MA301B	**MATHEMATICS –III**	**3 Credits**
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. Acquire the knowledge of functions of complex variables.
2. understand power series and expansion of analytic function.
3. understand Laurent Series, poles, singular points, Residue theorem and its applications.
4. analyze the solutions of partial differential equations.
5. discuss the boundary value problems, one dimensional wave equation, heat equation and Laplace Equation.

UNIT- I

Complex analysis - I: Analytical functions - Cauchy-Riemann equations – Construction of Analytic functions- Complex integration - Cauchy's theorem - Integral formula - Evaluation of integrals.

UNIT-II

Complex analysis - II: Taylor's and Laurent's' series- Transformations- Conformal mapping - Bilinear transformations - Transformation of 1/z, z^2, sin z and cos z.

UNIT- III

Complex analysis –III: Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluation of real integrals

UNIT- IV

Partial differential equations - I : Formation of differential equations - Classification - First order linear partial differential equations – Lagrange's' linear equation - Method of multipliers - first order non-linear partial differential equations - Charpits method.

UNIT- V

Partial differential equations - II: Method of separation of variables - One dimensional wave equation - Heat equation – Laplace's equation.

Text Books:

1.Grewal B S, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2.Venkataraman M K, Engineering Mathematics, Vol. I & II, National Publishing Company, 1993.
3.Venkataraman M K, Engineering Mathematics, National Publishing Company, 1995.
4.Grewal B S, Engineering Mathematics, 13th Edition, Khanna Publications.
5.Kreyszig E, Advanced Engineering Mathematics, 8th edition, Wiley, 1998.

EE302C	ELECTRO MAGNETIC FIELDS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. get acquainted with different coordinate systems and their transformation.
2. learn different concepts in Electrostatic fields.
3. learn different concepts in magnetic fields
4. get acquainted with time varying electric and magnetic fields.

UNIT-I

Electrostatic Fields: Review of Vector Algebra & Vector Calculus, Coulomb's law. Electric field intensity. Electric flux density and Gauss's law. Gauss's law in point form. Electrostatic potential. Potential gradient. Energy stored in electric field.

UNIT-II

Conductors and Dielectrics: Current and current density. Continuity equation. Conductors – Ohm's law, Resistance, Power dissipation, and Joule's law. Dielectrics – Dipole moment, Polarization, and bound charge densities. Boundary conditions. Capacitance.

UNIT-III

Magnetostatic fields: Force of a magnet on a current carrying wire**,** Biot-Savart law. Lorentz force law. Ampere's circuital law. Ampere's circuital law in point form. Scalar and vector Magnetic potential, Magnetic flux density.

UNIT-IV

Magnetic field in materials: Magnetic moment, Magnetization, and Bound current densities. Boundary conditions. Inductance. Energy stored in magnetic field.

UNIT-V

Maxwell's equations: Faraday's law – Motional and Transformer induced emfs, Faraday's law in point form. Displacement current. Maxwell's equations in differential and integral forms. Wave equation and its general solution for free space conditions.

Text Books:

1. Mathew N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press.
2. Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice-Hall of India Pvt. Ltd.

EE303C	NETWORK ANALYSIS	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Apply Network theorems for the analysis of electrical circuits.
2. Analyze the time domain behavior of electrical circuits under transient conditions.
3. Evaluate the network functions and two-port network parameters.
4. Synthesize the one port networks using Foster and Cauer methods.

UNIT-I

Network Theorems: Superposition Theorem– Reciprocity theorem -Thevenin's and Norton's Theorems – Maximum Power Transfer Theorem- Millman's Theorem — Tellegen's Theorem – Compensation Theorem - Application of these Theorems for D.C. circuits and sinusoidal steady state A.C. circuits.

UNIT-II

Transient Analysis: Time domain analysis of RL, RC, and RLC circuits for D.C. and sinusoidal excitations – Determination of initial conditions – Concept of time constant – Transient response of RL, RC, and RLC circuits using Laplace Transform techniques.

UNIT-III

Network Functions: One-port and Two-port networks – Driving point and transfer functions of networks – Properties of driving point and transfer functions – Concept of complex frequency, poles and zeros – Time domain response from pole-zero diagram – Restrictions on pole-zero locations.

UNIT-IV

Two-port Network Parameters: Open circuit impedance and short circuit admittance parameters – Hybrid and inverse-hybrid parameters – Transmission and inverse transmission parameters – Inter relationships between parameter sets – Series, Parallel, and Cascade connection of two-port networks – Conditions for reciprocity and symmetry of two-port networks. Terminated two-port networks – Image parameters.

UNIT-V

Elementary Ideas of Network Synthesis: Positive real functions - Hurwitz polynomials - Properties and realization of RL, RC, and LC immittance functions by Foster and Cauer methods.

Text Books:

1. Sudhakar and Shyammohan, Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh, Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Abhijit Chakrabarti: Circuit Theory Analysis and Synthesis, 7th Revised Edition, Dhanpat Rai & Co
4. M. E. Van Valkenburg; “Network analysis”; Pearson Education, Third Revised Edition.

EE304C	D.C. MACHINES AND TRANSFORMERS	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the concepts of energy conversion principles, constructional details and principle of operation of DC machines and Transformers.
2. Analyze the performance of the DC Machines under various operating conditions using their various characteristics and testing methods.
3. Analyze the parallel operation of DC machines and transformers and select appropriate machine as per applications.
4. Evaluate the performance of Transformers using phasor diagrams, connections, testing methods and equivalent circuits.

UNIT-I

Principles of electromechanical energy conversion: Energy in magnetic system, field energy and mechanical force, single and multiply-excited magnetic field systems, forces/torques in systems with permanent magnets, energy conversion via electric field, dynamical equations of electro mechanical systems.

UNIT-II

DC Generators: Construction, armature windings and its types, Emf equation, armature reaction, compensating windings, commutation, characteristics and types of generators.

Parallel operation of DC Generators: DC shunt and series generators in parallel, equalizing connections

UNIT-III

DC Motors: Force on conductor carrying current, Torque and power equations, speed control, starting and characteristics of dc motors, Losses and efficiency, testing and applications of DC machines.

UNIT-IV

Transformers: Principle, construction and operation, equivalent circuit, phasor diagrams, voltage regulation, losses and efficiency, all day efficiency, Testing of transformers**.**

Autotransformer: Construction, principle, applications and comparison with two winding transformers.

UNIT-V

Three-phase transformer: Construction, Cooling, types of connection and their comparative features, Phase conversions - Scott connection, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Parallel operation of transformers.

Text Books:

1. I.J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
2. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.

References Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. B. L Theraja, A. K. Theraja, "A text book of Electrical Technology, Vol. II, AC and DC Machines" S. Chand Publication, Multicolor edition, Reprint 2004

EE305C	ANALOG ELECTRONICS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. understand the characteristics of various components.
2. Understand the biasing techniques
3. Design and analyze various rectifiers, small signal amplifier circuits.
4. Design sinusoidal and non-sinusoidal oscillators.
5. Understand the functioning of OP-AMP and design OP-AMP based circuits.

UNIT-I

DIODE CIRCUITS: P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, clamping and clipping circuits. Input output characteristics of BJT in CB, CE, CC configurations, biasing circuits, Load line analysis, common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits,

UNIT-II

MOSFET CIRCUITS: MOSFET structure and I-V characteristics. MOSFET as a switch. small signal equivalent circuits - gain, input and output impedances, small-signal model and common-source, common-gate and common-drain amplifiers, trans conductance, high frequency equivalent circuit.

UNIT-III

MULTI-STAGE AND POWER AMPLIFIERS: Direct coupled and RC Coupled multi-stage amplifiers; Differential Amplifiers, Power amplifiers - Class A, Class B, Class C.

UNIT-IV

FEEDBACK AMPLIFIERS: Concepts of feedback – Classification of feedback amplifiers – General characteristics of Negative feedback amplifiers – Effect of Feedback on Amplifier characteristics – Voltage series, Voltage shunt, Current series and Current shunt Feedback configurations – Simple problems.

OSCILLATORS: Condition for Oscillations, RC type Oscillators-RC phase shift and Wien-bridge Oscillators, LC type Oscillators –Generalized analysis of LC Oscillators, Hartley and Colpitts Oscillators.

UNIT-V

OPERATIONAL AMPLIFIERS: Ideal op-amp, Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product, Inverting and non-inverting amplifier, Differentiator, integrator, Square-wave and triangular wave generators.

Text Books:

1. Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill Education, 2nd edition 2010
2. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 2003.

References:

1. Electronic Devices Conventional and current version -Thomas L. Floyd 2015, pearson.
2. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
3. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
4. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

EE306L	**ELECTRICAL CIRCUITS AND NETWORKS LAB**	**1.5 Credits**
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Verify Network theorems for the analysis of electrical circuits.
2. Analyze the time domain behavior of electrical circuits under transient conditions.
3. Draw the locus diagrams and analyse the resonance conditions.
4. Evaluate the two-port network parameters.

Experiments related to the course contents of two courses

(1) Electrical Circuits

(2) Network Analysis.

EE307L	**D.C. MACHINES AND TRANSFORMERS LAB**	**1.5 Credits**
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Test the performance of any DC machines and single-phase transformers, by conducting suitable experiments and report the results.
2. Analyze the various speed control methods of DC motors and characteristics of DC machines.
3. Understand the significance of different connections of three-phase transformers.

Experiments related to the course contents of the course D.C. Machines and Transformers.

EE309S	COMPUTER SKILLS	2 Credits
Sessional Marks: **40**	**1L:0T:2P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Identify basic terms, concepts, and functions of computer system components.
2. Select and use the appropriate software application to complete a particular task such as a word Processing skill to create, save, modify business documents.
3. Identify basic concepts and procedures for creating, viewing, and managing files, and folders for different operating systems.
4. Identify basic concepts of organization and procedures for creating, and viewing will software presentation such as PowerPoint.

Experiments related to the following topics:

- Installations of Computer Software.
- Word Processing using MS Office.
- Documentation using LaTex.
- Mathematical Calculations using Spreadsheet.
- Presentation using Power Point.
- Brief study of internet and types of networks.
- Brief Study of world wide web and web browsers.
- Brief Study of Electronic Mail management system.
- Preparation of various data collection forms.

MC310A	CONSTITUTION OF INDIA	0 Credits
Sessional Marks: **0**	**2L:0T:0P**	End Examination Marks: **100**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT-I

History of Making of the Indian Constitution: History. Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution: Preamble Salient Features

UNIT-II

- **Contours of Constitutional Rights & Duties:**
- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

UNIT-III

- **Organs of Governance:**
- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President

- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

UNIT-IV

- **Local Administration:**
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

UNIT-V

- **Election Commission:**
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books/References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

EE401C	POWER SYSTEMS-I	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will be able to

1. Understand the power system structure and principles of energy generation from conventional and renewable energy sources
2. Analyze the economic aspects of power generation.
3. Acquire the knowledge on parameter calculations and mechanical design in transmission lines.

UNIT-I

Fundamentals of Power systems: Evolution of Power Systems- Present Day Scenario-Structure of a power system-Conventional and Renewable Energy Sources.
Power Stations: Hydro-electric, Thermal Stations, Gas Turbine and Nuclear power Stations- Selection of site, Main parts, lay out and working principle.

UNIT-II

Renewable Energy sources: Necessity- principle of operation and working of Solar electric system, wind electric system, bio-mass and bio-gas plants, Fuel cells, Tidal and Geothermal power plants - applications.

UNIT–III

Economic aspects of power stations: Types of loads-Load curve, load duration and integrated load duration curves-Load factor-Demand factor-Diversity factor-Capacity factor-Utilization and plant use factors-The effect of these factors on generation-Number and size of generating units-Base load and peak load plants-Costs of electrical energy-Types of tariff charges on consumers.

UNIT-IV

Inductance and capacitance calculations of transmission lines: Line Conductors-Resistance-Inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacings-Composite conductors-transposition-Bundled Conductors-Effect of earth on capacitance.

UNIT-V

Mechanical design of Transmission line: Catenary curve-Sag tension calculations-Supports at equal and different levels, effect of wind and ice loading – stringing chart – sag template – conductor vibrations.
Corona: Introduction- critical disruptive voltages-Corona loss-factors affecting corona loss-Methods of reducing corona loss-Disadvantages of corona-Inductive interference between power and communication lines.

Text Books:

1. C..L.Wadhwa, "Generation Distribution and utilization of Electrical energy" , New Age International
2. Power plant Engineering by A.K.Raja etc, New age International Publishers.
3. G. D. Rai, 'Non-Conventional Energy Sources', Khanna Publishers, New Delhi, 2006.
4. C..L.Wadhawa, "Electrical Power systems" New age publications.
5. B.R.Gupta, "Power system analysis and design" third edition, Wheeler publishing.
6. William D.Stevenson "Elements of power system analysis" fourth edition, Mc Grawhill International editions.
7. AR Bergen and Vijay Vittal, "Power system analysis", Pearson education, 2001

EE402C	INDUCTION MOTORS AND SYNCHRONOUS MACHINES	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: Upon completion of this course, students will be able to

1. Understand the constructional details and principle of operation of Induction and Synchronous Machines.
2. Understand parallel operation, speed control and starting of AC machines.
3. Analyze the performance of the Induction and Synchronous Machines using the phasor diagrams, equivalent circuits and by testing.
4. Select appropriate AC machine for any application and appraise its significance.

UNIT-I

Three phase Induction Motors: Construction and principle of operation, types, torque equations, torque slip characteristics, phasor diagrams, equivalent circuit, circle diagram, testing and starting methods.

UNIT-II

Speed control of Three-phase Induction Motors: Pole changing, Cascade connection, injection of emf in to rotor circuit, V/f control of 3-phase induction motor, Double cage induction motor, induction generator and its applications.

Single-phase Induction Motors: Construction, principle, double revolving field theory, equivalent circuit, applications, starting methods, Universal motor

UNIT-III

Synchronous Generators: Construction, principle, emf equation, Armature reaction, leakage flux, synchronous reactance, equivalent circuit, Phasor diagram, voltage regulation, determination of regulation by synchronous impedance method, mmf method, ZPF method, ASA method.

UNIT-IV

Theory of Synchronous Machines: Phasor diagram, determination of X_d and X_q from Slip test, Expression for power expressions, power angle characteristics.

Parallel Operation of Synchronous Generators: Conditions, Synchronizing, load sharing, operation of alternator with infinite busbars, effect of change of mechanical input and excitation, Excitation systems, transient and sub- transient reactance.

UNIT-V

Synchronous Motors: Principle of operation, methods of starting, Phasor diagram, variation of current and power factor with excitation, Predetermination of V and inverted V curves, Hunting and use of damper bars, Synchronous condenser and power factor correction, Excitation and power circles.

Text Books:

1. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7th Edition,

2007.
2. Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.
3. M. G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers & Distributors Pvt. Ltd., New Delhi, 3rd Edition, 2002

Reference Books:

1. A.E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
3. P. C. Sen., "Principles of Electric Machines and Power Electronics", 2nd edition, John Wiley and Sons Inc., 1997.

EO403C	MANAGERIAL ECONOMICS AND ACCOUNTANCY	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand Macro Economic environment of the business and its impact on enterprise.
2. Identify various cost elements of the product and its effect on decision making.
3. Understand the concepts of financial management and smart investment.
4. Prepare the Accounting records and interpret the data for Managerial Decisions.

UNIT -I

Introduction to Engineering Economics, Fundamental concepts, Time value of money, Cash flow and Time Diagrams, choosing between alternative investment proposals, Methods of Economic analysis (pay back, ARR, NPV, IRR and B/C ratio), The effect of borrowing on investment, Equity vs Debt Financing, concept of leverage, Income tax leverage.

UNIT -II

Depreciation and methods of calculating depreciation (straight line, sum of the years digit method, Declining balance method, Annuity method, Sinking fund method), National income accounting Methods of estimation, Various concepts of National Income, Significance of National income Estimation and its limitations.

UNIT -III

Inflation: Definition, Process and Theories of inflation and Measure of control. New Economic Policy 1991(Industrial Policy, Trade Policy, Fiscal Policy), Impact on Industry.

UNIT -IV

Accounting Principles, procedure, Double entry system, Journal, ledger, Trial balance, Cashbook, preparation of Trading and Profit and Loss account, Balance sheet.

UNIT -V

Cost Accounting**:** Introduction, Classification of costs, Methods of costing, Techniques of costing, Cost sheet and preparation of cost sheet, Break-even Analysis, Meaning and its application, Limitation.

Text Books:

1. Henry Malcom Steiner, Engineering Economics Principles, 2nd Edition, McGraw Hill Education, 1996.
2. Dewett. K.K., Modern Economic Theory, Sultan Chand and Co., 2006.
3. A.N. Agarwal, Indian Economy, Wiley Eastern Limited, New Delhi.
4. Jain and Narang, Accounting Part-I, Kalyani Publishers, 2011.
5. Arora, M.N. Cost Accounting: Principles and Practice, 12th Edition, Vikas Publication, 2012.

EE404C	DIGITAL ELECTRONICS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.

UNIT-I

Fundamentals of Digital Systems and logic families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT-II

Combinational Digital Circuits: Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

UNIT-III

Sequential circuits and systems: A 1-bit memory, the circuit properties of Bi stable latch, the clocked SR flip flop, J- K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

UNIT-IV

A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, duals lope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

UNIT-V

Semiconductor memories and Programmable logic devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used

memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

EE405C	SIGNALS AND SYSTEMS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Differentiate between various types of signals and understand the implication of operations of signals
2. Understand and classify systems based on the impulse response behaviour of both continuous-time and discrete-time systems
3. Perform domain transformation from time to frequency and understand the energy distribution as a function of frequency
4. Usefulness of convolution for analysing the LTI systems and understand the concepts of power spectral density through correlation.
5. Solve differential and difference equations with initial conditions using Laplace and Z- transforms.

UNIT-I

Introduction to Signals and Systems: Definition and classification of signals and systems**,** Basic operations on signals, Elementary signals, Classification of Continuous-Time and Discrete-Time Systems, Basic System Properties, Linear Time-Invariant Systems - Discrete-Time LTI Systems, Convolution Sum, Continuous-Time LTI Systems Convolution Integral. Causal LTI Systems Described by Differential and Difference Equations.

Signal Analysis: Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions.

UNIT-II

Fourier series and Fourier Transform: Fourier series Representation of Continuous-Time Periodic Signals, Dirichlet's conditions, Properties of Continuous-Time Fourier Series. Trigonometric Fourier Series and Exponential Fourier Series with examples, Complex Fourier spectrum.

Deriving Fourier Transform from Fourier series, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Continuous-Time Fourier Transform,

Magnitude-Phase responses, Parseval's theorem, Inverse Fourier transform.

Discrete-Time Fourier Transform – Properties, Inverse Discrete-time Fourier Transform. Introduction to Hilbert Transform.

UNIT-III

Convolution and Correlation: Continuous-time convolution, Convolution sum, Correlation between signals, Cross correlation, Autocorrelation, Properties, Energy spectral density, Power spectral density, Relation between convolution and correlation.

UNIT-IV

Behavior of continuous time LTI systems: Distortion less transmission through a

system, signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

Sampling: Sampling Theorem, Reconstruction of a Signal from its Samples Using Interpolation, types of sampling-natural sampling, flat- top sampling and impulse sampling, Effect of under sampling -Aliasing.

UNIT-V

System Analysis using Laplace and z -Transforms:

Laplace Transform - Region of Convergence – Relation between Laplace and Fourier Transform, Inverse Laplace Transform, Properties, Analysis and Characterization of LTI Systems Using Laplace Transform, Z-Transform -Region of Convergence - Properties, Inverse z-Transform, Analysis and Characterization of LTI Systems Using z-Transforms.

Text Books:

1. A. Anand Kumar, Signals & Systems, PHI, 2011.
2. Alan V. Oppenheim, Alan S. Willsky, & S. Hamid Nawab, "Signals and Systems," Pearson Higher Education, 2nd Ed., 1997.
3. Simon Haykin and B. Van Veen, "Signals & Systems," John Wiley and Sons, 2nd Edition, 2007.

Reference Books:

1. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
2. B.P. Lathi, "Principles of LINEAR SYSTEMS and SIGNALS," Oxford Univ. Press, Second Edition, International version, 2009.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. Luis F. Chaparro, "Signals and Systems using MATLAB," Academic Press, 2011.
5. C. L. Philips, J. M. Parr and Eve A. Riskin, "Signals, Systems and Transforms," Pearson Education, 4th Edition, 2008.

EE406L	INDUCTION MOTORS AND SYNCHRONOUS MACHINES LAB	1.5 Credits
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Test the performance of induction motors and synchronous machines by conducting suitable experiments and report the results.
2. Analyze the speed control methods of three-phase induction motors by conducting suitable experiments.
3. Understand the parallel operation and estimate the regulation of alternators.

Experiments related to the course contents of the course - Induction & Synchronous Machines.

EE407L	ANALOG AND DIGITAL ELECTRONICS LAB	1.5 Credits
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Plot the characteristics of Electronic Devices to understand the behavior
2. Design, construct and test amplifier circuits and interpret results
3. Design and analyze combinational logic circuits
4. Design and analyze flip flops and Sequential logic circuits

Experiments related to the course contents of two courses

(1) Analog Electronics

(2) Digital Electronics.

EE409S	PYTHON PROGRAMMING	2 Credits
Sessional Marks: **40**	**1L:0T:2P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Implement python programming constructs to build small to large applications.
2. Implement the problems in terms of real-world objects.
3. Evaluate and handle the errors during runtime involved in a program.
4. Extract and import packages for developing different solutions for real time problems

Experiments related to the Python Programming Course:

- Python Programming Fundamentals
- Python Built-in Data Structures
- Classes & Objects
- Functions, I/O, Exception Handling in Python
- Applications

EEHN01	ELECTRICAL MACHINE DESIGN	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

HONOURS DEGREE

Course Outcomes: Upon completion of this course, students will be able to

1. Understand the construction and performance characteristics of electrical machines.
2. Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
3. Understand the principles of electrical machine design and carry out a basic design of an ac machine.
4. Use software tools to do design calculations.

UNIT-I

Introduction: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT-II

Transformers: Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

UNIT-III

Induction Motors: Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

UNIT-IV

Synchronous Machines: Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

UNIT-V

Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, “A Course in Electrical Machine Design”, DhanpatRai and Sons, 1970.
2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.
3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing, 2006.
4. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, Satya Prakashan, 1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, “Electrical Machine Design Data Book”, New Age International, 1979.
6. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft’s

Maxwell 2D machine design package.

EEMN01	ELECTRICAL CIRCUITS AND NETWORKS	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

MINOR DEGREE

Course Outcomes: Upon completion of this course, students will be able to

1. Understand and apply the basic circuit concepts to analyse D.C and A.C. Circuits.
2. Apply Network theorems for the analysis of electrical circuits.
3. Understand the resonance circuit concept.
4. Evaluate the two-port network parameters.

UNIT-I

Basic Circuit Concepts: Electrical circuit elements (R, L and C), Classification of Circuit elements, Voltage and Current sources, Source transformation Techniques– Kirchhoff's laws – Star-delta transformation – Network reduction techniques - Mesh and Nodal Analysis for D.C. Circuits. Time-domain analysis of first-order RL and RC circuits with step input.

UNIT-II

A.C. Circuits: Representation of sinusoidal waveforms - Average value, Effective value, Form factor and Crest factor. Phase and phase difference – Phasor notation – Concept of reactance, impedance, susceptance and admittance – Power factor -Active and reactive power – Impedance Triangle-Power triangle – Steady State analysis of single-phase A.C. circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel).

UNIT-III

Network Theorems: Superposition Theorem– Reciprocity theorem -Thevenin's and Norton's Theorems – Maximum Power Transfer Theorem- Millman's Theorem. Application of these Theorems for D.C. circuits and sinusoidal steady state A.C. circuits.

UNIT-IV

Resonance: RLC Series Circuits – Resonant frequency, Half power frequencies, bandwidth and Quality Factor.

Three Phase Circuits: Advantages of three phase systems – Phase sequence- Three-phase balanced circuits – Magnitude and phasor relationships between line and phase voltages and currents in balanced star and delta circuits.

UNIT-V

Two-port Networks Parameters: Two-port networks- Open circuit impedance and short circuit admittance parameters – Hybrid and inverse-hybrid parameters – Transmission and inverse transmission parameters – Inter relationships between parameter sets- Conditions for reciprocity and symmetry of two-port networks.

Text Books:

1. Sudhakar and Shyammohan, Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh, Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Abhijit Chakrabarti: Circuit Theory Analysis and Synthesis, 7th Revised Edition,

Dhanpat Rai & Co		
EEMN02	**ELECTRICAL MACHINES**	**4 Credits**
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

MINOR DEGREE

Course Outcomes: Upon completion of this course, students will be able to

1. Understand the concepts of energy conversion principles, constructional details and principle of operation of DC and AC machines.
2. Analyze the performance of the DC and AC Machines under various operating conditions using their various characteristics and testing methods.
3. Understand parallel operation, speed control and starting of DC and AC machines.
4. Select appropriate machine for any application and appraise its significance.

UNIT-I

DC Machines: Principle of operation of dc generator, emf equation, types of generators, magnetization and load characteristics, principle of operation of dc motor, torque equation, Speed control, efficiency calculations by Swinburne's test and direct load test.

UNIT-II

Transformers: Single phase transformer, principle of operation, types, constructional features, emf equation, phasor diagram on no load and load, equivalent circuit, losses and efficiency, predetermination of efficiency and regulation from OC and SC tests.

UNIT-III

Three phase induction motors: Constructional features, principle of torque production, torque equation, slip torque characteristics, efficiency calculation, starting methods

Single phase induction motor: Principle of operation, starting methods, types of single-phase induction motors.

UNIT-IV

Synchronous Machines: Constructional features, types of synchronous machines, Synchronous generators**:** emf equation, coil span factor, estimation of regulation by synchronous impedance method.

UNIT-V

Synchronous motors: Principle of operation, methods of starting, Phasor diagram, variation of current and power factor with excitation, Predetermination of V and inverted V curves, Hunting and use of damper bars.

Stepper Motors: Principle of operation and applications.

Text Books:

Text Books:

1. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

References Books:

3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

4. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
5. B. L Theraja, A. K. Theraja, “A text book of Electrical Technology, Vol. II, AC and DC Machines” S. Chand Publication, Multicolor edition, Reprint 2004