**EEE-2101: Mathematics – IV**

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| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |
| **Time** | **: 3 Hours** |

**VECTOR CALCULUS-1:** Differentiation of vectors, curves in space, velocity and acceleration, relative velocity and relative acceleration, scalar and vector point functions, vector operator $\nabla$ applied to scalar point functions- gradient, $\nabla$ applied to vector point functions- divergence and curl. Physical interpretation of $\nabla f$, $\nabla.\overline{F}$, $\nabla\times\overline{F}$, $\nabla$ applied twice to point functions, $\nabla$ applied to products of two functions; Irrotational and Solenoidal fields.

**VECTOR CALCULUS-2:** Integration of vectors, line integral, circulation, work done, surface integral-flux, Green's theorem in the plane, Stoke's theorem, volume integral, Gauss Divergence theorem.
Introduction of orthogonal curvilinear coordinates, cylindrical and spherical polar coordinates

**INTRODUCTION OF PARTIAL DIFFERENTIAL EQUATIONS:** Formation of partial differential equations, solutions of partial differential equations- equations solvable by direct integration, linear equations of first order: Lagrange's Linear equation, non-linear equations of first order, Charpit's method.
Homogeneous linear equations with constant coefficients- rules for finding the complementary function, rules for finding the particular integral (working procedure), non- homogeneous linear equations.

**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS:** Method of separation of variables, One dimensional wave equation-vibrations of a stretched string, one dimensional Heat equation, Two dimensional heat flow in steady state - solution of Laplace's equation in Cartesian and polar coordinates (two dimensional).
**INTEGRAL TRANSFORMS:** Introduction, definition, Fourier integral, Sine and Cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier Sine and Cosine transforms, Finite Fourier Sine and Cosine transforms, properties of Fourier transforms, Convolution theorem for Fourier transforms, Parseval's identity for Fourier transforms, Fourier transforms of the derivatives of a function, simple applications to Boundary value problems.

**TEXT BOOKS:**

1. Scope and treatment as in "Higher Engineering Mathematics", by Dr. B.S.Grewal, **43rd Edition**, Khanna Publishers.

**REFERENCE BOOKS:**

1. A text book of Engineering Mathematics by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.
2. Mathematical Methods of Science & Engineering aided with MATLAB by Kanti B.Dutta, Cengage Learning India Pvt. Ltd.
3. Advanced Engineering Mathematics by Erwin Kreyszig.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw Hill Company.
5. Advanced Engineering Mathematics by H.K.Dass. S.Chand Company.
6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

**EEE-2102: NETWORK THEORY**

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| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Network Elements:** Charge, Voltage, Current, Power, Energy, Circuit concept, Active and Passive circuit elements, Ideal, Practical and dependent sources and their V-I characteristics, Energy stored in Inductors and Capacitors , Kirchoffs Laws, Voltage and Current division, Nodal Analysis, Mesh Analysis, Star-Delta transformation and Source Transformation.

**Network Theorems:** Linearity and superposition, Thevinen's and Norton's, Reciprocity, Compensation, Maximum power transfer theorems, Tellegan's and Millman's theorems, Application of theorems to DC circuits.

**DC Transients:** Inductor, Capacitor, Source free RL, RC and RLC Response, Evaluation of Initial conditions, application of Unit-step Function to RL, RC and RLC Circuits, Concepts of Natural, Forced and Complete Response.

**Alternating Circuits:** The Sinusoidal Forcing Function Instantaneous, Peak, Average and RMS values of Voltage and Current, Crest factor, Form factor, Concept of phase and phase difference in sinusoidal waveform, Phase relation in pure resistor, Inductor and capacitor, Impedance diagram, phasor diagram, series and parallel circuits, compound Circuits, Instantaneous and Average Power, Complex Power Computation of active, reactive and complex powers, power triangle, power factor.

**Sinusoidal Steady State Analysis:** Steady State Analysis Using Mesh and Nodal Analysis, Application of Network Theorems to AC Circuits, Series resonance, Impedance and phase angle, voltages and currents, bandwidth and Q factor and its effect on bandwidth, parallel resonance, resonant frequency, variation of impedance with frequency, Q factor and its effect on bandwidth, Balanced 3-phase circuits, Resonance, Concept of Duality. Magnetically Coupled Circuits, Dot Convention, Y, Z, H, T – Parameters of Two – Port Networks.

**Laplace Transform Techniques:** Transforms of Typical Signals, Response of Simple Circuits to Unit – Step, Ramp and Impulse Functions, Initial and Final Value Theorem, Convolution Integral, Time Shift and Periodic Functions, Transfer Function.

**Text Books**


1. Engineering Circuit Analysis, Willam H. Hayt Jr., and Jack E. Kemmerly, 5th Edition, McGraw Hill.
2. Electric circuits by J.A Edminister ( Schaum outline series)
3. Network Analysis, M. E. Vanvalkenburg, 3rd Edition, PHI.

**EEE-2103 : ELECTRO MAGNETIC FIEDS**

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Introduction**: Rectangular, Cylindrical and Spherical Coordinate Systems.

**Electrostatics:** Superposition, Coulomb's Law, Electric Field of Different Charge Configurations using Coulomb's Law and Superposition, Flux of a Vector, Field Lines, Gauss's Law interms of E (Integral Form and Point Form), Applications of Gauss's Law, Curl of the Electric Field, Electric Potential, Calculation of Electric Field Through Electric Potential for given Charge Configuration, Electrostatic Energy.

Method of Images, Electric Dipoles, Polarization of Dielectrics, Bound Charges and Their Physical Interpretation, the Displacement Vector D, Comments about the Curl of D in Electrostatics, Linear Dielectrics, Determination of Electric fields in the Presence of Linear Dielectrics by finding D, Electrostatic Boundary Conditions at a Charged Surface(Assuming no Dielectric Polarization), Continuity Equation, Basic Properties of Conductors in Electrostatic Fields, Capacitance, Poisson's and Laplace's Equations, Properties of the Solutions of Laplace's Equations, Uniqueness Theorem, Examples on Laplace's and Poisson's equations.

**Magnetic Fields and Lorentz force Law:** Magnetic field intensity H, Magnetic flux Φ, flux density B, Biot-Savart's law, Determination of Magnetic Field using Biot-Savart's Law, Divergence and Curl of B, Ampere's Law in Integral and Differential Form, Applications, The Scalar and Vector Magnetic Potential, Calculation of Magnetic Field through the Vector Magnetic Potential for given Steady Current Configurations, Comparison of Electrostatics and Magnetostatics, Magnetostatic Boundary Conditions(assuming no magnetic polarizations)

**The Magnetic Dipole:** Diamagnetism, Paramagnetism & Ferro Magnetism, Torques and Forces on Magnetic dipoles, Magnetization, Bound current, Physical Interpretation of Bound Currents, the H Vector, the Divergence and Curl of H , Linear Magnetic Materials, Determination of Magnetic Fields in the Presence of Magnetic Materials by Finding H, EMF, Ohm's Law, Motional EMF, Faraday's Laws, Lenz's law, Quasistatic Fields, Inductance and Energy in Magnetic Fields.

**Time Varying fields and Maxwell's Equations:** Maxwell's modification of Ampere's Law, Maxwell's Equations in any medium in terms of E & B and in terms of D,E,B & H, General Boundary Conditions, The Uniform Plane Wave, Maxwell's Equations in Free Space, Plane Wave Propogation, Phase Velocity and Wave length, Intrinsic Impedance, Perfect Dielectrics, Attenuation, Phase and Propagation Constants, the Poyinting Vector and Power Considerations.

**Text Books:**


1. Introduction to Electrodynamics by David J. Griffiths, 3rd Edition, Prentice Hall, New Jersey, 1999.
2. Engineering Electromagnetics by William H. Hayt Jr. and John A. Buck, Sixth Edition, Mc Graw Hill, New Delhi, 2001.


**Reference Books**:


1. Principles of Electromagnetics by Mathew N.O. Sadiku, Oxford International Student edition, 2009.
2. Electromagnetics by John D Kraus, Mc Graw-Hill International Edition, 1999.

**EEE-2104: ELECTRONIC DEVICES AND CIRCUITS**

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| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Energy Band Theory of Solids:** Intrinsic and Extrinsic Semiconductors Doping, Doping Materials, Carrier Mobility, Conductivity, Diffusion and continuity equation, Hall – Effect and its Application.

**Semiconductor Diodes:** Band structure of PN Junction, Quantitative Theory of PN Diode, Volt – Amp. Characteristics, Temperature Dependence, Transition and Diffusion Capacitance of PN Junction, Zener and Avalanche Breakdowns, Tunnel Diode, LED, Schottky Barrier Diode, Varactor Diode, Photo Diode, PIN Diode, Point Contact Diode.

**Diode Rectifiers:** Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Ripple Factor and Regulation Characteristics.

**Bipolar Junction Transistor:** NPN and PNP junction Transistor, Characteristics of Current Flow across the Base Regions, Minority and Majority Carrier Profiles, CB, CE and CC Configurations and their Input and Output Characteristics. Comparison of CE, CB and CC Configurations. Junction Biasing for Saturation, Cutoff and Active Region, $\alpha$ and $\beta$ Parameters and the relation between them.

**JFET:** JFET and its characteristics, Pinch off Voltage, Drain Saturation Current, JFET biasing, MOSFET – Enhancement and Depletion Modes, Small signal models of FET.

**Small Signal – Low Frequency Transistor Amplifier Circuits:** Transistor as an Amplifier, h – parameter model, Analysis of Transistor Amplifier Circuits using h – parameters. CB, CE and CC Amplifier configurations and performance factors. Analysis of Single Stage Amplifier, RC Coupled Amplifiers. Effects of Bypass and Coupling Capacitors. Frequency Response of CE Amplifier, Emitter – Follower, Cascaded Amplifier.

**Text Books**:


1. Integrated Electronics, Analog Digital Circuits and systems, Jacob Millman and D. Halkias, McGraw Hill.
2. Electronic Devices and Circuits, Nashalky.


**References**:


1. Electronic Devices and Circuits 2nd Edition, B. V. Rao and K. Raja Rajeswari, Pearson Education
2. Electronic Devices and Circuits Theory, Boylsted and Nashelsky, Prentice Hall Publications.

**EEE-2105: FLUID MECHANICS & HYDRAULIC MACHINERY**

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| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Introduction To Fluid Mechanics**, Principle Of Continuum–Fluid Properties–Mass Density, Specific Weight, Specific Gravity, Viscosity, Surface Tension, Capillarity, Compressibility & Bulk Modulus Of Electricity, Vapour Pressure.

**Fluid Statics** – Fluid Pressure And Its Measurement, Pascal's Law, Hydrostatic Pressure Distribution, Manometers-Micromanometers-Mechanical Gauges, Hydrostatic Forces On Plane Surfaces.

**Fluid Kinematics**-Definition Of Steady and Unsteady, Uniform and Non Uniform, Compressible and Incompressible, Rotational and Irrotational, 1-D, 2-D and 3-D, Laminar and Turbulent Flows, Stream Line, Path Line, Streak Line, Stream Function, Velocity Potential Function, Local And Convective Accelerations-Flow Nets, Principle Of Conservation Of Mass, 3-D Continuity Equation In Cartesian Coordinates, Continuity Equation For Stream Tube.

**Fluid Dynamics**-Derivation Of Bernoulli's Equation From The Concepts Of Work Done, Total Head, Limitations Of Bernoulli's Principle, Application Of Bernoulli's Equation, Venturi Meter, Orifice Meter, Flow Nozzle, Pitot Tube, Momentum Principle-Impulse Momentum Equation And Its Application To Pipe Bends And Reducers, Impact Of Jets On Single Stationary Plates.

**Flow Through Pipes**-Laws Of Friction, Reynolds Experiment, Darcy-Weichbach Equation, Major And Minor Losses, Pipes In Series, Pipes In Parallel, Pipes Connecting Two Reservoirs, Siphon, Power Transmission Through Pipes And Nozzles, Water Hammer (Concept only) .

**Hydraulic Machines**-Impact Of Jets On Series Of Stationary And Moving Vanes, Velocity Triangles, Work done-Turbines-Hydraulic, Mechanical And Overall Efficiency, Classification, Component Parts And Working Principles Of Pelton, Francis And Kaplan Turbines, Unit Quantities, Specific Speed, Characteristic Curves.

**Pumps**: Classification of Pumps, Positive Displacement and Rotodynamic Pumps, Centrifugal Pumps-Components Parts, Working Principles, Manometric, Static And Overall Efficiency, Work Done- Pumps In Parallel And Series, Specific Speed And Pump Characteristic Curves.

**TEXT BOOKS**:


1. Fluid Mechanics and Hydraulic Machinery by P.N. MODI & SM SETHI
2. Fluid Mechanics and Hydraulic Machinery by A.K.Jain.

**EEE-2106: THERMAL PRIME MOVERS**

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Laws Of Thermodynamics** (Statements Only), Gas Laws, Relation between Gas Constant and Specific Heat at Constant Pressure And Constant Volume, Thermodynamics Processes of Perfect Gases and Entropy, Properties of Steam and Use of Steam Tables, Extent Work and Internal Energy, Thermodynamic Processes of Vapor and Entropy Of Steam.

**Boilers:** Classification, Simple Vertical, Cochron, Lancashire, and Babcock & Wilcox Boilers.

**I C Engines:** Classification, Otto Cycle, Diesel Cycle and Duel Combustion Cycle. Working Of 2-Stroke And 4-Stroke Engines, Petrol Engines and Diesel Engines, Power and Efficiency of IC Engines.

**Steam Nozzles:** Flow through Steam Nozzles Critical Pressure Ratio, Effect of Friction and Super Saturation.

**Steam Turbines:** Impulse And Reaction Turbines, And Velocity diagrams, Methods of Reduction of Rotor Speed.

**Gas Turbines:** Introduction, Classification Of Gas Turbines. Analysis Of Constant Pressure Closed Cycle Gas Turbines, Open Cycle Gas Turbines. Methods to Improve the Thermal Efficiency Of Gas Turbines.

**Text Books:**


1. Thermal Engineering By R.S. Khurmi And J.K. Gupta, S.Chand & Co Ltd.
2. Elements Of Heat Engines, Vols. I & Ii By R.C. Patel And C.J. Karam Chandani, Acharya Book Depot, Baroda.

**EEE-2201: ELECTRICAL MACHINES –I**

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| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Electro mechanical Energy Conversion:** Principles, Forces and Torques in Magnetic Field Systems, Energy Balance, Energy and Force in Singly Excited Magnetic Field System, Coenergy, Multiply Excited Magnetig Field Systems.

**D.C.Generators:** Principle of Operation, Constructional Features, emf Equation of a D.C.Generator, Collection and Flow of Current from Armature, Armature Reaction, Methods to Reduce Effects of Armature Reaction and Commutation Process, Armature Winding Diagram (Lap and Wave), Methods of Excitation, Generator Characteristics, Parallel Operation, Losses occur in DC Generator, Efficiency and Applications.

**D.C. Motors:** Principle of operation, Types of DC Motors, Back emf of a DC Motors, Torque and Speed Equations, DC Motor characteristics, Speed Control Methods of a D.C. Motors, Starting and Starters, Efficiency and Applications.

**Testing of D.C. Motors:** Brake Test, Swinburne's Test, Hopkinson's Test, Retardation Test, Field's Test and Separation of Losses.

**Transformers:** Principle of operation, Constructional features, Types of Transformers, emf equation of a Transformer, Transformer on No-Load and Load and its vector diagrams, Equivalent Circuit of a Transformers, Losses in a Transformer, Voltage Regulation and Efficiency, OC and SC Tests of a Transformer, Three Winding Transformers, Three Phase Transformer Connections, Parallel Operation and Load Sharing, Three Phase to Two Phase Conversion and Vice-Versa.

**TEXT BOOKS:**


1. Electrical Machinery by DR.P.S.BIMBHRA, KHANNA PUBLISHER.
2. Electrical Machines by D P KOTHARI and I J NAGRATH, Mc Graw Hill Education (India) Private Limited.


**Reference Books:**


1 Electrical Machines, by J B Gupta, S K Kataria & Sons

2 Electrical Machines by U A Bakshi and M V Bakshi, Technical Publications

**EEE-2202: ELECTRICAL MEASUREMENTS**

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Instruments:** Objectives of Measurements, Analog Versus Digital Measurements, Accuracy, Precision And Uncertainty, Sources Of Measurement Error, Standard Cell And Standard Resistance. Basic

**Characteristics of measuring instruments with a moving element instruments**: Ammeter, Voltmeter, Expression for Torque of Moving Coil, Moving Iron, Dynamometer, Induction and Electrostatic Instruments.

**Extension of Range Of Instruments**. Wattmeters, Torque Expression For Dynamometer Instruments. Reactive Power Measurement, Energy Meters Single Phase And Poly Phase, Driving Torque And Braking Torque Equations, Errors And Testing, Compensation, Maximum Demand Indicator, Power Factor Meters, Frequency Meters, Electrical Resonance And Weston Type Of Synchro Scope.

**Bridge Methods:** Measurement Of Inductance, Capacitance & Resistance Using Bridges. Maxwell's, Anderson's, Wein's Heave-Side & Campbell's, Desauty's, Schering's Bridges, Kelvin's Double Bridge, Price Guard Wire Bridge, Loss Of Charge Method, Megger, Wagner's Earthing Device.

**Magnetic Measurements:** Ballastic Galvanometer, Calibration Of Hibbert's Magnetic Standard Flux Meter, Lloydfischer Square For Measuring Iron Loss. Testing Of Ring And Bar Specimens, Determination Of B-H Curve And Hysteresis Loop Using Cro, Determination Of Leakage Factor.

**Potentiometers & Instrument Transformers:** Crompton's D.C. Potentio Meter, A.C. Polar And Co-Ordinate Type Potentio Meters.Applicationsmeasurement Of Impedance, Calibration Of Ammeters, Voltmeters And Wattmeters. Use Of Oscilloscope In Frequency, Phase And Amplitude Measurements, Indian Standard Specifications For Voltmeters, Ammeters, Energy Meters, Insturmnet Transformers –Ration And Phase Angle Errors And Their Reduction.

**Text Book :**

1. Electric And Electronic Instrumentation By A.K. Sawhney, Dhanpat Rai & Sons, Delhi, 11 Th Edition, 1995.

**Reference Books :**

1. Electrical & Electronic Instrumentation By Umesh Sinha, Satya Prakashan, Newdelhi,1998
Electrical Measurements By E.W.Golding. & Widdis, 5th Edition, Wheeler Publishing

**EEE-2203: DIGITAL LOGIC DESIGN**

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Numbering Systems:** Basic structure and brief description of Digital computers and Digital systems - Binary, Octal, Decimal and Hex numbering systems – Number base Conversions – (n-1)'s and n's complements of the various numbering systems – Binary arithmetic – Various methods to represent signed binary numbers.

**Binary Codes:** BCD, Excess-3 codes – Binary arithmetic using BCD and Excess-3 codes – Gray code – Error detecting codes : parity checking and Hamming code – Error correcting codes: Hamming code – Basic idea of 2421, 84-2-1, ASCII codes.

**Boolean Algebra and Boolean Functions:** Boolean theorems and postulates – Logic gates – Truth table - Boolean functions – Dual of a function – Complement of a function – Canonical and standard forms – Simplification of Boolean functions using Boolean theorems and postulated, Karnaugh map (K-map) with maximum of 5 variables – Quine-McCluskey Tabular method.

**Combinational Logic Circuits- I:** Boolean function implementation using AND-OR logic, multilevel NAND and multilevel NOR implementation – Transformation of multilevel NAND and NOR circuits to AND-OR diagram – Combinational logic design - Half adder – Full adder – Half subtractor – Full subtractor – Parallel adder – Parallel adder/subtractor –Carry look ahead adder – BCD adder – Magnitude comparator – Even an odd functions – Parity generator and checker – code converters.

**Combinational Logic Circuits- II:** Decoders – Encoders – Demultiplexer – Multiplexer – Read Only Memory (ROM) – PLA – PAL – implementation of the Boolean functions using decoders, multiplexers, ROMs, PLA, and PAL.

**Sequential Logic Circuits:** Differences between combinational logic and sequential logic – Flip-flops (R-S, J-K, D, T, Master-slave J-K flip) – Truth tables and excitation tables of the flip-flops, Conversions of flip-flops – state diagram – Mealy and Moore models – Design of sequential circuits with various flip-flops – Design of synchronous counters – Serial adder.

**Micro Computer Components Design with Flip-flops:** Register – Register with parallel load – Shift register – Bidirectional shift register with parallel load – Ripple counters (Binary and BCD) – Binary counters with parallel load.

**Text Book:**

1. M. Morris Mano, Digital Design, Prentice-Hall of India Pvt. Limited, New Delhi, 2nd Edition. 2000.

**Reference Books:**

1. Zvi Kohavi, Switching and Finite Automata Theory, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd Edition, 2008.
2. Frederick J. Hill and Gerald R. Peterson, Introduction to Switching Theory and Logic Design, John Wiley & sons, Inc. New York, 3rd edition, 1981.

**EEE-2204: SIGNALS, SYSTEMS AND SYNTHESIS**

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Signals**, Transformations of Independent Variables, Basic Continuous Time Signals, Basic Discrete Time Signals, Signal Energy and Power Systems, Properties of Systems, Linear Time – invariant Systems. Continuous Time and Discrete time.

**Fourier series**. Convergence of Fourier series, Fourier Transform. Periodic Signals and Continuous and discrete Fourier Transform. Z-transform of a Discrete Sequence, Region of Convergence for the Z-transform. Inverse Z-transform, Properties of Z-transform, Relation Between Z and Fourier Transform.

**Linear Time – Invariant (LTI) Systems** Representation of Signals in terms of Impulses, Discrete Time LTI Systems, the Convolution Sum, Continuous Time LTI Systems, the Convolution Integral. Properties of LTI Systems, Systems Described by Differential and Difference Equations. Block Diagram Representation of LTI Systems Described by Differential Equations and, Singularity Functions. Frequency Response Characterized by Linear Constant Coefficient Differential Equations. First-order and Second-order Systems. Representation of DTFT, First-order and Second-order Systems

**Sampling Theorem**, Reconstruction of a Signal from Samples, the Effect of under sampling, Discrete Time Processing of Continuous Time Signals. Sampling in Frequency Domain, Sampling of Discrete Time Signals

**Positive Real Function and Other Properties**, Herwitz Polynomials, Computation of Residues, Even and Odd Functions, Test for Positive Real Functions. Network Synthesis Elementary Synthesis Operation, LC Network Synthesis, Properties of RC Network Functions, Foster and Cauer Forms of RC and RL Networks.

Text Books:


1. A.V. Oppenheim et al.,(1997) Signals & Systems (2nd Edition), Prentice Hall., ISBN 0-13-814757-4
2. P.Rama Krishna Rao, “Signals & Systems”, 1st Edition, TMH, 2008..
3. Modern Network Synthesis, M. E. Van Valkenburg, Wiley Eastern

## EEE-2205: ANALOG ELECTRONIC CIRCUITS

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Multistage Amplifiers:** BJT and FET RC Coupled Amplifiers – Frequency Response. Cascaded Amplifiers. Calculation of Band Width of Single and Multistage Amplifiers. Concept of Gain Bandwidth Product.

**Feedback Amplifiers:** Concept of Feedback Amplifiers – Effect of Negative feedback on the amplifier Characteristics. Four Feedback Amplifier Topologies. Method of Analysis of Voltage Series, Current Series, Voltage Shunt and Current Shunt feedback Amplifiers.

**Sinusoidal Oscillators:** Condition for oscillations –LC Oscillators – Hartley, Colpitts, Clapp and Tuned Collector Oscillators – Frequency and amplitude Stability of Oscillators – Crystal Oscillators – RC Oscillators -- RC Phase Shift and Weinbridge Oscillators.

**Power Amplifiers:** Classification of Power Amplifiers – Class A, Class B and Class AB power Amplifiers. Series Fed, Single Ended Transformer Coupled and Push Pull Class A and Class B Power Amplifiers. Cross-over Distortion in Pure Class B Power Amplifier, Class AB Power Amplifier – Complementary Push Pull Amplifier, Derating Factor – Heat Sinks.

**Tuned Voltage Amplifiers:** Single Tuned and Stagger Tuned Amplifiers – Analysis – Double Tuned Amplifier – Bandwidth Calculation.

**Operational Amplifiers**: Concept of Direct coupled amplifiers, Ideal Characteristics, Differential amplifier, normalized transfer characteristics, Measurement of Op-Amp Parameters.

**Applications of Op-Amps**: Inverting and Non-inverting Amplifiers, Integrator, Differentiator, Comparator, Logarithmic Amplifiers, Instrumentation Amplifiers.

**Text Books:**


1. Integrated Electronics, Analog Digital Circuits and systems, **Jacob Millman** and **D. Halkias**, McGraw Hill, 1972
2. OP-Amps and Linear Integrated Circuits, Gayakwad, 4th ed. PHI publications, 1993.


**References:**


1. Linear Integrated Circuits, D Choudhury Roy, New Age International Pvt Ltd, publishers, New Delhi, 2004
   Electronic Devices and Circuits – G.K.Mithal, Khanna Publishers, 23rd Edition, 2004

**EEE-2206: ENVIRONMENTAL STUDIES**

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

Unit-1 : Introduction To Environmental Sciences – Importance - Types Of Ecosystems – Lake – River – Marine – Forest – Desert – Bio-Deversity.

Unit-2: Resources Natural – Water – Mineral – Food – Forest – Energy – Land – Use And Exploitation - Environmental Degradation - Remedial Measures.

Unit-3: Environmental Pollution Causes, Effects, Standards And Control Of
(A) Air Pollution;
(B) Water Pollution;
(C) Soil Pollution;
(D) Marine Pollution;
(E) Noise Pollution.

Unit-4 : Legal Aspects Of Pollution
(A) Air (Prevention And Control Of Pllution) Act.
(B) Water (Prevention And Control Of Pollution) Act.
(C) Environmental Protection (19860 Act.
(D) Forest Conservation Act.

Unit-5: Role Of People To Protect Envvironment – Role Of Ngos.
A. Global Issues.
B. Green Houseeffect
C. Global Warming
D. Nuclear Accidents
A. Local Issues. Causes And Action
B. Air Pollution Due To Industries
C. Automobiles
C. Public Interest Litigation Case Studies – Success Stories
Leather Industries
Taaj & Mathura Refinery
Silent Valley

**Recommended text Books:**


1. Introduction To Environmental Sciences – Turk & Turk And Witties &Witties.
2. Environmental Sciences – P.D.Sarma

# EEE 3101: POWER SYSTEMS I

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**Introduction:** Power Generation, Comparison of different Sources of Energy.

## Renewable Energy Sources

**Hydro Electric Plants:** Choice of Site, Hydrology, Classification of Plants, General Arrangement, Functions of Different Components of A Hydro Plant

To Understand the Importance, Working Principle, types, Site Selection, Plant Layout, Components, Merits and Demerits for **Solar Power Plant, Wind Mill Power Plant, Fuel Cells, Tidal Power Plant & Bio-Mass Power Plant**.

## Non Renewable Energy Sources

**Thermal Power Stations:** Line Diagram, Location, Coal Handling, Draught, Condensers, Cooling Water Systems.

**Nuclear Power Plants:** Schematic Arrangement, Components of Nuclear Reactor, Classification of Reactors, Different Power Reactors.

**Diesel Power Plant:** Understand the Working Principle, Site Selection, Plant Layout, Components, Merits and Demerits

**Gas Turbine Plants:** Layout, Components of A Gas Turbine Plant, Open Cycle and Closed Cycle Plants.

**Magneto Hydro Dynamic (MHD) Power Generation:** Basic Concepts, Principle, Classification, Coal Burning MHD Steam Power Plant, Gas Cooled Nuclear MHD Power, Liquid Metal MHD Generator.

**Operational Aspects of Generating Stations:** Load Curves and Associated Definitions, Selection of Units, Load Duration Curves.

**Economic Considerations:** Capital and Running Costs of Generating Stations, Different Tariffs, Comparison of Costs.

**Text Book:**

1. A Text Book on Power System Engineering by Soni, Gupta, Bhatnagar & Chakrabarti, Dhanpat rai & Co.

**Reference Books:**

1. Generation & Utilization by C.L.Wadhwa
2. Electrical Power by S. L. Uppal, Khanna Publishers

# EEE 3102: PULSE AND DIGITAL CIRCUITS

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**UNIT- I: LINEAR WAVE SHAPING**: High pass and Low pass RC circuits, Response of High pass and Low pass RC circuits to sinusoidal, step, pulse, square, exponential and Ramp inputs, High pass RC circuit as a differentiator, Low pass RC circuit as an integrator. Attenuators and its application as CRO probe, RL and RLC Circuits and their response for step input, Ringing Circuit.

**UNIT- II: NONLINEAR WAVE SHAPING**: Diode clippers, Transistor Clippers, Clipping at two independent levels, Comparator, Applications of voltage Comparators, Diode Comparator, Clamping Operation, Clamping Circuits using Diode with Different Inputs, Clamping Circuit Theorem, Practical Clamping circuits, Effect of diode Characteristics on Clamping Voltage.

**UNIT- III: BISTABLE MULTIVIBRATORS**: Transistor as a switch, Switching times of a transistor, Design and Analysis of Fixed-bias and self-bias transistor binary, Commutating capacitors, Triggering schemes of Binary, Transistor Schmitt trigger and its applications.

**UNIT- IV: MONOSTABLE AND ASTABLE MULTIVIBRATORS:** Design and analysis of Collector coupled Monostable Multivibrator, Expression for the gate width and its waveforms. Design and analysis of Collector coupled Astable Multivibrator, expression for the Time period and its waveforms, The Astable Multivibrator as a voltage to frequency convertor.

**UNIT- V: TIME BASE GENERATORS:** General features of a time-base signal, Methods of Generating time base waveform, Exponential voltage sweep circuit, Basic principles of Miller and Bootstrap time base generators, transistor Miller sweep generator, transistor Bootstrap sweep generator, Current Sweep circuit, Linearity correction through adjustment of driving Waveform.

**UNIT VI: LOGIC GATES**: Realization of gates using diodes and Transistors, RTL, DTL.

**Text Books:**

1. Pulse Digital and Switching Waveforms, J. Millman and H. Taub, McGraw-Hill, 2nd Edition 1991.
2. Pulse switching and digital circuits – David A.Bell,PHI ,5th Edn., oxford university press.

**Reference Books:**

1. Pulse and Digital Circuits, K.VenkatRao, Pearson Education India, 2nd Edition, 2010.
2. Pulse and Digital Circuits, A. Anand Kumar, PHI, second edition, 2005.

# EEE 3103: ELECTRICAL MACHINES – II

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**Induction Motors - I :**
Principle of operation, Constructional details, Rotating Magnetic field, Types of rotors, Slip, Stator and Rotor current frequencies, Development of torque and torque calculations, Torque-Speed Characteristics, Power flow and performance calculations, Equivalent circuit, Calculation of equivalent circuit parameters from No-load and Rotor-blocked tests.

**Induction Motors - II :**
Predetermination of performance characteristics using circle diagram and load test, Starting of Induction motors using Rheostat/reactor starter, Auto-transformer starter, Star-Delta starter, and Rotor Resistance starter, Crawling and cogging, Brief description of the induction motor speed control using Voltage control, frequency control, pole changing, rotor resistance control, cascading, and rotor emf injection, Induction generator and principle of operation, Double-cage rotors.

**Synchronous Generators:**
Basic requirements, Constructional details, EMF equation, Effect of chording and distribution of winding, Armature reaction, Phasor diagram, Regulation of Synchronous Generators using EMF, MMF and ZPF method, Synchronization of alternators, Parallel operation of two-alternators, Parallel operation of Synchronous Generator to infinite bus, Sharing of real and reactive powers, Capability curve, Salient-pole synchronous machine, Two-reaction theory, Determination of direct axis and quadrature axis reactances of salient-pole machines, Power-Angle characteristics of cylindrical and salient-pole machines.

**Synchronous Motors:**
Principle of operation, starting methods, phasor diagram, effect of changing load and changing excitation on machine performance, V and Inverter 'V' curves, Hunting, Damper winding, power developed by synchronous motor.

**Special Machines:**
Single phase Induction motors: Double-field revolving theory, Principle of operation of Split-phase, capacitor start, capacitor start and run, shaded pole machines.
Principle of operation of hysteresis motor, Reluctance motor, BLDC motor and Doubly-fed Induction generator.

**Text books:**


1. M G Say, The performance and Design of Alternating Current Machines, 3rd edition, CBS Publishers & Distributors, New Delhi, 2002.
2. P S Bhimbhra, Electrical Machinery, 7th edition, Khanna Publishers, New Delhi, 2011.


**Reference books:**


1. A E Fitzferald, Chrles Kingsley, Jr., and Stephen D Umans, Electric Machinery, 6th edition, Mc. Graw-Hill, New Delhi, 2003.

# EEE 3104 : CONTROL SYSTEMS

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

Basic Structure of a Feedback Control System-Introduction to Mathematical Modeling of Physical Systems – Equations of Electrical Networks – Modeling of Mechanical Systems – Equations of Mechanical Systems, Analogous Systems.

Transfer Functions of Linear Systems– Impulse Response of Linear Systems – Block Diagrams of Control Systems – Signal Flow Graphs (Simple Problems) – Reduction Techniques for Complex Block Diagrams and Signal Flow Graphs (Simple Examples). Feedback Characteristics of Control Systems.

Time Domain Analysis of Control Systems – Time Response of First and Second Order Systems with Standard Input Signals – Steady State Error Constants – Effect of Derivative and Integral Control on Transient and Steady State Performance of Feedback Control Systems.

Concept of Stability and Necessary Conditions for Stability – Routh-Hurwitz Criterion, Relative Stability Analysis, the Concept and Construction of Root Loci, Analysis of Control Systems with Root Locus (Simple Problems to understand theory).

Correlation between Time and Frequency Responses – Polar Plots – Bode Plots – Log Magnitude versus Phase Plots – All Pass and Minimum Phase Systems – Nyquist Stability Criterion – Assessment of Relative Stability – Constant M and N Circles-The Nichols Chart.

**Text Books:**

1. Automatic Control Systems, Benjamin C. Kuo, PHI Publication (5th Edition).

**Reference Books:**

1. Modern Control Engineering, Ogata, PHI.
2. Control Systems Engineering, I. J. Nagrath and M. Gopal, Wiley Eastern Ltd.
3. Control Systems Principles and Design M.Gopal, McGrawHill

# EEE 3105 (a): LINEAR ICS AND APPLICATIONS

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**1. Operational Amplifiers:** Design Aspects of Monolithic Op-Amps, Ideal Characteristics, AC and DC Characteristics, Data sheet Specifications, Offset Voltages and Currents, Frequency Compensation Techniques, Measurement of Op-Amp Parameters.

**2. Applications of Op-Amps:** Inverting and Non-inverting Amplifiers, Integrator, Differentiator, Comparator, Logarithmic Amplifiers, Instrumentation Amplifiers, Op-Amp Phase Shift, Wein-bridge and Qudrature Oscillator, Voltage Controlled Oscillators, Voltage to Current and Current to Voltage Converters., Analog Multiplexers.

**3. Signal Conditioning Circuits:** Rectifiers, Peak Detection and, Wave form Generators, Sample and Hold Circuits, Multivibrators, Square Wave Generators, Schmittrigger.

**4. Active Filters**: LPF, HPF, BPF, BEF, All-pass Filters, Higher Order Filters and their Comparison, Switched Capacitance Filters.

**5. Special ICs**: 555 Timers, 556 Function Generator ICs and their Applications, Three Terminal IC Regulators, IC 1496 (Balanced Modulator), IC 565 PLL and its Applications, Function Generators, Voltage to Frequency and Frequency to Voltage Converters.

**6. Digital to Analog and Analog to Digital Converters**: DAC techniques, Weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, Different types of ADCs-parallel Comparator type ADC, Counter type ADC, Successive approximation ADC and dual type ADC, DAC and ADC specifications, Integrated ADC and DACs.

**Text Books:**

1. Op-Amps and Linear ICs- Ramakanth Gayakwad, PHI, 1987.
2. Linear Integrated Circuits- D.Roy Chowdhury, New Age International(p) Ltd, 2nd Edition ,2003.

**Reference Books:**

1. Integrated Circuits- Botkar, Khanna Publications.
2. Applications of Linear ICs- Clayton.
3. Microelectronics- Jacob Millman.

# EEE 3106 (a): COMPUTER ARCHITECTURE AND ORGANISATION

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

1. **Register Transfer and Micro operations:** Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit.

2. **Basic Computer Organization and Design:** Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output and Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic.

3. **Micro programmed Control**: Control Memory, Address Sequencing, Micro program Example, Design of Control Unit.

4. **Central Processing Unit:** Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC)

5. **Pipeline and Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISK Pipeline, Vector Processing, Array Processors.

6. **Input/output Organization:** Peripheral Devices, I/O interface, Asynchronous data transfer, Modes of transfer, priority Interrupt, Direct memory access, Input-Output Processor (IOP), Serial Communication.

7. **Memory Organization**: Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Hardware.

**Text Book:**


1. Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd., Third Edition, Sept. 2008.


**Reference Books:**


1. Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003.
2. Computer Organization and Architecture, Linda Null, Julia Lobur, Narosa Publications ISBN 81- 7319-609-5

Computer System Architecture", John. P. Hayes

# EEE 3107: MOOCS – I

**No. of Credits: 2**
**Total Marks**: **100**

## List of Courses:

1. **Digital Communication**
2. **Cloud Computing**
3. **Rural Technology And Community Development**
4. **Knowledge Management**
5. **Global Strategy And Technology**
6. **Microelectronic Devices and Circuits**

# EEE 3108: ELECTRICAL MACHINES LAB – II

| | |
|---|---|
| **No. of Credits** | **: 2** |
| **No. of Periods/ Week** | **: 3** |
| **Internal Examination - Max. Marks** | **: 50** |
| **External Examination - Max. Marks** | **: 50** |
| **Total Marks** | **: 100** |

**List of Experiments:**

1. No Load and Blocked rotor test on 3-phase slip ring induction motor
2. Brake test on 3-phase on squirrel cage motor
3. No load and Blocked rotor test on 1-phase induction motor
4. Regulation on 3-phase alternator using EMF
5. Regulation on 3-phase alternator using MMF
6. Sumperners test on 1-phase transformers
7. Brake test on 3-phase squirrel cage induction motor
8. Speed control on 1-phase induction motor
9. Brake test on 1-phase induction motor
10. Speed control on 3-phase induction motor
11. Starting od induction motor using DOL starter.

# EEE 3109: PULSE AND DIGITAL CIRCUITS LAB

| | |
|---|---|
| **No. of Credits** | **: 2** |
| **No. of Periods/ Week** | **: 3** |
| **Internal Examination - Max. Marks** | **: 50** |
| **External Examination - Max. Marks** | **: 50** |
| **Total Marks** | **: 100** |

**EEE 3201: POWER SYSTES – II**

**No. of Credits : 4**
**No. of Periods/ Week : 4**
**Internal Examination - Max. Marks : 30**
**External Examination - Max. Marks : 70**
**Total Marks : 100**

Power Supply Systems: Comparison between Various Systems and Copper Efficiencies, Effect of System Voltage on Transmission Efficiency, Choice of Transmission Voltage, Conductor Size and Kelvin's Law.

Power Distribution Systems: Radial and Ring Main Systems, Different types of AC Distributors with Concentrated and Distributed Loads.

Transmission Line Constants: Inductance and Capacitance of Single Phase and Three Phase Lines, Concept of Self GMDR Mutual GMD Double Circuit Line, Inductance of Composite Conductors, Transposition, Skin Effect and Proximity Effect.

Transmission Line Modeling: Generalized Network Constants, Modeling of Short, Medium and Long Transmission Lines, Rigorous Line Modeling, Circle Diagrams.
Mechanical Design of Transmission Lines: Sag and Tension Calculations, Line Supports, Conductor Materials, Overhead Lines Vs Underground Cables.

Over Head Line Insulators: Types of Insulators, Potential Distribution over a String of Insulators and Methods of Equalizing Potential.

Under-Ground Cables: Types of Cables, Insulation in Cables, Armonning & Covering of Cable, Insulation Resistance OFR Cables, Stress in Insulation, Sheathing in Cable, Use of Inter Sheaths, Capacitance Grading, Capacitance in 3-Core Cables.

EHV & HVDC Transmission:
Introduction, Need of EHV Transmission Lines, Advantages and Disadvantages of EHV Lines, HVDC Transmission System Introduction, Advantages, Disadvantages and Applications of HVDC Transmission System, Types of DC Links.
Corona: Phenomenon of Corona, Critical Voltages, Power Loss due to Corona, Factors Affecting Corona Loss, Radio Interference.

Text Books:

1. A Text Book on Power Systems Engineering by Sony, Gupta, Bhatnagar and Chakrabarti, Dhanapatrai & Co.
2. Electrical Power Systems by C. L. Wadhwa.

Reference Books:

1. Electrical Power by S. L. Uppal.
2. A Course in Power Systems by J. B. Gupta.
3. Electrical Power Transmission and Distribution by S. Siva Nagaraju and S. Satyanarayana.

# EEE 3202: MICROPROCESSORS AND MICROCONTROLLERS

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**8085 Microprocessor:**
Introduction to microprocessors, micro computers – Architecture of 8085 microprocessor – pin-out diagram of 8085 – Detailed description of the 8085 pins – addressing modes – Memory structure and its requirements – Basic concepts in memory interfacing – Address decoding – Memory mapping – Machine cycles and bus timings for memory read, memory write, I/O read, I/O write operations – Memory mapped I/O and I/O mapped I/O.

**8085 Instructions and programming:**
Difference between Machine language, Assembly language and High level language – Brief description of the 8085 instruction set – 8085 programming using data transfer group, arithmetic group, logical group, branch transfer group, stack and subroutines – counters and delay - code conversions.

**Interfacing peripherals to 8085:**
Function of D/A and A/D converters – Interfacing D/A and A/D converters and necessary programming – Detailed description and interfacing of 8251 USART, 8253/8254 programmable timer, 8255 PPI, 8257 DMA controller, 8259 programmable interrupt controller, 8279 programmable keyboard/display interface

**8051 Microcontroller:**
Introduction to microcontrollers – Comparison between microprocessors and microcontrollers – Functional block diagram of 8051 microcontroller and its description – 8051 pin-out diagram and description of 8051 pins – Interfacing external memory to 8051 – implementing counters and timers in 8051 – Serial data transfer using 8051 – Various interrupts and its programming in 8051.

**Advanced topics in Microprocessors:**
Architecture of 8086 microprocessor – Addressing modes – RS232 communication standard – Interfacing Stepper motor, elevator, traffic controller to 8085 microprocessor.

**Text books:**

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming, and Applications, New Age International Publishers, New Delhi, 2nd edition, 1996.
2. Kenneth J. Ayala, The 8051 Microcontroller : Architecture, Programming, & Applications, Penram International Publishing (I) Pvt. Ltd., Mumbai, 2nd edition, 2006.
3. Douglas V. Hall, Microprocessor and Interfacing : Programming and hardware, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1997.

# EEE 3203: POWER ELECTRONICS

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Thyristors**: Introduction, Principle of Operation, Two Transistor Model, Gate Characteristics, Turn On Methods, Turn Off Methods, Thyristor Ratings, Measurement of Thyristor Parameters, Protection Circuits.

**Gate Triggering Circuits**: Firing of Thyristors, Pulse Transformers, Opto Isolators, Gate Triggering Circuits, Resistance Firing, Resistance-Capacitance Firing, UJT, Programmable UJT (PUT), UJT as an SCR Trigger, Synchronized UJT Triggering.

**Series And Parallel Operation of Thyristors**: Equalizing Networks, Triggering, String Efficiency, De-rating.

**Phase Controlled Rectifiers**: Single Phase-Half Wave, Full Wave & Bridge Controlled Rectifiers, Three-Phase Half Wave and Fully Controlled Rectifiers, Three-Phase Fully Controlled Bridge Rectifier.

**Inverters:** Classification, Series and Parallel Inverters, Self Commutated Inverters, The Mc Murray Inverter, The Mc Murray Bedford Inverter, Harmonic Reduction, Current Source Inverters.

**Choppers:** Principle of Operation, Step Up, Step Down Choppers, Jones Chopper, Morgan Chopper

**Cyclo-converters:** Principle of Operation, Single Phase To Single Phase Cyclo-converters, Cyclo-converter Circuits for Three-Phase Output, Control Circuits

**Modern Power Semiconductor Devices:** Basic Structure and Characteristics of Diode, Transistor, MOSFET, IGBT, GTO, DIAC, TRIAC

**FACTS Devices:** Introduction to SVC, TCSC, SSSC, STATCOM

**Text Books:**


3. Power Electronics by M.D.Singh, K.B.Khanchandani, Tata Mc Graw Hill Education (India) Private Limited.
4. FACTS controllers in Power Transmission and Distribution by K.R.Padiyar, New Age International.


**Reference Books:**


1. Power Electronic Circuits Devices and Applications by M.H.Rashid, Pearson India
2. Power Electronics by Dr. P S Bhimbra, Khanna Publishers

**EEE 3204: ELECTRIC DRIVES AND TRACTION**

**No. of Credits : 4**
**No. of Periods/ Week : 4**
**Internal Examination - Max. Marks : 30**
**External Examination - Max. Marks : 70**
**Total Marks : 100**

Electric Drive: Definition, Components of electric drive system, Advantages and applications of drives, factors governing the selection of motors, classification of drives, Drive characteristics and nature of load conditions, selection of motor for particular drive, Dynamics of motor load combination, Multi quadrant operation, Nature, classification and components of load torques.

Speed Control of DC Motor Drives: Speed Control methods, Single phase rectifier fed uncontrolled and controlled drives, chopper fed drives, closed loop control and Phase locked loop control of DC drives.

Speed Control of AC Motor Drives: Speed control methods of induction motors, phase controlled drives; frequency controlled drives, slip power recovery schemes, voltage current and frequency control and closed loop control. Variable frequency control of synchronous motor drives, self controlled synchronous motor drives.

Electric Traction: Definition and features of traction, Classification of traction systems, Types and choice of track electrification systems, Review of characteristics and suitability of traction motors. Transmission of drive and auxiliary equipment, Loco wheel arrangement and riding qualities, Train lighting system.

Control of Traction Motors: Speed time curves and speed distance curves, Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion, control of traction motors, rheostatic control, series parallel control, drum controllers, constant current systems, multiple unit control, thyristor and feedback controls. Magnetic levitation suspension systems.

Text Books:
1. Fundamentals of Electrical Drives by GK Dubey
2. Power Electronics: Circuits, Systems and Applications by MH Rashid
3. A First Course on Electric Drives by SK Pillai
4. Utilisation of Electrical Energy by E. Open Shaw Taylor and VVL Rao

Reference Books:
1. Electrical Drives and Traction by N. Prema Kumar
2. Electrical Drives by Vedam Subramanyam
3. Modern Elecric Traction by H. Partab

**EEE 3205 (b) : UTILIZATION OF ELECTRICAL ENERGY (UEE)**

**No. of Credits : 4**
**No. of Periods/ Week : 4**
**Internal Examination - Max. Marks : 30**
**External Examination - Max. Marks : 70**
**Total Marks : 100**

**UNIT—I**

**Electric Heating & Welding:** Electric Heating: Advantages and methods of electric heating, resistance heating induction heating and dielectric heating. Electric welding: resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

**UNIT — II**

**Illumination:** Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps — comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

**UNIT-III**

**Electrical Circuits used in Refrigeration** Air Conditioning and Water Coolers: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants Description of Electrical circuit used in refrigerator, air conditioner, Lift wiring and Automobile wiring.

**UNIT-IV**

**Electrolytic Processes:**

Need of electro-deposition, Laws of electrolysis, process of electrodeposition – clearing, operation, deposition of metals, polishing, buffing, Equipment and accessories for electroplating, Factors affecting electrodeposition, Principle of galvanizing and its applications, Principle of anodising and its applications, Electroplating on non-conducting materials, Manufacture of chemicals by electrolytic process and electrolysis process

**UNIT V**

**ELECTRICAL SAFETY, WIRING & INTRODUCTION TO POWER SYSTEM**

Safety measures in electrical system- types of wiring- wiring accessories-
staircase, fluorescent lamps & corridor wiring- Basic principles of earthing-Types of earthing- Simple layout of generation, transmission & distribution of power.

**Text Books:**

1. C.L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', New Age International Pvt. Ltd, 2003.
2. B.R. Gupta, 'Generation of Electrical Energy', Eurasia Publishing House (P) Ltd, New Delhi, 2003.

**Reference Books:**

1. H. Partab, 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Co, New Delhi, 2004.
2. E. Openshaw Taylor, 'Utilization of Electrical Energy in SI Units', Orient Longman Pvt. Ltd, 2003
3. Dash.S.S, Subramani.C,Vijayakumar.K,"BasicElectrical Engineering", First edition, Vijay Nicole Imprints Pvt.Ltd,2013

**EEE 3206 (a) : NON CONVENTIONAL ENERGY SOURCES**

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | : **100** |

**Energy Sources:** Classification, Indian energy scenario, prediction regarding fossil fuels, generation of non conventional and renewable energy resources, Description of renewable energy sources, Achievements of renewable energy in India, Use of renewable energy in agriculture in India.

**Solar Energy:** Environmental impact of solar power, principles of solar radiation, solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surfaces, solar radiation data, instruments for measuring solar radiation, sun shine.

**Solar Energy Collectors:** Principles of solar energy conversion, Flat plate and Concentrating type collectors, energy balance and collector efficiency, solar thermal plants, thermal energy storage for solar heating and cooling, limitations and applications.

**Photovoltaic Technology:** Present status, solar cells, cell technology, characteristics of PV systems, equivalent circuit, array design, Integrated PV systems, components, sizing and economics, peak power operation, MPPT, Standalone and grid integrated systems.

**Wind Energy:** Wind power sources, wind characteristics, site selection, criterion, momentum theory, Components of wind energy systems, performance and limitations, classification of wind energy collectors, aerodynamic forces acting on blades, applications and environmental impacts.

**Nonconventional Energy:** Detailed description of nonconventional energy sources of bio energy, chemical energy, MHD, geothermal energy, ocean energy systems, General features, Basic principles of operation, classification, applications and environmental impacts.

**Renewable Energy Generation in Power Systems:** Distributed Generation, Renewable energy penetration, Point of common coupling (PCC), Connection voltage, Voltage Effects, Steady state voltage rise, Thermal Limits, Other Embedded Generation Issues, Islanding.

**Text Books:**

1. Non Conventional Energy Sources by GD Rai, Khanna Publishers.
2. Renewable Energy in Power Systems by Leon Freris and David Infield, John Wiley & Sons, Ltd.

**Reference Books:**

1. Advanced renewable energy systems; Part 1 by S. C. Bhatia, Woodhead Publishing India Pvt Ltd.
2. Renewable Energy Sources and Methods by Anne Maczulak, Green technology info print publication.
3. Internet resources

# EEE 3207: MOOCS – II

**No. of Credits: 2**
**Total Marks**: **100**

## List of Courses:

1. **Planning For Sustainable Development**
2. **Infrastructure Systems Planning**
3. **Materials In Electrical Systems**
4. **Mechatronics**
5. **Probability And Statistics**
6. **Computer Aided Analysis And Design**

# EEE 3208: CONTROL SYSTEMS LAB

| | |
|---|---|
| **No. of Credits** | **: 2** |
| **No. of Periods/ Week** | **: 3** |
| **Internal Examination - Max. Marks** | **: 50** |
| **External Examination - Max. Marks** | **: 50** |
| **Total Marks** | **: 100** |

## List of Experiments

1. D C SERVO MOTOR SPEED TORUQE CHARACTERISTICS
2. P I D CONTROLLER
3. MAGNETIC AMPLIFIER
4. SYNCHRO TRANSMITTER – RECEIVER PAIR
5. STUDY OF POTENTIOMETER
6. MICROPROCESSOR BASED STEPPER – MOTOR CONTROLLER
7. ON/OFF TEMPERATURE CONTROLLER
8. LINEAR SYSTEM SIMULATOR
9. D C POSITION CONTROL SYSTEM
10. ANALOG AND DIGITAL SERVO MOTOR
11. A C SERVO MOTOR SPEED TORQUE CHARACTERISTICS
12. LEAD-LAG COMPENSATING NETWORK
13. ARMATURE CONTROL OF D C SERVO MOTOR
14. FIELD CONTROL DC SERVO MOTOR
15. CLOSED LOOP FEEDBACK CONTROL SYSTEM
16. LINEAR VOLTAGE DIFFERENTIAL TRANSFORMER
17. MOCROPROCESSOR BASED P I D CONTROLLER
18. TRANSDUCER TRAINER
19. MAGNETIC LEVITATION SYSTEM
20. TWIN ROTOR MIMO SYSTEM TRAINER
21. INVERTED PENDULUM CONTROL SYSTEM
22. GIMBAL STABILISATION SYSTEM TRAINER

# EEE 3209: POWER ELECTRONICS LAB

| | |
|---|---|
| **No. of Credits** | **: 2** |
| **No. of Periods/ Week** | **: 3** |
| **Internal Examination - Max. Marks** | **: 50** |
| **External Examination - Max. Marks** | **: 50** |
| **Total Marks** | **: 100** |

## LIST OF EXPERIMENTS

1) STUDY AND DESIGN OF VALVE FIRING CIRCUITS
2) DESIGN OF R,RC FIRING CIRCUITS FOR SCR
3) SINGLE PHASE HALF CONTROLLED BRIDGE RECTIFIER WITH R, RL, RLE LOADS
4) SINGLE PHASE FULL CONTROLLED BRIDGE RECTIFIER WITH R, RL, RLE LOADS
5) SINGLE PHASE DUAL CONVERTER CIRCUIT
6) SINGLE PHASE CYCLOCONVERTER CIRCUIT
7) DC JONES CHOPPER
8) SINGLE PHASE SERIES INVERTER
9) SINGLE PHASE PARALLEL INVERTER
10) SINGLE PHASE AC CONTROLLER USING TRIAC
11) DESIGN OF COMMUTATION CIRCUITS FOR SCR'S

# EEE 3210: MICROPROCESSORS AND MICROCONTROLLERS LAB

| | |
|---|---|
| **No. of Credits** | **: 2** |
| **No. of Periods/ Week** | **: 3** |
| **Internal Examination - Max. Marks** | **: 50** |
| **External Examination - Max. Marks** | **: 50** |
| **Total Marks** | **: 100** |

## EEE 4101: POWER SYSTEM ANALYSIS & STABILITY

| | |
|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**UNIT –I**

**Per Unit Representation & Topology** Per Unit Quantities–Single line diagram– Impedance diagram of a power system – Graph theory definition – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Y– bus matrix by singular transformation and direct inspection methods.

**UNIT –II**

**Power Flow Studies**: Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) –Decoupled and Fast Decoupled methods

**UNIT –III**

**Symmetrical Fault Analysis**: Formation of Z–Bus: Partial network– Algorithm for the Modification of Zbus Matrix for addition element for the following cases: Addition of element from a new bus to reference– Addition of element from a new bus to an old bus– Addition of element between an old bus to reference and Addition of element between two old busses (Derivations and Numerical Problems).– Modification of Z–Bus for the changes in network (Problems). 3–Phase short circuit currents and reactances of synchronous machine–Short circuit MVA calculations.

**UNIT –IV**

**Symmetrical Components**: Synthesis of unsymmetrical phasor from their symmetrical components– Symmetrical components of unsymmetrical phasor–Phase – shift of symmetrical components in Y–Δ–Power in terms of symmetrical components – Sequence networks – Positive, negative and zero sequence networks

**UNIT –IV**

**Unsymmetrical Faults:** Various types of faults LG– LL– LLG and LLL on unloaded alternator– unsymmetrical faults on power system.

**UNIT – VI**

**Power System Stability Analysis**: Elementary concepts of Steady state– Dynamic and Transient Stabilities– Description of Steady State Stability Power Limit–Transfer Reactance Synchronizing Power Coefficient –Power Angle Curve and Determination of Steady State Stability –Derivation of Swing Equation–Determination of Transient Stability by Equal Area Criterion–Application of Equal Area Criterion–Methods to improve steady state and transient stability.

**Text Books:**


1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Modern Power system Analysis – by I.J.Nagrath & D.P.Kothari: Tata Mc Graw–Hill Publishing Company, 2nd edition.

## EEE 4102: POWER SYSTEM PROTECTION

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| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**Introduction to protection scheme**: Need for Protective systems - Nature and causes of Faults - Types of faults - Effect of faults - fault statistics - Evolution of protective relays - Zones of protection - Primary and Back -up Protection - Essential qualities of Protection -Classification of Protective schemes -Automatic reclosing - current transformer for Protection - potential transformer - basic relay terminology.

**Relays**: General considerations - sensing of faults - construction of electro-magnetic attraction and induction types relays - Buchholz and negative sequence relay -concept of reset, pick up, inverse time and definite time characteristics, over current, over voltage, directional, differential and distance relays on R-X diagram - Static Relays: Introduction, advantage and limitation of static relays, static over current, directional, distance and differential relays. Electronic relays - static relays functional circuits: comparators, level detectors, logic and training circuits, microprocessor and computer based protection schemes.

**Protection:** Types & detection of faults and their effects, alternator protection scheme - Power transformer protection , generator-transformer unit protection scheme, bus bar protection - Transmission line protection, Pilot relaying schemes, power line carrier protection.

**Switchgear:** Theory of current interruption- energy balance and recovery rate theory, arc quenching, recovery and restriking voltages - Types of circuit breakers - Rating selection and testing of circuit breakers/operating mechanisms - LT switchgear, HRC fuses, types construction and applications.

**Text Books:**


1. Badriram & Vishwakarma, “Power System Protection”, Tata McGraw-Hill Education, 2011.
2. Paithankar Y. G., S. R. Bhide., “Fundamentals of power system protection”, PHI Learning Pvt. Ltd., 2004.


**Reference Books:**


1. Ravindra Nath.B, and Chandar.M, “Power systems protection and switchgear”, New age international (P) Ltd. 2005.

2. Rao Sunil.S, “Switchgear and protection”. Khanna Publishers, 1999. 3. Paithankar.Y.G,” Transmission Network Protection: Theory and Practice”, Marcel Deicker, Inc.1998.

# EEE 4103: ENGINEERING ECONOMICS

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**Introduction to Managerial Economics** – Wealth, Welfare and Scarce Definitions of Economics; Micro and Macro Economics; Demand- Law of Demand, Elasticity of Demand, types of elasticity and Factors determining price elasticity of Demand: Utility- Law of Diminishing Marginal Utility and its limitations.

**Conditions of Different Market Structures**– Perfect Competition, Monopolistic Competition, **Monopoly**, Oligopoly and Duopoly**.**

**Forms of Business Organizations**- Sole Proprietorship, Partnership, Joint Stock Company- Private limited and public limited companies, Public enterprises and their types.

**Introduction to Management**: Functions of Management -Taylor's Scientific Management; Henry Fayol's Principles of Management; **Human Resource Management–** Basic functions of H R Manager; Man Power Planning, Recruitment, Selection, Training, Development, Placement, Compensation and Performance Appraisal (in brief).

**Production Management –** Production Planning and Control, Plant Location, Break – Even Analysis, assumptions and applications.

**Financial Management** – Types of Capital: Fixed and Working Capital and Methods of Raising Finance; Depreciation: Straight Line and Diminishing Balance Methods. **Marketing Management** - Functions of Marketing and Distribution Channels.

**Entrepreneurship** - Entrepreneurial Functions, Entrepreneurial Development: Objectives, Training, Benefits; Phases of Installing a Project.

**Text Books:**


1. K.K. DEWETT, **Modern Economic Theory**, S. Chand and Company, New Delhi.-55.
2. S. C. Sharma and Banga T. R., **Industrial Organization & Engineering Economics,** Khanna Publications, Delhi -6.


**Reference Books:**


1. A.R. Aryasri, **Management Science**, Tata Mc Graw- Hill, New Delhi – 20.
2. A.R. Aryasri ,Managerial Economics and Financial Analysis, Tata Mc Graw- Hill, New Delhi – 20.

## EEE 4104: POWER SYSTEM OPERATION AND CONTROL

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| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**Optimal System Operation:** Characteristics of various steam units, combined cycle plants, cogeneration plants, Hydro-electric units, Steam units economic dispatch problem with and without considering losses and solution using Legrange multiplier method only, **Hydro-Thermal Coordination:** Hydro-electric plant models, Scheduling energy, Short-term hydrothermal scheduling.

**Unit Commitment:** Constraints in unit commitment, Generation of state, optimizing the states using Priority-list method, Unit commitment problem solution using Priority-list method and Dynamic Programming; **Optimal Power Flow:** Optimal power flow problem formulation for loss and cost minimisation, Solution of optimal power flow problem using Newton's method and Linear Programming technique.

**Automatic Generation Control:** Control System structure, Automatic Load–frequency control of single area system with and without control, Steady state and dynamic responses of single area ALFC loop, Automatic Load-frequency control of two area system, Tie-line bias control of two area and multi-area system, **Voltage Control:** Automatic voltage regulator, Exciter types, Exciter modelling, Generator modelling, Static and Dynamic response of AVR loop.

**Power System Security:** Introduction, Factors affecting the power system security, Contingency analysis procedure, Linear sensitivity factors: Line outage distribution factors and Generation shift factors, and its derivation; AC power flow method, contingency selection.

**State Estimation:** Weighted Least Square State Estimation, Basic concepts about network observability, Pseudo-measurements, Bad data detection and identification.

**Text Books:**


1. Power Generation, Operation and Control, Allen J. Wood and Bruce F. Wollenberg, John Wiley & Sons, Inc., New York, 2nd edition, 1996.
2. Electric Energy Systems Theory: An Introduction, Olle I. Elgerd, TMH Publishing Company Ltd., New Delhi, 2nd edition, 1983.

# EEE 4105 (b): ADVANCED CONTROL SYSTEMS

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|---|---|
| **No. of Credits** | **: 4** |
| **No. of Periods/ Week** | **: 4** |
| **Internal Examination - Max. Marks** | **: 30** |
| **External Examination - Max. Marks** | **: 70** |
| **Total Marks** | **: 100** |

**UNIT I ::** Control Systems Components: DC & AC Tachometers-Synchros, AC AND DC Servo Motors - Stepper Motors and its use in Control Systems, Amplidyne Metadyne - Magnetic Amplifier – Principle, Operation and Characteristics Ward - Leonard Systems.

**UNIT II ::** State Variable Analysis: concept of State Variables & State Models, State model for Linear Continuous Time Systems, State-Space Representation Using Physical Variables, State-Space Representation Using Phase Variables.

**UNIT III ::** Diagonalization, Jordan Canonical Form, Solution Of State Equations, Properties Of State Transition Matrix, Computation Of State-Transition Matrix (Using Laplace Transformation, Cayley-Hamilton Theorem).

**UNIT IV::** Concept of Controllability & Observability, Controllable Companion Form, Observable Companion Form (For Siso And Mimo Systems), Pole Placement By State Feedback.

**UNIT V::** Introduction to Design: Introduction-Preliminary Considerations of Classical Design - Lead Compensation, Lag Compensation, Realization of Compensating Networks, Cascade Compensation In Time Domain And Frequency Domain (Root Locus And Bode Plot Techniques).

**Text Books::**

(1) Control Systems Engineering, Ij Nagrath, M.Gopal, New Age International Publishers.

(2) Modern Control System Theory, M. Gopal, New Age International Publishers.

# EEE4106 (a): OPERATIONS RESEARCH

**No. of Credits** : 4

**No. of Periods/ Week** : 4

**Internal Examination - Max. Marks** : 30

**External Examination - Max. Marks** : 70

**Total Marks** : 100

**Introduction to Optimization**: Engineering Applications of Optimization, Statement of Problem, Classification of Optimization Problem Techniques.

**Linear Programming :** Introduction, Requirements For a LP Problem, Examples on The Application of LP, Graphical Solution of 2-Variable LP Problems, Some Exceptional Cases, General Mathematical Formulation For LPP, Canonical And Standard Forms of LP Problem, Simplex Method, Examples on The Application of Simplex Techniques.

**Artificial Variable Techniques:** Big-M Method and Two Phase Techniques.

**Transportation Problem:** Matrix Terminology, Definition and Mathematical Representation of Transportation Model, Formulation and Solution of Transportation Models (Basic Feasible Solution by North-West Corner Method, Inspection Method. Vogell's Approximation Method).

**Assignment Problem:** Matrix Terminology, Definition of Assignment Model, Comparison With Transportation Model, Mathematical Representation of Assignment Model, Formulation And Solution of Assignment Models.

**Pert Network:** Introduction, Phases of Project Scheduling, Network Logic, Numbering the Events (Fulkerson's Rule), Measure of Activity. **Pert Network Computations:** Forward Pass And Backward Pass Computations, Slack Critical Path, Probability of Meeting the Scheduled Dates.

**Inventory Models:** Introduction, Necessity For Maintaining Inventory, Classification of Inventory Models, Inventory Models With Deterministic Demand, Demand Rate Uniform Production Rate Infinite, Demand Rate Non-Uniform Production Rate Finite, Demand Rate Uniform-Production Rate Finite.

**Game Theory:** Useful Terminology, Rules For Game Theory, Saddle Point, Pure Strategy, Reduce Game By Dominance, Mixed Strategies, 2x2 Games Without Saddle Point.

**TEXT BOOKS:**

1. "Operations Research-An Introduction' By H.Taha, Prentice Hall Of India Pvt. Ltd.

2. "Engineering Optimization-Theory & Practice" By S.S. Rao, New Age International (P) Ltd.

3. "Operations Research – An Introduction" By P.K.Gupta & D.S.Hira, S. Chand & Co. Ltd.

# EEE 4107: POWER SYSTEM SIMULATION LAB

**No. of Credits : 2**
**No. of Periods/ Week : 3**
**Internal Examination - Max. Marks : 50**
**External Examination - Max. Marks : 50**
**Total Marks : 100**

**1.**Formation of Y-Bus Matrix By Using singular transmission method for the given single line diagram

| Bus | Impedance | Line charge admittance |
|---|---|---|
| **1-2** | **0.2+0.8J** | **0.02J** |
| **2-3** | **0.3+0.9J** | **0.03J** |
| **2-4** | **0.25+1J** | **0.04J** |
| **3-4** | **0.2+0.8J** | **0.02J** |
| **1-3** | **0.1+0.4J** | **0.01J** |

2.A Transmission line has a Impedance of **1.25+66j** & Admittance of **400-4j** with a terminal voltage of **220kv** find Surge impedance loading?

3.To find the Dynamic response of the given load frequency control problem theoritically and plot &verify the result in Simulink

The parameters for the Load frequency Control of Single Area are

speed governor gain $K_g$**=10**

time constant of speed governor $T_g$**=0.4**

speed regulation of speed governor $R = 3$

gain of turbine $K_t$**=0.1**

time constant of turbine $T_t$**=0.5**

gain of power system $K_P$**=100**

change in load $\Delta_{pd}$**=0.01pu**

intigral controller gain $K_i$**=0.09**

**4.** To find parameters of a given transmission line using nominal-pi method &verify using mat lab A **50hz** transmission line **300km** long as a total series impedance of **40+125j**&total shunt admittance of **1000 mho** the receiving end load is **50mw** at **220kv** with **0.8 lagging** pf finding the sending end voltage ,current, power &power factor using nominal $\boldsymbol{\pi}$ method

5. To find the dynamic response of the given two area frequency control problem theoretically and plot &verify the result in simulink

the parameters for the load frequency control of two area are

speed governor gain $\boldsymbol{K_g}$**=10**

time constant of speed **governor** $\boldsymbol{T_g}$**=0.4**

speed regulation of speed governor $\boldsymbol{R = 3}$

gain of **turbine** $\boldsymbol{K_t}$**=0.1**

time constant of turbine $\boldsymbol{T_t}$**=0.5**

gain of power system $\boldsymbol{K_P}$**=100**

time constant of power system $\boldsymbol{T_{ps}}$**=10**

proportional plus intigral gain $\boldsymbol{K_i}$**=0.07**

synchronizing coefficient $\boldsymbol{T_r}$**=0.05**

frequency bias **0.425sec**

6.To find parameters of a given transmission line using nominal-t method &verify using mat lab a **50hz** transmission line **300km** long as a total series impedance of 40+125j&total shunt admitence of **1000 mho** the receiving end load is 50mw at 220kv with **0.8 lagging** pf finding the sending end voltage ,current, power &power factor using **Nominal T–method**

7. To find **Ferranti effect** of a **500km** transmission line &to plot the locus of the voltage for a given problem &verify result in mat lab

A three phase transmission line is 500km long line parameters are **R=0.125 ohm/meter**,**x=0.4 ohm** and **y=2.8*10$^{-6}$ mho/km** if the line is open circulated with a receiving end voltage of **220kv** find the rms value and phase angle of the following use the receiving end line to neutral voltage as reference

(a)the incident and reflected voltage to neutral

(b) the incident and reflected voltage to neutral at **200km** from the receiving end

(c)the resultant voltage at 200km from the receiving end

Solve problem theoretically vary the length of the long transmission line in steps of 10km from zero to 500km and plot of the sending end phasor using mat lab

8. Drawn a Root locus of G(S)= $\frac{\boldsymbol{K}}{\boldsymbol{S(S+1)(S+2)(S+3)}}$

9.Drawn a bode plot of **G(S)=** $\frac{\boldsymbol{80}}{\boldsymbol{(S+1)(S+2)(S+20)}}$

10. Drawn a step Response, time domain &frequency domain parameters of **G(S) =** $\frac{\boldsymbol{2}}{\boldsymbol{(S+1)(S+2)}}$

# EEE 4108: POWER SYSTEM PROTECTION LAB

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|---|---|
| **No. of Credits** | **: 2** |
| **No. of Periods/ Week** | **: 3** |
| **Internal Examination - Max. Marks** | **: 50** |
| **External Examination - Max. Marks** | **: 50** |
| **Total Marks** | **: 100** |

LIST OF EXPERIMENTS:

1) Determination of A, B, C, D parameters of a Medium Transmission line model.
2) Determination of A, B, C, D parameters of a Short Transmission line model.
3) Determination of A, B, C, D parameters of a long Transmission line model.
4) Determination of Ferranti effect for a Short Transmission line under no load condition. Also calculate the line performance with R, L & C loads.
5) Determine the Time-Current Characteristics of a Fuse.
6) Determine the Time-Current Characteristics of an MCB.
7) Familiarization of different types of fuses.
8) Familiarization of different types of Insulators.
9) Familiarization of different types of circuit breakers.
10) Study the performance of Long Transmission lines.