC); Hall effect.

CRO and oscilloscopic measurements, Signal Generators, EVM, DVM, Harmonic distortion, Wave and spectrum Analyzers, Electronic frequency meter. A/D and D/A conversions (ladder and weighted resistor type DACs, Successive Approximation and Dual-Slope Integrating type ADCs), and Hold circuit, Data Acquisition Systems. Noise in electronic systems.

Recommended Books:

1. Electrical Measurements and Measuring Instruments- E. W. Golding, F. C. Widdis.
2. Modern Electronic Instrumentation and Measurement Techniques - A. D. Helfrick, W. D. Cooper.
3. Elements of Electronic Instrumentation and Measurements- J. J. Carr.
4. A Course in Electrical and Electronic Measurements and Instrumentation - A. K. Sawhney.
5. A Course in Electronics and Electrical Measurements and Instrumentation - J. B. Gupta.

Magnetic Circuit

Transformer: Performance of single-phase transformer, Construction, Connections and operation of 3-phase transformer, Vector groups, Phase conversion, Tap changers, Parallel operation, Tertiary windings, Auto-transformer, Harmonics, Magnetising inrush current. Testing of transformer.

DC Machines: Armature winding, Armature reaction, Commutation, Interpoles, Compensating winding.

DC Generators: Voltage regulation, Characteristics, Parallel operation.

DC Motors: Starters, Speed control, Speed-torque and Load-torque characteristics.

Recommended Books:

1. The performance and design of alternating machines – M. G. Say.
2. The performance and design of direct current machines – Clayton and Hancock.
3. Theory of alternating current machinery – Alexander S. Langsdorf.
4. Electric Machinery – Fitzgerald, Kingsley, Umans.
5. Electrical Machines – P. K. Mukherjee and S. Chakravorti.

Boolean algebra, logic gates and circuits, Minimization of logic expressions.

Different Logic families RTL, DTL, TTL, ECL, NMOS and CMOS, their operation and specifications.

Combinational circuit adder, subtractor, encoder, decoder, comparator, multiplexer, demultiplexer, parity generator, etc. Design of combinational circuits-programming logic devices and gate arrays.

Sequential Circuits - Flip - Flops, various types of registers and counters, sequential circuits.

Different types of A/D and D/A conversion techniques.

Interfacing TTL-CMOS Interfacing, CMOS-TTL Interfacing.

Interfacing with Buzzers, Relays, Motors and Solenoids. Interfacing with opto-isolators.

Memory Systems: RAM, ROM, EPROM, EEROM Waveform generation using gates, Timing circuits.

Recommended Books:

1. Digital Principles & Application Leach & Malvino.
2. Digital Logic Design Morris Mano.
3. Digital Integrated Electronics H. Taub & D. Shilling.
4. Digital Principles & Design Givone.
5. Introduction to Digital Computer Design V. Rajaraman and T. Radhakrishnan.

Part-I: Numerical Methods

Solution of algebraic and transcendental equation by bisection, iteration, false position and Newton-Raphson methods.

Solution of a system of linear simultaneous equations by Gauss elimination, Gauss-Jordan, Crout's triangularisation, Jacobi and Gauss-Seidel methods.

Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton-Gregory

forward and backward, Gauss forward and backward, Stirling, Bessel and Lagrange's formulae, Inverse interpolation by Lagrange and iterative methods, Numerical differentiation and integration: Trapezoidal, Simpson's $1/3^{\text{rd}}$, Simpson's $3/8^{\text{th}}$ and Weddle quadrature formulae.

Numerical solution of first order ordinary differential equations by Taylor's series, Picard's, Euler's, Modified Euler's, Runge-Kutta and Milne's methods. Solution of simultaneous first order and second order ordinary differential equations with initial conditions by Runge-Kutta and Milne's methods. Numerical solution of boundary value problems by finite difference method.

Part II: Statistical Methods

Moments, skewness and kurtosis.

Probability: Various approaches of probability, two theorems (without proof), conditional probability, Bayes theorem.

Random variable: Definition, probability mass & density functions, distribution function, mathematical expectation and moment generating function.

Probability distributions: Bernoulli, binomial, Poisson and normal distributions.

Theory of least squares and curve fitting.

Correlation and Regression: Simple, multiple & partial correlation coefficients, regression lines, regression coefficients and their properties.

Test of significance: Normal test, t-test, chi-square test and F-test.

Recommended Books:

1. An Introduction to Numerical Analysis - S. S. Sastry.
2. Numerical Methods and Fortran 77 - C. Xavier.
3. Mathematical Statistics - M. Ray and H. S. Sharma.
4. Mathematical Statistics - J. N. Kapur and H. C. Saxena.

MMR14101

MECHANICAL ENGINEERING II

(3 - 1 - 0)

Analysis of various thermodynamic processes, P-V and T-S diagrams. Analysis of Air Standard cycles.

Classifications, applications and performance estimation of Internal combustion engines, Gas turbines and Compressors, Basic maintenance steps. Performance study and power estimation based on laboratory experimental data.

Properties of fluid; Classifications; Ideal fluid, Newtonian and Non-Newtonian fluids; Newton's law of viscosity.

Fluid Statics: fluid pressure and its measurement.

Fluid Kinetics: Continuity equation; types of flow.

Fluid dynamics: One dimensional equations of motion; Bernoulli's equation; applications of Bernoulli's equation; venturimeter.

Flow through pipes Darcy Weisbach's equations.

Classifications, basic construction and applications of different types of pumps and water turbines.

Performance study and power estimation based on laboratory experimental data.

Recommended Books:

1. Fluid Mechanics and Machinery - S. K. Agarwal.
2. Fluid Mechanics and Fluid Power Engineering - D. S. Kumar.
3. Fundamentals of Fluid Mechanics - R. K. Purohit.

4. Engineering Thermodynamics - P.K. Nag.
5. Engineering Thermodynamics - Lynn D. Russel.

EEC 14211 ELECTRICAL MEASUREMENTS PRACTICAL (0 - 0 - 3/2)

Experiments on study of various instruments such as galvanometer, PMMC, moving iron, electro dynamometer, induction type, digital meters, CRO and measurement of voltage, current, power, power-factor, frequency, resistance, inductance, capacitance, magnetic flux.

EEC14212 ELECTRICAL MACHINES I PRACTICAL (0 - 0 - 3/2)

Experiments on testing of transformer, connection of three-phase transformer, separation of losses of transformer, characteristics of DC generators and motors, Speed control of DC motors, testing of DC machines.

EEC14213 DIGITAL ELECTRONICS PRACTICAL (0 - 0 - 3/2)

Verification of function of IC7400 and implementation of standard Gates, Realization of Boolean expressions using only NAND gates, Binary adder, Binary subtractor, BCD adder, Binary comparator, Cascading of MUX, Latches and flip-flops using Gates and ICs, Counters, Multivibrators using IC555.

V- SEMESTER

Sl. No.	Course No.	Name of the course	L	T	P	Cr. Hrs.
1.	EEC15111	Electrical Machines II	3	1	0	7
2.	EEC15112	Control Systems I	3	1	0	7
3.	EEC15114	Microprocessors and Microcontrollers	3	0	0	6
4.	EEC15115	Digital Signal Processing	3	0	0	6
5.	EEC15116	Power Systems I	3	0	0	6
6.	EEC15311	Electrical Machines and Power System Design	3	0	0	6
7.	EEC15211	Electrical Machines II Practical	0	0	3/2	1.5
8.	EEC15212	Control Systems I Practical	0	0	3/2	1.5
9.	EEC15213	Power Systems I Practical	0	0	3/2	1.5
10.	EEC15214	Microprocessors and Microcontrollers Practical	0	0	3/2	1.5
11.	EEC15411	Project & Seminar	0	0	4	4
		Total	18	2	10	48

EEC15111

ELECTRICAL MACHINES II

(3 - 1 - 0)

Three-phase Induction motor: Construction and types, Rotating Magnetic Field, Equivalent circuit, Phasor diagram, Speed-torque characteristics, Circle diagram, Deep bar rotor and Double cage rotor. Cogging and Crawling, Starting and Speed control of 3-phase induction motor, induction generator.

Single phase Induction motors: Construction, Theories of operation, Revolving Field Theory, Equivalent Circuit, Starting methods, Speed- torque characteristics, Phasor diagram, Cross-field theory.

Synchronous Generator: Constructions and types, Emf equation, Phasor diagram, Armature reaction, Characteristics, Voltage regulations, Synchronization, Parallel operation, Alternator connected to infinite bus, Power angle characteristics, Synchronizing power, Excitation characteristics. Salient pole synchronous machine: Two- reaction theory, Phasor diagram and Voltage regulation.

Synchronous Motor: Expression for torque, Phasor diagram, Operating characteristics, Electrical and mechanical power, Circle diagrams, V- curves and O-curves, Starting, Hunting and Damper winding.

Recommended Books:

1. The performance and design of alternating machines - M. G. Say
2. Theory of alternating current machinery - Alexander S. Langsdorf
3. Electric Machines - Kothari & Nagrath
4. Electric Machinery and Transformers - Kosow
5. Electrical Machines - P. K. Mukherjee and S. Chakravorti

EEC15112

CONTROL SYSTEMS I

(3 - 1 - 0)

Introduction: Types of control systems and control strategies.

Mathematical model of physical systems: Differential equations, Transfer Function, Block diagram, Signal flow graph, Modelling of different types of systems (e.g., electrical, mechanical, thermal, etc.)

Control System Components: Potentiometer, Differential amplifier, Synchro,

Tachogenerator, Servomotor, Stepper motor, Hydraulic valves.
Time response of first and second order systems, Steady-state errors and Error constants, Performance specifications in time domain.
Frequency response analysis: Bode plot, Nyquist plot, Performance specifications in frequency domain.
Concept of stability, Routh stability criterion, Gain margin, Phase margin. Root-locus technique, Nyquist criterion,
Compensation Technique: Performance goals, Lag-lead compensators, PID controllers.

Recommended Books:

1. Modern Control Engineering - K. Ogata.
2. Automatic Control Systems - B. C. Kuo.
3. Feedback Control Theory-I.C.Doyle, B.A.Francis and A.R. Tannenbaum.
4. Feedback Control of Dynamic Systems - G. Franklin, J. D. Powell and A. EmamiNaeni.
5. Control Systems Engineering - I. J. Nagrath and M. Gopal.

EEEC15114 MICROPROCESSORS & MICROCONTROLLERS (3 - 0 - 0)

Architecture and organization of 8085A Microprocessor: Hardware Interrupts, Interrupt driven I/O Operation.
Memories and I/O: Various types, interfacing with microprocessor, memory mapped and I/O mapped I/O, memory mapped memory.
Functional descriptions of the Intel chips: 8255, 8253, 8259 and 8257. Analog Interfacing: Interfacing of A/D & D/A converters.
8086 Architecture, organization and pin out details, memory segmentation minimum mode and maximum mode of operation. Instruction sets of 8086.
Pin out descriptions of 8051, Memory organization, Register Banks, special function registers, External Memory: External code memory access, External data memory access, Address decoding, Addressing modes of 8051, Instructions types.

Recommended Books:

1. Microprocessors and Interfacing - D. V. Hall.
2. The Intel Microprocessors 8086/8088, 80186/80188, 80286,80386, 80486, Pentium, Pentium processors, Pentium II, Pentium III,
3. Pentium-IV, Architecture, Programming and interfacing- B. B. Bery.
4. Advance Microprocessors and Peripherals - A. K. Ray and K. M. Bhurchandi
5. The 8051 Microcontroller and Embedded systems: Using Assembly and C - Mazidi, Mazidi & McKinlay.
6. Micro controllers: Architecture, Programming, Interfacing and System Design - Raj Kamal.

EEEC 15 115 DIGITAL SIGNAL PROCESSING (3 - 0 - 0)

Sampling, aliasing, z-transform and its properties, discrete LTI systems, z-transfer function, discrete convolution, inverse z-transform.
Digital filters - FIR and IIR filters, Filter structure, Design of FIR and IIR filters, Effect of finite word length.
Random signals: Probability, correlation, power spectral density, Fourier transform.
Discrete Fourier Transform: DFT and FFT algorithms, Applications of FFT - spectrum

analysis, FFT based digital filtering.

Digital processing of continuous time signals - sampling, anti-aliasing filter, sample and hold process, reconstruction filter.

Recommended Books:

1. Discrete Time Signal Processing-A.V. Oppenheim and R. W. Schafer.
2. Theory and Application of Digital Signal Processing - L. R. Rabiner and B. Gold.
3. Digital Signal Processing - M. H. Hayes and S. Bhattacharya.
4. Digital Signal Processing: Principles, Algorithms and Applications - J. G. Proakis, D. G. Manolakis and D. Sharma.
5. Digital Signal Processing: A Computer Based Approach - S. K. Mitra.

EEEC15116

POWER SYSTEMS I

(3 - 0 - 0)

Fundamental of Power Systems: 3 phase transmission, complex power, the per unit system, Basic concept of various types of Power Generation; Overhead Transmission Line: Choice of voltages, Types of conductors, Inductance and capacitance of single and three phase symmetrical and unsymmetrical configurations, Bundle conductors, Transposition, Concept of GMD and GMR. Overhead Line Construction: Line supports, Towers, Poles, Sag, Tension and clearance, Effect of wind and ice on sag, Dampers. Insulators: Types, String insulator, String efficiency & methods of its improvement. Corona: Principle of corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of corona, Methods of reduction of corona. Underground Cables: Types of cables, Capacitance of single core and 3 core cables, Dielectric stress, Optimum cable thickness, Grading, Dielectric loss and loss angle. Performance of Lines: Short, Medium (nominal π , T) and long lines and their representation. A, B, C, D constants, Voltage regulation, Ferranti effect, Power equations and line compensation, Power circle diagrams. Distribution Systems: Feeders and distributors, radial & ring main distribution system, Substation, Type of substation, Bus bar layout. Rate making of electricity and various types of tariffs.

Recommended Books:

1. Power System Analysis -- J.J. Grainger and William D. Stevenson. Jr.
2. Generation, Transmission and utilization -- A. T. Starr.
3. Power System Analysis -- Hadi Saadat.
4. Electrical Power Systems -- C.L. Wadhwa.
5. Power System Engineering -- Nagrath & Kothari

EEEC15311

ELECTRICAL MACHINES AND POWER SYSTEM DESIGN(S)

(3 - 0 - 0)

General considerations for design: Temperature rise, Output coefficients, Main dimensions, Winding design, Analysis of magnetic circuits, Design of transformer and induction motor, Computer aided design.

Design of transmission and distribution system, design of substation.

Use of softwares: Application of software for design of electrical machines & power system.

Recommended Books:

1. The performance and design of alternating machines -- M. G. Say.
2. The performance and design of direct current machines Clayton and Hancock.
3. Design of Transformer -- Indrajit Dasgupta.

VI-SEMESTER

Sl. No.	Course No.	Name of the course	L	T	P	Cr. Hrs.
1.	EEC 16111	Power Electronics	3	1	0	7
2.	EEC 16113	Instrumentation and Process Control	4	0	0	8
3.	EEC 16114	Control Systems II	3	1	0	7
4.	EEC 16115	Power Systems II	3	1	0	7
5.	CSR 16101	Computer Networks	3	0	0	6
6.	EEC 16211	Power Electronics Practical	0	0	3/2	1.5
7.	EEC 16212	Power Systems II Practical	0	0	3/2	1.5
8.	EEC 16213	Instrumentation and Process Control Practical	0	0	3/2	1.5
9.	EEC 16214	Control Systems II Practical	0	0	3/2	1.5
10.	EEC 16511	Composite Viva-Voce	0	0	0	4
11.	EEC16411	Project & Seminar	0	0	4	4
Total			16	3	10	49

EEC16111

POWER ELECTRONICS

(3 - 1 - 0)

Brief Introduction of Power Electronics Components -- Thyristors, DIACs, TRIACs, GTOs, Power Transistors (BJT, MOSFET and IGBT), Losses and Cooling, Triggering circuits for Thyristors and Power Transistors, Snubber design and protection, Commutation Circuit for Thyristors.

AC to DC conversion: Single phase controlled rectifiers -- Phase angle control, Single-phase half-wave controlled rectifier, Single-phase full-wave controlled rectifier, Single-phase half controlled and fully controlled bridge converters, The effect of input source impedance, Dual converter (for DC drives).

Three phase controlled rectifiers -- M-3, B-6, Dual converter.

DC to DC Converter: Buck and Boost converters using BJT and IGBT: problems, design, operation and application, Class A, B, AB, C, D, CD, ABCD Chopper operation for DC drives

DC to AC Converter: Classification of inverter, Single phase and three phase inverters operation using BJTs and MOS devices for VSI and CSI, Basic concept of PWM controlled inverter (for AC drives).

AC to AC Converter: AC voltage controllers. Single and three-phase Cycloconverter circuits, blocked group operation, circulating current mode operation (for AC drives).

Application: ON-Line & OFF-line UPS, SMPS, Electronic Ballast, HVDC transmission, A.C. Line Filters for EMI & RFI suppression, HF inverters for induction heating.

Recommended Books:

1. Power Electronics - Rashid M H
2. Power Electronics - Mohan N, Underland T M & Robbins W P
3. Power Electronics - Sen P C
4. Modern Power Electronics & AC Drives - Bimal K. Bose
5. Thyristorised Power Controllers - Dubey G. K

Variable Resistance, Inductance and Capacitance type Transducers, Piezoelectric, Optical, Magnetic and Thermal Transducers, Digital Displacement Transducers (incremental and absolute types). Application of Transducers for measurement of Displacement, Force, Strain, Pressure, Flow, Temperature and other non-electrical quantities.

Instrumentation Amplifiers, Isolation Amplifiers, Programmable Gain Amplifiers, Signal conditioning, V/F, F/V Conversion, Filtering (passive and active), Linearisation, Telemetry systems: Voltage, Current, Position, Frequency and Pulse Telemetry, Components of Telemetry.

Microprocessor Based Instrumentation, Programmable instruments and digital interface: serial, parallel and GPIB (IEEE488).

Characteristics of chemical process -- blending, heat exchangers, distillation column, etc. Process Controllers: On-off, Cascade, Feed Forward, Ratio, PID. PID controller settings. Electronic simulation of PID controllers.

Recommended Books:

1. Measurement Systems : Application and Design - E. O. Doebelin and D. N. Manik.
2. Transducers and Instrumentation - D. V. S. Murty.
3. Process Control Instrumentation Technology - C. Johnson.
4. Process Control -- Harriott.
5. Process System Analysis and Control - Coughanowr.

Sampled-Data System:

Sampling-and-hold operation, Sampling theorem, Signal reconstruction, Difference equation, z-transform, Pulse transfer function, Inverse z-transform and response of linear discrete-time systems, z-transform analysis of sampled-data control system, Standard transformation techniques, Modified z-transform, Stability analysis, Root Locus technique, Compensation technique by digital computer.

State Space Analysis:

State variables, State model for linear continuous-time systems, Types of state models, Diagonalization, Eigenvalues and eigenvectors, Solution of state equation, State transition matrix, Computation of state transition matrix by Laplace transformation, Controllability and Observability, Transfer matrix. Control system design by pole-placement using state feedback.

Introduction to Optimal Control, Adaptive Control and Fuzzy Control.

Recommended Books:

1. Discrete Time Control Systems - K. Ogata.
2. Digital Control Systems - B. C. Kuo.
3. Digital Control, Vol I and II - R. Isermann.
4. Modern Control Systems - R. C. Dorf and R. H. Bishop.
5. Analog and Digital Control System Design: Transfer-function, State- space and Algebraic Methods - C. T. Chen.

Nature of faults in electrical systems, symmetrical components and sequence networks: symmetric and asymmetric faults, Load Flow Studies: Introduction, Bus classification, Nodal admittance matrix, Development of load flow equations, Methods of load flow equations, Gauss-Seidal method and Newton-Raphson method, comparison of load flow analysis method; Transients in power system: Transients in simple circuits, Traveling waves in transmission line, over voltage due to arcing ground; Transient stability: Equal area criterion, methods of improving transient stability studies, representation of excitation system and its inclusion in stability studies. Introduction of Multi-machine transient stability, its mathematical formulation; Economic operation: Introduction, Characteristics of generating units, Economic dispatch neglecting transmission losses; Power System Control: Voltage, Active & Reactive power control, VAR compensators.

Recommended Books:

1. Power System Analysis- J.J. Grainger and William D. Stevenson. Jr.
2. Power System Analysis - A.R. Bergen and V. Mittal
3. Electrical Power Systems - C.L. Wadhwa.
4. Power System Engineering - I. J. Nagrath and D. P. Kothari.
5. Electric energy systems theory - Olle J. Elgard.

Overview of data communication and networking, Network Architecture; Physical layer communication: Signals, Media, Bits, Digital transmission; Circuit/Packet switching; Error detection/correction techniques; Data link control and protocols, Medium access control Pure/Slotted ALOHA, CSMA/CD: CSMA/CA; Ethernet addressing and wiring; Internetworking: Architecture; IP addressing; Address binding with ARP; Datagram encapsulation and fragmentation; Link-state and Distance-vector routing; Dijkstra's algorithm; IPv6 Internet Protocols; UDP and TCP; TCP segment format; Protocol ports; ICMP and Error handling; Network applications: Client/Server concept; Socket API; DNS, Electronic mail, HTTP and WWW including HTML.

Experiments on characteristics of power semi-conductor devices, single-phase and three-phase controlled rectifiers, dual converter, DC chopper, inverter, cycloconverter.

Study of symmetrical and unsymmetrical fault, Experiments on characteristics of induction pattern overcurrent relay and thermal overload relay, induction pattern directional overcurrent relay earth fault relay, Merz-price protection, digital relay, circuit breaker.

Experiments on characteristics of various types of transducers, measurement of displacement, angular speed, vibration, temperature, pressure, luminous flux; Simulation study with standard softwares like LABVIEW data acquisition system.

Experiments on microcomputer based analysis and control of simulated systems. Use of standard softwares like MATLAB for time response, frequency response, stability analysis of discrete-time systems, state space analysis.

VII-SEMESTER

Sl. No	Course No.	Name of the course	L	T	P	Cr. Hr.
1.	EEC17111	Electrical Drives	3	1	0	7
2.	EEC17113	Switchgear and Protection	3	1	0	7
3.	MSC17152	Industrial Engineering and Management	3	0	0	6
4,5.		Electives (Any Two)	2 x (4 - 0 - 0)			16
(i)	EEE 17111	Advanced Power Electronics				
(ii)	EEE 17112	Electrical Engineering Material				
(iii)	EEE 17113	Mine Electrical Technology				
(iv)	EEE 17114	Communication Engineering				
(v)	EEE 17116	Illumination and Utility Services				
(vi)	EEE 17117	Power Plant Instrumentation and Control				
(vii)	EEE 17118	Systems Modelling and Simulation				
(viii)	EEE 17119	Soft Computing Techniques				
(ix)	EEE 17120	Filter Design and Synthesis				
(x)	EEE 17121	Bio-medical Instrumentation				
(xi)	EEE 17122	Robotics				
(xii)	EEE 17123	Reactive Power and Voltage Control				
(xiii)	CSE 17113	Information and Coding Theory				
6.	EEC 17011	Vocational Training/In-House Training	0	0	0	5
7.	EEC17211	Electrical Drives Practical	0	0	3/2	1.5
8.	EEC 17212	Switchgear and Protection Practical	0	0	3/2	1.5
9.	EEC17411	Project and Seminar	0	0	6	6
		Total	17	2	9	50

Note: Vocational Training taken at the end of VI-th Semester is credited in VII-th Semester.

EEC17111

ELECTRICAL DRIVES

(3 - 1 - 0)

Dynamics of Electrical Drives: Types of loads, Quadrantal diagram of speed-Torque characteristics, Dynamics of Motor-Load combination.

Starting: Starting characteristics of electric motor, starting time, Energy relation during starting.

Electric Braking: Types of electric braking, Braking of DC motor, Induction motor and Synchronous motor, Energy relation during braking, Dynamics of braking.

Motor power rating selection: Loading conditions and classes of duty, motor heating &

cooling characteristics: determination of motor power rating for different application, Load equalization.

Solid State Speed Control of DC Motor: Controlled Rectifier fed DC drives, chopper-controlled DC drives, Microprocessor based controllers for DC drives.

Solid State Speed Control of Induction Motor: AC voltage controllers, Voltage Source Inverter control, Current Source Inverter control Cycloconverter control, Static Rotor Resistance Control, Slip power recovery: Static Scherbius drive, Static Kramer drive.

Solid State Speed Control of Synchronous Motor: Constant V/f control, Cycloconverter control, Self-controlled Synchronous Motor drive. Introduction to mine electrical drives.

Recommended Books:

1. Electric Drive - M. Chilikin.
2. Fundamentals of Electrical Drives - G. K. Dubey.
3. A first Course an electrical drives - S. Pillai.
4. Modern Power Electronics and AC Drives - B. K. Bose.
5. Power Electronics Circuits, Devices and Applications - M. H. Rashid.

EEEC17113

SWITCHGEAR AND PROTECTION

(3 – 1 - 0)

Formation of electric arc. Arc built-up and quenching theory. Natures of transient short circuit current, recovery voltage and RRRV. Arc restriking phenomena. Problems of capacitive and low inductive current interruptions. Rating of circuit breakers. Different types of arc quenching media and special devices for arc quenching. Different types of circuit breakers (air, air blast, oil, vacuum & SF₆) construction, operating principle, merits and demerits; Fundamental principles of protective relays, their properties and block diagrams; Single input relays, over-current, earth fault and over voltage relays; Principle of 2 input comparison, two and multi input comparators. Distance relays – their setting, errors and remedies to errors. Differential relays current and voltage comparison; Protection of Generators, Transformers, Bus bars and transmission line; Different types of pilot protection wire, carrier and wireless pilot. Carrier aided distance protection. Carrier phase comparison schemes; Introduction to static relay; Insulation Coordination and over voltage protection: Volt-time curve, overvoltage protection, ground wires, surge protection of rotating Machine; Neutral Grounding: Effectively Grounded System, Underground system, Resonant Grounding, Methods of Neutral Grounding, Generator Neutral Breaker, Grounding practice.

Recommended Books:

1. Protective Relays vol. I & vol. II - A. R. Van C Warrington.
2. The art and Science of Protective Relaying - C. R. Mason.
3. The J & P Switchgear Book - R. T. Lythall.
4. Switchgear Protection and Power System - Sunil S. Rao.
5. Power System Protection and Switchgear -B. Ravindranath and M. Chandar.

MSC17152

INDUSTRIAL ENGINEERING AND MANAGEMENT

(3 - 0 - 0)

Basic function of Management- Planning, organization, starting, directing and controlling.

Introduction to Industrial Engineering techniques.

Productivity: definition, measurements.

Work study and its role in improving productivity of an organization. Types of production systems.

Introduction to production planning and control.

Concepts of Human Resource Managements - Selection, Training and Development.
Finance Management - Capital Budgeting Techniques. Pay back period ARR, APV, IRR, PI; Sources of capital; Cost concepts and Break-even analysis. Project Management- Introduction, Network construction and identification of critical activities in CPM and PERT

Recommended Books:

1. Essential of Management - Harold Koontz and O' Donnel.
2. Financial Management - Prasanna Chandra.
3. Operations Research - an Introduction - H.A. Taha .
4. Industrial Management - M E Thukaram Rao.
5. Introduction to Work study - International Labour Office, Geneva.

EEE17111 **ADVANCED POWER ELECTRONICS** **(4 - 0 - 0)**

Brief Introduction of Advanced Power Electronics Components: Static Induction Transistors (SITs), MOS-Controlled Thyristor (MCTs). Synchronous Rectifier: Synchronous Rectifier in Switch Mode Regulator, Design and performance of MOSFET Synchronous Rectifiers, Gate drive circuits for Synchronous Rectifiers.

Introduction to Resonant Converters: Review of Series and Parallel Resonance, Soft Switching Techniques. Soft Switching in DC-DC Converter, ZCS Transistor Action, ZVS Transistor Action.

Application: Application of PWM principle to converters and inverters, Static VAR Control (SVC) in transmission lines, High Frequency Coreless Induction Heating, Microprocessors controlled Stepper and Switched Reluctance Motor Drive.

EEE17112 **ELECTRICAL ENGINEERING MATERIAL** **(4 - 0 - 0)**

Introduction: Atomic structure of materials and energy levels. Gross electrical and thermal properties of materials in terms of cohesive energies. Crystal geometry, Crystal systems, Space lattices, Unit cells. Structure of solids : Bonded structures (covalent, metallic, ionic), complex structures (plastic, fibres, elastomers). Crystal imperfections in insulators.

Insulators: Dielectric property, Frequency and temperature dependency, Dielectrics in alternating fields, dielectric losses, classification of insulating materials. High polymers, Active dielectrics and their applications.

Conductors: Electrical conductivity of metals, Lorents theory, free electron theory etc. Electron scattering and resistivity of metals. Atomic interpretation of ohm's law. Temperature coefficient of resistance. Alloys and other conductors for engineering application

Semiconductor: Junction diode and transistor, Zener breakdown. Field effect, Photoelectric phenomena. Hall effect, Gamm effect, Tunnelling effect.

Magnetic materials: Atomic interpretation of magnetic properties, Weissfield and magnetic domains; Spontaneous magnetization and Curie Weiss law. Ferro and ferrimagnetism. magnetic anisotropy, magnetostriction, magnetic materials for engineering applications.

Super conductivity: Critical field and critical current density, Transition temperature, normal and superconducting states. Super conducting materials, Superconducting magnets, dryconductors (superconductors) Josephson-junction effects, Quantum Hall effect.

EEE17113 **MINE ELECTRICAL TECHNOLOGY** **(4 - 0 - 0)**

Concept of earth fault current limitation in underground (UG) mine power systems, Type of

electrical power supply systems for UG coal mines, solidly-earthed, restricted-neutral and insulated-neutral systems of power supply- their comparison.

Earth fault protection techniques for various types of mine power supply systems, sensitive and fail-safe earth fault relays.

On-line insulation monitoring for UG insulated neutral electrical distribution systems.

Mining type circuit breaker - air circuit breaker, vacuum and SF₆ breaker, Transwitch unit, Gate-end box, drill panel, Remote control and interlock circuits for mining type circuit breakers, Solid-state protective devices for modern mining type circuit breakers.

Electrical power planning for mechanized longwall faces general electrical distribution scheme, voltage drop problems and remedial measures, Inbye substation capacity selection
General Scheme of electrical power distribution in open-cast project, quarry sub-station capacity selection.

Haulage signaling and longwall face signaling systems, Illumination planning for UG coal mines roadway lighting systems, Intrinsically safe lighting systems for longwall faces.

Earthing practice in mines: earth pits, earthing of mobile electrical equipment in mines, mining cable- types and contraction details, Principle of flame-proof enclosure.

Introduction to Mining methods & regulations, Intrinsically safe circuit methods of attaining intrinsic safety, zener safety, barriers and their applications, Indian electricity rules as applied to mines.

EEE17114 **COMMUNICATION ENGINEERING** **(4 - 0 - 0)**

Elements of an Electrical Communication System; Analog Modulation Techniques (Block diagrams only) - AM, DSB, SSB, FM, PM; Random Processes; Effect of noise on analog modulation techniques; Pulse modulation -- Sampling, PCM, DM, DPCM; Base band Pulse transmission -- Matched filter, Intersymbol interference; Pass band Digital Transmission -- ASK, FSK, PSK, QPSK; Introduction to Information theory and Coding; Selected topics --- Spread Spectrum Systems; Multiuser Radio Communication.

EEE17116 **ILLUMINATION AND UTILITY SERVICES** **(4 - 0 - 0)**

Radiation, colour, eye and vision; different entities of illuminating systems; Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers; Luminaries, wiring, switching & control circuits.

Laws of illumination: illumination from point, line and surface sources. Photometry and spectrophotometry; photocells, Environment and glare. General illumination design.

Interior lighting: Industrial, Residential, Office, Departmental stores, Indoor stadium, Theater and Hospitals.

Exterior lighting: Food, Street, Aviation and Transport lighting, Lighting for displays and signaling-neon signs, LED-LCD displays beacons and lighting for surveillance.

Utility services for large building/office complex and layout of different meters and protection units.

Different type of loads and their individual protection, Selection of cable/wire sizes, potential sources of fire hazards and precautions.

Emergency supply: Stand-by and UPS. A specific design problem on this aspect.

EEE17117 **POWER PLANT INSTRUMENTATION AND CONTROL** **(4 - 0 - 0)**

Block Diagram of different parts of a Power Plant and scope of Instrumentation. Measurements on Boiler Plant, turbo-generator Plant and Nuclear Reactors.

cardiography, Ballisto-cardiography, Plethysmography, Magneto-cardiography, Cardiac Pace-maker and computer application.

Measurement of electrical activities in muscles and brain: Electroencephalograph, Electromyograph and their interpretation.

Medical Imaging: Ultra sound imaging, Radiography and application

EEE17122 **ROBOTICS** **(4 - 0 - 0)**

Robotics instrumentation, Basic concepts, classification and structure of robotic systems. Kinematics of manipulators, Selection of co-ordinate frames, Transformations, Configuration kinematics forward and inverse kinematics. Solution of kinematics and manipulator dynamics, NewtonEuler dynamic formulations, Trajectory planning, position, velocity, force control, feedback systems, digital control, sensors, actuators and effectors. Introduction to robot vision. Basic robot programming. Applications in manufacturing and others.

EEE17123 **REACTIVE POWER AND VOLTAGE CONTROL** **(4 - 0 - 0)**

Concept of Surge impedance loading; Implication of reactive power on voltage; Operation of uncompensated transmission line; Causes of reactive power unbalance; Reactive loss in lines and implication of rate of change of reactive power loss; Fundamental aspects of voltage stability; Methods of passive and active compensation in power systems; Voltage control in power systems

CSE17113 **INFORMATION AND CODING THEORY** **(4 - 0 - 0)**

Measure of information, source encoding, data compaction, Huffman coding, binary symmetric channel, channel capacity, channel coding, information capacity and limit, compression of information.

Principle of error control coding; Linear block codes, syndrome decoding and Hamming codes. Cyclic codes, generation and decoding, syndrome calculation; Bose-Chaudhuri-Hocquenghem (BCH) codes and Reed-Solomon codes; Burst error detecting and correcting codes, Interlaced codes for burst and random error detection; Convolution codes, code tree and state diagram; Introduction to turbo coding. Selection of coding scheme.

EEC 17211 **ELECTRICAL DRIVES PRACTICAL** **(0 - 0 - 3/2)**

Experiments on braking of motors, solid state speed control of DC motors and induction motors, microprocessor/microcomputer based DC motor speed control.

EEC17212 **SWITCHGEAR AND PROTECTION PRACTICAL** **(0 - 0 - 3/2)**

Experiments on study of switchgears, various protective relays such as electromagnetic relays, static relays, directional relay, differential relay, distance relay, testing of relays, protection of motor, transformer, feeder, study of switchgears.

VIII-SEMESTER

Sl.No	Course No	Name of the course	L	T	P	Cr.Hr
1.	EEC18112	Industrial Automation and Control	4	0	0	8
2.	EEC18114	Special Purpose Electric Machines and Drives	3	1	0	7
3.	EEC18115	EHV AC & DC Transmission	4	0	0	8
4, 5.		Electives (Any Two)	2 x (4 - 0 - 0)			16
(i)	EEE18122	Static Relays				
(ii)	EEE18123	Opto - Electronics				
(iii)	EEE18124	Digital Instrumentation				
(iv)	EEE18127	Power System Dynamics and Control				
(v)	EEE18128	High Voltage Engineering				
(vi)	EEE18129	Optimal Control				
(vii)	EEE18130	Pattern Recognition				
(viii)	EEE18131	Mine Instrumentation				
(ix)	EEE18132	Utilization of Electrical Power				
(x)	EEE18133	Electrical Energy Systems				
6.	EEC18411	Project and Seminar	0	0	6	6
7.	EEC18511	Composite Viva-Voce	0	0	0	4
		Total	19	1	6	49

Brief introduction about industrial processes and their automation, Elements of pneumatic, hydraulic and electrical control systems, valves and actuators, Stepper motors. PID controllers and their tuning, Implementation of digital controller, control strategies for industrial processes, Programmable Logic Controller.

Real-time issues on signal transmission and control, Communication systems for industrial automation. Data acquisition, Introduction to SCADA.

Recommended Books:

1. Process Control Instrumentation Technology - C. Johnson.
2. Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Control - Kissel.
3. Modern Control Systems - R. C. Dorf and R. H. Bishop.
4. Modern Control Engineering - K. Ogata.
5. Microprocessors and Interfacing - Programming and Hardware - D. V. Hall.

Single Phase Commutator Motors: Torque equation, Equation for induced emf; Universal motor, AC series motor, Repulsion motor; Commutation of Repulsion motor & AC series motor; DC Servomotor: Field controlled, Armature controlled, Permanent magnet armature controlled, Series split field; AC Servomotor, AC Tachometer; Stepper Motor; Permanent magnet type, variable reluctance type, hybrid type; Synchronous Induction Motor; Reluctance motor, Hysteresis Motor; Brushless Synchronous Motor, Induction voltage Regulator; synchros; Linear Motors: Linear induction motor, linear DC motor, linear synchronous motor; Magnetic levitation devices, Magnetic levitation vehicles; Switched Reluctance motor, permanent magnet AC motor drives, Brushless DC motor drives, Solar and Battery powered drives, Traction drives, Vector controlled AC motor drives.

Basic design aspects of EHV AC and DC lines, transmission line models for steady state and transient stueies – AC transmission systems: series compensation, shunt compensation; HVDC transmission systems: comparison of AC and DC transmission systems; HDVC converters and their control, harmonics and filters, Multi-terminal DC systems; Flexible AC Transmission Systems: concepts of reactive power support and voltage stability. Compensation at a bus and over a line . The synchronous condenser, static VAR Compensation, static phase shifter, Thyristor controlled switched capacitor, Unified power flow controller. Reactive power balance over a network and optimization.

General introduction to static relays, comparators: amplitude comparators, phase comparator, semiconductor comparator and circuits for static relays.

Solid state power supply circuits directional relays, phase comparator directional unit, amplitude comparator directional unit, polyphase directional relays, applications.

Overcurrent relays - instantaneous overcurrent relay, application of different type of time-current characteristics, basic principles of time overcurrent relays, practical circuits.

Differential relays - basic principle, multi-input differential comparator circuit, analysis of static

differential relays, static differential relay schemes.

Distance relay - principle of distance measurement, fault area on impedance diagram, multi-input comparator, conic section characteristics, synthesis of quadrilateral characteristics, practical static distance relay circuits.

Computer application to protective relaying - block diagram of digital relaying, sampling theorem, Fourier analysis of analog signal, digital filtering basics, digital overcurrent protection, digital differential and distance protection fundamentals

EEE18123**OPTO ELECTRONICS****(4 - 0 - 0)**

Characteristics of optical radiation, LED, Photodiodes, Phototransistor, CCD, Opto-couplers and their applications in analog and digital devices.

Optical fiber fundamentals, Modes in fiber, Step index and Graded index fibers, fiber coupling.

Fiber optic sensors: Modulation techniques, displacement, pressure, acceleration, flow, current, voltage etc. Interferometers, Optical signal processing.

Characteristics of Laser Radiation, structure of Gas and Solid state Lasers, Pulse mode Lasers, Semiconductor Lasers, Holographic data systems, Memories and read-out, Optical data processing fundamentals.

EEE18124**DIGITAL INSTRUMENTATION****(4 - 0 - 0)**

Sampling, signal digitization, Special digitization techniques: Non-linear ADCs, Flash and hybrid ADCs, ADC codes and Quantisation errors.

Discrete modeling of LTI systems, System identification techniques, Discrete signal conditioning techniques: Linear and exponential averaging, median filtering, Random signal statistics, Probabilistic measurement techniques, Correlation method of measurement, Frequency domain analysis.

Microprocessor based instruments: Design of intelligent and smart instruments, PC based instruments and instrumentation systems: PC architecture, analog/digital interface, Ohmic isolation techniques, I/O systems, RS 232C serial link, GPIB (IEEE)

EEE18127**POWER SYSTEM DYNAMICS AND CONTROL****(4 - 0 - 0)**

Introduction of problems related to power system stability, synchronous machine models, excitation systems, prime mover and governor models, load models. Transient stability analysis of a multi-machine system, effect of excitation control. Dynamic equivalents, approaches based on modal analysis techniques and coherency identification. Dynamic stability analysis: Effect of AVR gain, application of power system stabilizers. Techniques for the improvement of stability. Different levels of power system control, generating unit controls, excitation and prime-mover controls, p-f and q-v loops. Automatic generations control, SCADA and computer control of power systems.

EEE18128**HIGH VOLTAGE ENGINEERING****(4-0-0)**

Cables, insulators and bushings, Voltage distribution and string efficiency in suspension insulators, Stress in cables, oil filled and gas filled cables, Cross linked cables, Capacitance grading, Inter-sheath grading, Breakdown and mechanism of break-down in dielectrics (gaseous, liquid & solids) Partial breakdown corona & EMI (electromagnetic interference)

Utility of bushings, oil filled, condenser bushings, optimum characteristics, Lightning, switching

and Power frequency over voltages, The physical phenomenon of lightning, interaction between lightning and power system, causes of switching surges, and power frequency over voltages.

The protection of systems and equipment against over voltages, Some basic ideas about protection, lightning arresters and surge suppressors, Ground wires, grounding practices, insulation, Coordination scheme of an open air sub-station, Basic Impulse level.

Generation of High/Test Voltages for laboratory works, Alternating Voltages - Transformers in cascade, the series resonant circuit, Transient voltages - Impulse Generator, Tripping and synchronization with oscilloscope, Direct Voltages - Voltage Doublers and Cascade Circuits, Electrostatic Generators.

Measurement of High Voltages - Electrostatic Voltmeters, Sphere gaps, Uniform field gap, Ammeter in series with High Impedance, Potential Dividers.

Non-destructive High Voltage Testing: Testing of insulators, transformers, isolators, circuit breakers and cables as per relevant Indian standard specifications. High Voltage Schering Bridge, Mega ohmmeter.

EEE18129 **OPTIMAL CONTROL** **(4 - 0 - 0)**

Calculus of variations. Application to optimal control of dynamical systems. Pontryagin's minimum principle and its application to optimal control problems with constraints. Dynamic programming. BellmanJacobi equation and its application. Introduction to optimal control of distributed parameter systems.

EEE18130 **PATTERN RECOGNITION** **(4 - 0 - 0)**

2-D/3-D image representation, Time domain/Frequency domain representation, Correlation characteristics, Sampled data structure in 2- D/3-D representation.

PCM coding for image digitization, Redundancy in images and psycho- visual characteristic, IP and ER techniques for image coding, Image coding without memory and with memory, DPCM, ADPCM, block/transform coding, Entropy coding, Enhancement/ Restoration techniques.

Image analysis/synthesis and image understanding techniques.

EEE18131 **MINE INSTRUMENTATION** **(4 - 0 - 0)**

Mine environment monitoring:

Methane, carbon monoxide, pressure, temperature, air velocity, humidity and convergence monitoring.

Microprocessor and micro controller applications in mine instrumentation.

Advanced mine signaling: Winder signaling & instrumentations, Mine Communication and data transmission.

Digital techniques of mine instrumentation. Fiber optic based mines instrumentation system.

EEC181132 **UTILIZATION OF ELECTRICAL POWER** **(4 - 0 - 0)**

Traction: System of track electrification, supply system, power factor & harmonics, train movement, Speed time curves and Energy consumption, tractive effort, factors affecting energy consumption, Electric and diesel traction systems, traction motors, starting and braking of traction motors, protective devices, Over Head Equipment.

Drives used in electric vehicle: DC drives, vector controlled ac motor drives, Permanent magnet

brushless motor drives, switched reluctance motor drives, Linear Induction motor. Battery powered Vehicles

Illumination: Laws of illumination, polar curves, photometry, integrating spheres, types of lamps, lamp fittings, Light control, design aspects of indoor and outdoor lighting. Energy efficient Lighting.

Welding: Its classification, resistance, arc and ultrasonic welding, characteristics of welding transformers, modern welding techniques and control.

Heating: Resistance heating, Induction heating and Dielectric heating.

Recommended Books:

1. Utilization of Electrical Eneergy - Openshaw Taylor.
2. Generation Distribution and Utilization of Electrical Power - C. L. Wadhwa
3. Modern Power Electronics and AC Drives - B. K. Bose.

EEEC18133

ELECTRICAL ENERGY SYSTEMS

(4 - 0 - 0)

Conventional Energy Sources:

Energy Audit,

Choice of power station and unit: Type of generator, size of generator and number of units.

Thermal power station: Main parts and working, main flow circuits of thermal power station, power station auxiliaries, cooling system of alternators, starting up procedure of thermal units.

Nuclear power station: Principle of nuclear reactor, layout of nuclear power station, types of power reactors, main parts and control reactors, nuclear waste disposal, radioactivity and hazards.

Hydroelectric power station: Steam flow, hydrographs, flow duration curve, arrangement and location of hydroelectric station, principle of working, power station control, pump and storage system.

Advanced direct energy conversion systems: Basic principles of design and operations of photovoltaic energy systems, fuel cells, magneto- hydrodynamic power generators.

Non-Conventional Energy Sources (NCES):

Energy sources - Classification, need and potential of NCES, electricity generation from NCES: Photovoltaics, mono, poly-crystalline and amorphous silicon solar cells, efficiency and cost of PV systems; Wind electricity, wind as an energy source, wind electricity generating system - Basic components, wind electric generators, setting of wind farms; Energy from biomass-gasifiers and biogas reactors; Tidal energy; wave and geothermal energy; environmental effects and economics of NCES.

Recommended Books:

1. Renewable Energy Sources & Conversion Technology-Bansal, Kleeman and Melisa.
2. Solar Energy - S P Sukhatme.
3. Renewable Energy Sources - Abbasi & Abbasi
4. Renewable Energy Resources - Twidell & Weir.
5. Surves of Energy Conservation in India 2006 - Labour & Industria Chronicle