

**B. Tech. (Electrical and Electronics Engineering)**  
**Semester III (Second Year)**

| Code       |             | Category | Course Title                                | Hours/Week |   |    | Total | Credits | Marks |     |       |
|------------|-------------|----------|---------------------------------------------|------------|---|----|-------|---------|-------|-----|-------|
| Department | University  |          |                                             | L          | T | P  |       |         | CIE   | SEE | Total |
| EE3301C    | 7-3-3-01R25 | MA-BS    | Complex Variables, Probability & Statistics | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3302C    | 7-3-3-02R25 | EE-ES    | Electro Magnetic Fields                     | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3303C    | 7-3-3-03R25 | EE-PC    | Network Analysis                            | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3304C    | 7-3-3-04R25 | EE-PC    | Electrical Machines-I                       | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3305C    | 7-3-3-05R25 | EC-PC    | Analog Electronics                          | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3306L    | 7-3-3-R25P1 | EE-PC    | Electrical Circuits and Simulation Lab      | 0          | 0 | 3  | 3     | 1.5     | 40    | 60  | 100   |
| EE3307L    | 7-3-3-R25P2 | EE-PC    | Electrical Machines-I Lab                   | 0          | 0 | 3  | 3     | 1.5     | 40    | 60  | 100   |
| EE3308S    | 7-3-3-R25S1 | EE-SC    | MATLAB                                      | 1          | 0 | 2  | 3     | 2       | 40    | 60  | 100   |
| EE3309M    | 7-0-3-R25M1 | CE-MC    | Environmental Science                       | 2          | 0 | 0  | 2     | 0       | 100   | 0   | 100   |
|            |             |          |                                             | 18         | 0 | 08 | 26    | 20      | 420   | 480 | 900   |

All interested students are advised to **register for Minors degree or Honors degree** at the end of this semester by submitting filled in registration form available from the Head of the Department /Chair person, Board of Studies (UG) of the parent department.

  
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**COMPLEX VARIABLES, PROBABILITY & STATISTICS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 3-0-0 | 7-3-3-01R25 | EE, EC   |

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

1. Understand the analyticity of complex functions and apply Cauchy's integral formula and Cauchy's integral theorem to evaluate improper integrals along contours.
2. Compute the residue of a function and use the Residue Theory to evaluate a contour integral or an integral over the real line.
3. Identify linear and Nonlinear PDE by different methods and apply Variables separable methods to solve boundary value problems and find the solution of one-dimensional wave equation, heat equation and Laplace equation.
4. Apply the concepts of probability and Evaluate discrete and continuous probability distributions.
5. Understand different types of distributions and their properties.

**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: Sequences, series, convergence tests, -Taylor's and Laurent's series - Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluation of real integrals.

**UNIT-III**

Partial differential equations - First order linear partial differential equations – Lagrange's linear equation- first order non-linear partial differential equations by Charpit's method - Method of separation of variables - One dimensional wave equation - Heat equation – Laplace's equation.

**UNIT-IV**

Probability- Introduction- axiomatic approach, - combinatorial probability -joint and conditional probability- Baye's theorem - stochastic process - Random variables - Discrete and Continuous distributions – expectation – variance.

**UNIT-V**

Probability distributions: Binomial distribution-Poisson distribution- exponential distribution-normal distribution.



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**Text Books:**

1. Grewal B S, Higher Engineering Mathematics, 42th Edition, Khanna Publications, 2007.
2. Mathematics-III by T.K.V.Iyenger, B. Krishna Gandhi et al, S. Chand & Company Ltd
3. Mathematical Methods by T.K.V.Iyenger, B. Krishna Gandhi et al, S. Chand & Company Ltd
4. T. K. V. Iyengar et al, Probability and Statistics 2nd Edition, S. Chand & Company Ltd, 2010
5. S P Gupta, Statistical Methods, 38th Edition, Sultan S. Chand & Sons Educational Publishers, 2009

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| COs \<br>POs/PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1               | 3   | 2   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | 1    | 2    | –    |
| CO2               | 3   | 3   | –   | 1   | 1   | –   | –   | –   | –   | –    | –    | 1    | 2    | –    |
| CO3               | 3   | 2   | 1   | 2   | 1   | –   | –   | –   | –   | –    | –    | 1    | 2    | 1    |
| CO4               | 3   | 3   | –   | 2   | 1   | –   | –   | –   | –   | –    | –    | 2    | 3    | –    |
| CO5               | 3   | 2   | 1   | 2   | 1   | –   | –   | –   | –   | –    | –    | 2    | 3    | 1    |



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**ELECTRO MAGNETIC FIELDS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 3-0-0 | 7-3-3-02R25 | EE       |

**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.



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**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.

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| COs \<br>POs / PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1                 | 3   | 2   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | 1    | 2    | –    |
| CO2                 | 3   | 3   | 1   | 2   | 1   | –   | –   | –   | –   | –    | –    | 1    | 3    | 1    |
| CO3                 | 3   | 3   | 1   | 2   | 1   | –   | –   | –   | –   | –    | –    | 1    | 3    | 1    |
| CO4                 | 3   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |



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**NETWORK ANALYSIS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 3-0-0 | 7-3-3-03R25 | EE       |

**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. Determine transient responses of RL, RC, and RLC circuits using time-domain and Laplace techniques.
3. Evaluate network functions and analyze systems using poles and zeros.
4. Analyze two-port networks using various two-port network parameters.
5. Apply basic network synthesis techniques to realize RL, RC, and LC Networks.

**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 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 – 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.

**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.



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**Text Books:**

1. Sudhakar and Shyammohan, Circuits and Networks: Analysis and Synthesis, 5<sup>th</sup> 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.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| COs \<br>POs/PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b>        | 3   | 3   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | 1    | 3    | 2    |
| <b>CO2</b>        | 3   | 3   | –   | 2   | 1   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| <b>CO3</b>        | 3   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| <b>CO4</b>        | 3   | 3   | 2   | –   | 2   | –   | –   | –   | –   | –    | –    | 1    | 3    | 3    |
| <b>CO5</b>        | 3   | 2   | 3   | –   | 2   | –   | –   | –   | –   | –    | 1    | 2    | 3    | 3    |



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**ELECTRICAL MACHINES - I****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 3-0-0 | 7-3-3-04R25 | EE       |

**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, Vector groups, Phase conversions - Scott connection, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Parallel operation of transformers.



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**Text Books:**

1. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5<sup>th</sup> edition, 2017.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 7th edition, 2011.

**References Books:**

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 7<sup>th</sup> edition, 2014.
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. S. Chand Publication, Twenty Fourth edition, 2025.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| COs \ POs/PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1            | 3   | 2   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | 1    | 3    | 2    |
| CO2            | 3   | 3   | 1   | 2   | 1   | –   | –   | –   | –   | –    | –    | 1    | 3    | 2    |
| CO3            | 3   | 3   | 2   | 2   | 1   | –   | –   | –   | –   | –    | –    | 1    | 3    | 3    |
| CO4            | 3   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 1    | 3    | 2    |



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**ANALOG ELECTRONICS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 3-0-0 | 7-3-3-05R25 | EE       |

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

1. Analyze diode circuits and BJT amplifiers.
2. Explain MOSFET characteristics and MOSFET amplifiers.
3. Design and analyze multistage and power amplifiers.
4. Evaluate feedback amplifiers and their performance.
5. Explain oscillators and op-amp based waveform generators.

**UNIT-I**

**DIODE AND BJT CIRCUITS:** Review of half-wave and full-wave rectifiers, clamping and clipping circuits. BJT 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.

**UNIT-V**

**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.

**OPERATIONAL AMPLIFIERS:** Inverting and non-inverting amplifier, Square-wave and triangular wave generators.



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**Text Books:**

1. Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill Education, 2<sup>nd</sup> 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.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| COs \<br>POs/PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1               | 3   | 3   | 1   | 2   | 2   | –   | –   | –   | –   | –    | –    | 1    | 3    | 3    |
| CO2               | 3   | 3   | 1   | 2   | 2   | –   | –   | –   | –   | –    | –    | 1    | 3    | 3    |
| CO3               | 3   | 2   | 3   | 2   | 2   | –   | –   | –   | –   | –    | –    | 1    | 3    | 3    |
| CO4               | 3   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 1    | 3    | 3    |
| CO5               | 3   | 2   | 2   | 1   | 2   | –   | –   | –   | –   | –    | –    | 1    | 3    | 3    |



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**ELECTRICAL CIRCUITS AND SIMULATION LAB****Credits: 1.5****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 0-0-3 | 7-3-3-R25P1 | EE       |

**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 analyze the resonance conditions.
4. Evaluate the two-port network parameters.

**LIST OF EXPERIMENTS:**

1. Verification of Kirchhoff's Laws
2. Measurement of Inductance.
3. Verification of the Reciprocity Theorem
4. Verification of Thevenin's and Norton's Theorems
5. Current Locus Diagrams of RL and RC Series Circuits
6. Verification of the Maximum Power Transfer Theorem
7. Determination of Two-Port Network Parameters for T-Network
8. Determination of Two- Port Network Parameters for  $\pi$  (Pi) Network
9. Simulation of DC Transient Response in RL, RC, and RLC series Circuits using PSPICE software.
10. Study of Series Resonance in a series RLC Circuit using MATLAB software
11. Study of Parallel Resonance in a parallel RLC Circuit using MATLAB software

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| COs \ POs/PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1            | 3   | 3   | –   | 3   | 3   | –   | –   | –   | 2   | 2    | –    | 1    | 3    | 2    |
| CO2            | 3   | 3   | –   | 3   | 3   | –   | –   | –   | 2   | 2    | –    | 1    | 3    | 2    |
| CO3            | 3   | 2   | 1   | 2   | 3   | –   | –   | –   | 2   | 2    | –    | 1    | 3    | 2    |
| CO4            | 3   | 3   | 1   | 2   | 3   | –   | –   | –   | 2   | 2    | –    | 1    | 3    | 2    |

  
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**ELECTRICAL MACHINES-I LAB****Credits: 1.5****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 0-0-3 | 7-3-3-R25P2 | EE       |

**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.

**LIST OF EXPERIMENTS:**

1. OC and SC Test on a Single-Phase Transformer.
2. Open Circuit Characteristics of a DC Generator
3. Load test on a Single-Phase Transformer.
4. Sumpner's Test
5. Field's Test
6. Scott Connection
7. Speed Control of DC Shunt Motor
8. Load test on DC Shunt Generator
9. Brake test on DC Shunt Motor
10. Swinburne's Test

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| COs \ POs/PSOs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1            | 3   | 3   | –   | 3   | 3   | –   | –   | –   | 2   | 2    | –    | 1    | 3    | 2    |
| CO2            | 3   | 3   | 1   | 2   | 2   | –   | –   | –   | 2   | 2    | –    | 1    | 3    | 2    |
| CO3            | 3   | 2   | 2   | 2   | 2   | –   | –   | –   | 2   | 2    | –    | 1    | 3    | 3    |

  
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**MATLAB****Credits: 2****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 1-0-2 | 7-3-3-R25S1 | EE       |

**Course Outcomes:** At the end of the course, the student will be able to :

1. Learn and use the MATLAB environment and programming fundamentals.
2. Write programs using MATLAB commands and built-in functions.
3. Solve engineering problems using MATLAB and generate plots.
4. Create effective plots and graphical representations.

**LIST OF EXPERIMENTS**

1. Matrix operation and Various functions.
2. Solutions of linear equations and Factorial of a number.
3. Geometric progression and Convolution of two signals.
4. Draw a circle and Different type of plots.
5. Different types of waveforms with and without switch case.
6. Integral and Differentiation of a polynomial.
7. Largest & Smallest and Ascending & Descending order.
8. Date & Calendar and given input year is leap year or not
9. Displaying multiplication table and Factorial of a given number.
10. Students and Employee details

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | –   | –   | 3   | –   | –   | –   | –   | –    | –    | 2    | 2    | 1    |
| CO2         | 3   | 3   | 2   | 2   | 3   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO3         | 3   | 3   | 3   | 3   | 3   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO4         | 2   | 2   | 2   | 2   | 3   | –   | –   | –   | –   | 1    | –    | 2    | 2    | 3    |

  
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**ENVIRONMENTAL SCIENCE****Credits: 0****Assessment: 100 + 0**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| III      | 2-0-0 | 7-0-3-R25M1 | EE       |

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

1. Acquire knowledge in diverse components of environment and natural resources.
2. Understand ecosystem and biodiversity and its conservation methods.
3. Identify and resolve the issues related to sources of different types of pollution and its global effects
4. Provide solutions to individuals, industries and government for sustainable development of natural resources
5. Apply environmental ethics in resolving social issues for protection of diversified ecosystems.

**UNIT I****Environmental Studies and Natural Resources**

Definition, Scope and importance of Environment, Environmental studies, Need for public awareness

**Components of Environment-** Atmosphere, Hydrosphere, Lithosphere.

**Renewable and Non-Renewable Resources and associated problems**

Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.

Forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

Land resources: Land as a resource, land degradation, Man induced landslides, soil erosion and desertification.

Mineral resources: Use and overexploitation, Environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, Case studies.

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

Role of an individual in conservation of natural resources.



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## UNIT II

### **Ecosystem and Biodiversity**

**Ecosystem** - Concept of an ecosystem.

Structure and functions of an ecosystem.

Producers, consumers and decomposers.

Energy flow in the ecosystem.

Ecological succession.

Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystem.

(a) Forest ecosystem. (b) Grassland ecosystem

(c) Desert ecosystem. (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

### **Biodiversity and its conservation:**

Definition, genetic species and ecosystem diversity.

Biogeographically classification of India.

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

Biodiversity at global, National and local levels.

India as a mega-diversity nation.

Hot-spots of biodiversity.

Threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts.

Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

## UNIT – III

### **Environmental pollution and Global Effects**

Definition, Causes, Effects, and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Pollution case studies.

Disaster management: Floods, earthquakes, cyclone, landslides, Tsunami.

Climate change-Global warming, Acid rain, Ozone depletion.

## UNIT – IV

### **Environment Issues and Management**

Environment and Human health – Epidemic diseases, HIV/AIDS, Aviation Flue, Water Borne Diseases.

Environmental Impact Assessment, Sustainable Development, Clean Production and Clean Development Mechanisms



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Environment Legislation: Environmental Protection Act, Water Act, Air Act, Wild Life Protection Act, Forest Conservation Act, Public Liability & Insurance Act, Issues involved in Enforcement of Environmental legislation.

### UNIT – V

#### Social Issues and the Environment

Population growth, Population Explosion, Population Control, Women and Child welfare.

Urbanization, Industrialization, Development projects, Resettlement and Rehabilitation of people – Problems concerned, Case studies.

Consumerism and Waste Products Conservation, Public Awareness, Water Conservation, Rain water harvesting, watershed management, Wasteland reclamation, Human Rights, Value education, Environmental ethics- Issues and possible solution.

Role of information Technology in Environment and Human Health.

#### Text Books / Reference Books:

1. AnubhaKaushik& C P Kaushik, Environmental studies, New age International Publishers, 2008
2. Benny Joseph, Environmental studies, Tata McGraw-Hill Publishers, 2005
3. M Chandra Sekhar, Environmental Science, Hi-Tech Publishers, 2004
4. Keerthinarayana and Daniel Yesudian, Principles of Environmental Sciences and Engineering, Hi-Tech Publishers, 2005
5. AmalK.Datta, Introduction to Environmental Science and Engineering, Oxford & IBH Publishing Co.Pvt.Ltd, 2000
6. SanthoshkumarGarg,RajeshawriGarg and RajniGarg, Ecological and Environmental studies, Khanna publishers, 2006
7. Gilbert M, Introduction to Environmental Engineering and Science, Masters Publication by Prentice –Hall of India Private Ltd., 1991
8. William P Cunningham and Mary Ann Cunningham, Principles of Environmental Science, Tata McGraw Hill Publishing Co.Ltd, 2002

#### CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 2   | 2   | –   | –   | –   | 2   | 3   | –   | –   | –    | –    | 2    | –    | –    |
| CO2         | 2   | 3   | –   | 2   | –   | 2   | 3   | –   | –   | –    | –    | 2    | –    | –    |
| CO3         | 2   | 3   | 2   | 2   | –   | 3   | 3   | –   | –   | –    | –    | 2    | –    | –    |
| CO4         | 2   | 3   | 3   | 2   | –   | 3   | 3   | –   | –   | –    | –    | 2    | –    | –    |
| CO5         | 1   | 2   | 2   | –   | –   | 3   | 3   | 3   | 2   | 2    | –    | 2    | –    | –    |

  
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**B. Tech. (Electrical and Electronics Engineering)**  
**Semester IV (Second Year)**

| Code       |             | Category | Course Title                                   | Hours/Week |          |           | Total     | Credits   | Marks      |            |             |
|------------|-------------|----------|------------------------------------------------|------------|----------|-----------|-----------|-----------|------------|------------|-------------|
| Department | University  |          |                                                | L          | T        | P         |           |           | CIE        | SEE        | Total       |
| EE3401C    | 7-3-4-01R25 | EE-PC    | Power systems-I                                | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3402C    | 7-3-4-02R25 | EE-PC    | Electrical Machines-II                         | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3403C    | 7-0-3-01R25 | EN-HS    | Managerial Economics and Financial Accountancy | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3404C    | 7-3-4-04R25 | EC-PC    | Digital Electronics                            | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3405C    | 7-3-4-05R25 | EC-PC    | Signals and Systems                            | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3406L    | 7-3-4-R25P1 | EE-PC    | Electrical Machines-II Lab                     | 0          | 0        | 3         | 3         | 1.5       | 40         | 60         | 100         |
| EE3407L    | 7-3-4-R25P2 | EC-PC    | Analog and Digital Electronics Lab             | 0          | 0        | 3         | 3         | 1.5       | 40         | 60         | 100         |
| EE3408S    | 7-3-4-R25S1 | EE-SC    | Python Programming                             | 1          | 0        | 2         | 3         | 2         | 40         | 60         | 100         |
| EE3409M    | 7-0-3-R25M1 | EE-HS    | Constitution of India                          | 2          | 0        | 0         | 2         | 0         | 100        | 0          | 100         |
| EE3410C    | 7-0-4-R25M2 | EE-BS    | Elements of Quantum Computing                  | 2          | 0        | 0         | 2         | 2         | 100        | 0          | 100         |
| EE3411N    |             | EE-NG    | NCC / NSS / NSO Activities                     | 0          | 0        | 0         | 0         | 0         | 0          | 0          | 0           |
|            |             |          |                                                | <b>20</b>  | <b>0</b> | <b>08</b> | <b>28</b> | <b>22</b> | <b>520</b> | <b>480</b> | <b>1000</b> |

All students shall mandatorily register for NCC/NSO/NSS and complete 60 hours of activities beginning from the 1<sup>st</sup> semester but to be completed before 4<sup>th</sup> semester in one of these three options to earn **Non-graded (NG) Credits** as core requirement. Grade shall be awarded as Satisfactory or Unsatisfactory by the concerned HoD on the basis of participation, attendance, performance and behaviour. If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

All interested students shall **register for Minors degree or Honors degree** just before or at the time of commencement of this semester by submitting filled in registration form available from the Head of the Department /Chair person, Board of Studies (UG) of the parent department.

Students shall undergo **Community Service Project (CSP)** for a duration of **six to eight (6-8) weeks** during the summer vacation by completing **45 – 60** hours of work with at least **75%** attendance, to be evaluated and reflected in 5<sup>th</sup> semester.



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**POWER SYSTEMS-I****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 3-0-0 | 7-3-4-01R25 | EE       |

**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 – Depreciation methods.**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.

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**Text Books:**

1. C..L.Wadhwa, “Generation Distribution and utilization of Electrical energy” , New Age International publishers, 5th edition, 2017.
2. G. D. Rai, ‘Non-Conventional Energy Sources’, Khanna Publishers, New Delhi, 6th edition, 2018.
3. D P Kothari, I J Nagrath, “Modern Power System Analysis” Tata McGraw Hill Education Private Limited, 5th edition, 2022.
4. C..L.Wadhawa, “Electrical Power systems” New age publications, 8th edition, 2022.
5. V.K. Mehtha, Rohit Mehtha, “Principles of Power System”, S.CHand & Company Ltd, 2022.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | –   | –   | –   | 2   | 3   | –   | –   | –    | –    | 2    | 2    | 2    |
| CO2         | 2   | 3   | 1   | –   | –   | 2   | 2   | –   | –   | –    | 3    | 2    | 1    | 1    |
| CO3         | 3   | 3   | 3   | 2   | 2   | 2   | 2   | –   | –   | –    | 2    | 2    | 3    | 2    |



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**ELECTRICAL MACHINES – II****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 3-0-0 | 7-3-4-02R25 | EE       |

**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 methods 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, slip, effect of slip on rotor circuit, torque equations, relation between torques, torque slip characteristics, Rotor Power Input, Rotor Copper Loss and Mechanical Power Developed and their inter relationship, 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 field revolving 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, 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.

**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.



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**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.

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | –   | –   | –   | 1   | 1   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO2         | 3   | 3   | 2   | –   | 2   | 2   | 1   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO3         | 3   | 3   | 3   | 2   | 2   | 2   | 1   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO4         | 2   | 2   | 3   | 1   | –   | 2   | 2   | –   | 2   | 2    | 2    | 2    | 3    | 3    |



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**MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTANCY****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 3-0-0 | 7-0-3-01R25 | EE       |

**Course Outcomes:** After the completion of the course the student will be able to;

- CO1** Understand the concepts of financial management and smart investment.
- CO2** Identify various cost elements of the product and its effect on decision making.
- CO3** Understand Economic and regulatory environment of the business and its impact on enterprises.
- CO4** Prepare the Accounting records and interpret the data for Managerial Decisions.
- CO5** Identify various cost elements of the product and its effect on financial decision making.

**UNIT -I**

Managerial Economics: Definition, Characteristics and Scope – Basic economic tools in Managerial Economics. Managerial Economics and its relation with other subjects – Demand and Supply: Concept and Analysis – Time value of money, Cash flow and Time Diagrams – Choosing among alternative investment proposals: Methods of Economic analysis (Pay Back, ARR, NPV, IRR and B/C ratio)

**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 limitations.

**UNIT -III**

Types of Industrial Organization: Characteristics of Industrial organization, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, State/Public Enterprises and their types – The Business cycles and their relevance to decision making – Inflation: Definition, Process of inflation and measure of controlling inflation – New Economic Policy 1991 (Industrial Policy, Trade Policy, Fiscal Policy). It's Impact on Industry.

**UNIT -IV**

Accounting Principles, procedure, Double entry system, Journal, Ledger, Trial balance, Cashbook – Preparation of Trading account 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, its application and Limitation.



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**Text Books**

1. Gupta, G.S. (2018), Managerial Economics (2e), McGraw Hill Education (India) Pvt. Ltd., Chennai.
2. Dewett. K.K. (2006), Modern Economic Theory, Sultan Chand and Co., New Delhi.
3. Agarwal A.N. (2019), Indian Economy, New Age International Pvt. Ltd., New Delhi.
4. Jain and Narang (2011), Accounting Part-I, Kalyani Publishers, New Delhi.
5. Arora, M.N. (2012), Cost Accounting: Principles and Practice (12e), Vikas Publication, New Delhi.

**Reference Books**

1. Henry Malcom Steiner (1996), Engineering Economics Principles (2e), McGraw Hill Education.
2. Leland Blank and Anthony Tarquin (2012), Engineering Economy (7e), McGraw Hill, New York.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 1   | 2   | 2   | –   | –   | 2   | 1   | –   | –   | –    | 3    | 2    | –    | –    |
| CO2         | 1   | 3   | 2   | –   | –   | 2   | 1   | –   | –   | –    | 3    | 2    | –    | –    |
| CO3         | –   | 2   | 1   | –   | –   | 3   | 2   | 2   | –   | –    | 2    | 2    | –    | –    |
| CO4         | 1   | 3   | 2   | 2   | –   | 2   | –   | 1   | –   | 2    | 3    | 2    | –    | –    |
| CO5         | 1   | 3   | 2   | –   | –   | 2   | 1   | –   | –   | –    | 3    | 2    | –    | –    |



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**DIGITAL ELECTRONICS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 3-0-0 | 7-3-4-04R25 | EE       |

**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 logic 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 ICs, 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 ICs, 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, dual slope 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



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**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.

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | 2    | 2    | 1    |
| CO2         | 3   | 3   | 3   | 2   | 2   | –   | –   | –   | 1   | –    | –    | 2    | 3    | 2    |
| CO3         | 3   | 3   | 2   | 2   | 2   | 1   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO4         | 3   | 3   | 3   | 2   | 3   | 1   | –   | –   | 1   | 1    | –    | 2    | 3    | 3    |



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**SIGNALS AND SYSTEMS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 3-0-0 | 7-3-4-05R25 | EE       |

**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.



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**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. Anand Kumar, Signals & Systems, PHI, 2011.
2. Alan V. Oppenheim, Alan S. Willsky, & S. Hamid Nawab, "Signals and Systems," Pearson Higher Education, 2<sup>nd</sup> Ed., 1997.
3. Simon Haykin and B. Van Veen, "Signals & Systems," John Wiley and Sons, 2<sup>nd</sup> 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, 4<sup>th</sup> Edition, 2008.

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b>  | 3   | 3   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | 2    | 2    | 1    |
| <b>CO2</b>  | 3   | 3   | 2   | 2   | 1   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| <b>CO3</b>  | 3   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| <b>CO4</b>  | 3   | 3   | 3   | 2   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |
| <b>CO5</b>  | 3   | 3   | 3   | 2   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |



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**ELECTRICAL MACHINES – II LAB****Credits: 1.5****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 0-0-3 | 7-3-4-R25P1 | EE       |

**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.

**LIST OF EXPERIMENTS**

1. No Load Test and Blocked Rotor Test on 3- $\phi$  Induction Motor.
2. Direct Load Test on 3- $\phi$  Squirrel Cage Induction Motor.
3. Speed Control of 3- $\phi$  Induction Motor  
(a) Pole Changing (b) Rotor Resistance Control
4. V/F Speed control of on 3- $\phi$  Induction Motor
5. No Load Test and Blocked Rotor Test on 1- $\phi$  Induction Motor.
6. EMF and MMF Tests on Alternator.
7. ZPF Test on Alternator.
8. Slip Test on Alternator.
9. V And Inverted V Curves of Synchronous Motor
10. Speed Control of Universal Motor

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CO1         | 3    | 2    | 1    | 3    | 3    | 2    | 1    | –    | 2    | 2     | –     | 2     | 3     | 2     |
| CO2         | 3    | 3    | 2    | 3    | 3    | 2    | 1    | –    | 2    | 2     | –     | 2     | 3     | 2     |
| CO3         | 3    | 3    | 2    | 2    | 2    | 2    | 1    | –    | 2    | 2     | –     | 3     | 3     | 3     |


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**ANALOG AND DIGITAL ELECTRONICS LAB****Credits: 1.5****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 0-0-3 | 7-3-4-R25P2 | EE       |

**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

**LIST OF EXPERIMENTS**

1. Logic gates
2. Realization of Boolean Expressions using Gates
3. Binary adders and Subtractors
4. Design and realization of a 4 – bit Gray to Binary and Binary to Gray Converter
5. Verify the functionality of Mux ICs
6. Weighted Resistor DAC
7. V-I Characteristics of P-N Junction diode
8. V-I Characteristics of Zener diode
9. BJT-CE Configuration
10. Op-Amp Application – I(Scalar, summer, voltage follower)
11. Precision Rectifier
12. Op- Amp Application-II (Inverting and Non- Inverting Amplifiers)

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 1   | 3   | 3   | 2   | –   | –   | 2   | 2    | –    | 2    | 3    | 2    |
| CO2         | 3   | 3   | 3   | 3   | 3   | 2   | –   | –   | 2   | 2    | –    | 2    | 3    | 3    |
| CO3         | 3   | 3   | 3   | 2   | 3   | –   | –   | –   | 2   | 2    | –    | 2    | 3    | 3    |
| CO4         | 3   | 3   | 3   | 2   | 3   | –   | –   | –   | 2   | 2    | –    | 2    | 3    | 3    |


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**PYTHON PROGRAMMING****Credits: 2****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 2-0-0 | 7-3-4-R25S1 | EE       |

**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

**LIST OF EXPERIMENTS**

1. Programs on Basic and Arithmetic Operations
2. Programs on String Manipulations and Input/Output Functions
3. Programs using If Statements
4. Programs on Looping Statements
5. Programs using Lists and Tuples
6. Programs using Dictionaries and Sets
7. Simple Python Functions
8. Programs on Classes and Objects
9. Programs on Modules and Packages.
10. Solving Electrical Networks using Python

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 2   | 1   | 3   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO2         | 2   | 3   | 3   | 1   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO3         | 2   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 2    | 2    | 2    |
| CO4         | 2   | 2   | 2   | 2   | 3   | –   | –   | –   | –   | –    | –    | 3    | 3    | 3    |



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**CONSTITUTION OF INDIA****Credits: 0****Assessment: 100 + 0**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 2-0-0 | 7-0-3-R25M1 | EE       |

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

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

**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



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**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.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | –   | 2   | –   | –   | –   | 3   | 2   | 3   | –   | 2    | –    | 1    | –    | –    |
| CO2         | –   | 2   | –   | –   | –   | 3   | 2   | 3   | –   | 2    | –    | 1    | –    | –    |
| CO3         | –   | 2   | –   | –   | –   | 3   | 2   | 3   | –   | 2    | –    | 1    | –    | –    |
| CO4         | –   | 2   | –   | –   | –   | 3   | 2   | 3   | –   | 2    | –    | 1    | –    | –    |



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**ELEMENTS OF QUANTUM COMPUTING****Credits: 2****Assessment: 100 + 0**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| IV       | 2-0-0 | 7-0-4-R25M2 | EE       |

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

1. Understand basic principles of quantum mechanics relevant to computation.
2. Understand basics of quantum states, qbit and gates.
3. Understand physical implementation of Qubit
4. Understand Quantum algorithms and their implementation.
5. Understand the Impact of Quantum Computing on Cryptography

**UNIT – I:****Evolution of computation:** classical to quantum paradigm, Limitations of classical computation, Basic principles of quantum mechanics relevant to computation.**Introduction to Quantum Computing:** Bits Vs Qubits, Classical Vs Quantum logical operations**UNIT - II**

Quantum states and qubits, Superposition principle and quantum measurement. Quantum entanglement and its importance.

Quantum gates: Pauli, Hadamard, Phase, CNOT, Toffoli.

Bloch sphere representation of qubit states.

**UNIT - III****Qubit:** Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.**UNIT - IV****Quantum Algorithms:** Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm.**UNIT - V****Noise and error correction:** Graph states and codes, Quantum error correction, fault-tolerant computation. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation

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**TEXT BOOKS:**

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge

**REFERENCE BOOKS:**

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci.
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information,
3. Vol. I: Basic Concepts, Vol II
4. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | –   | 2   | –   | –   | –   | –   | –   | –    | –    | 2    | 2    | 2    |
| CO2         | 3   | 2   | 2   | 2   | 3   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO3         | 2   | 2   | 2   | 3   | 3   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO4         | 3   | 3   | 3   | 2   | 3   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO5         | 2   | 3   | –   | 2   | 2   | 2   | –   | 3   | –   | –    | –    | 2    | 2    | 2    |



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**B. Tech. (Electrical and Electronics Engineering)**  
**Semester V (Third Year)**

| Code       |             | Category | Course Title                                                   | Hours/Week |          |           | Total     | Credits   | Marks      |            |             |
|------------|-------------|----------|----------------------------------------------------------------|------------|----------|-----------|-----------|-----------|------------|------------|-------------|
| Department | University  |          |                                                                | L          | T        | P         |           |           | CIE        | SEE        | Total       |
| EE3501C    | 7-3-5-01R25 | EE-PC    | Power Systems-II                                               | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3502C    | 7-3-5-02R25 | EE-PC    | Linear Control Systems                                         | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3503C    | 7-3-5-03R25 | EE-PC    | Power Electronics                                              | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3504C    | 7-3-5-04R25 | EE-PC    | Utilization of Electrical Power                                | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3505E    | 7-3-5-R25E1 | EE-PE    | Professional Elective - I                                      | 3          | 0        | 0         | 3         | 3         | 40         | 60         | 100         |
| EE3506L    | 7-3-5-R25P1 | EE-PC    | Control Systems and Simulation Lab                             | 0          | 0        | 3         | 3         | 1.5       | 40         | 60         | 100         |
| EE3507L    | 7-3-5-R25P2 | EE-PC    | Power Electronics and Simulation Lab                           | 0          | 0        | 3         | 3         | 1.5       | 40         | 60         | 100         |
| EE3508S    | 7-3-5-R25S1 | EE-SC    | Electrical CAD                                                 | 1          | 0        | 2         | 3         | 2         | 40         | 60         | 100         |
| EE3509K    | 7-3-5-R25MK | EE-IK    | IKS For Electrical & Electronics Engineering (IKS – Mandatory) | 2          | 0        | 0         | 2         | 0         | 100        | 0          | 100         |
| EE3510I    | 7-0-5-R25CS | EE-CI    | Community Service Project                                      |            |          |           |           | 2         | 100        | 0          | 100         |
|            |             |          |                                                                | <b>18</b>  | <b>0</b> | <b>08</b> | <b>26</b> | <b>22</b> | <b>520</b> | <b>480</b> | <b>1000</b> |

Students shall ensure that IKS MOOKS and IKS Mandatory courses are not same either in title and/or in syllabi.



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## **ELECTRICAL & ELECTRONICS ENGINEERING**

### **PROFESSIONAL ELECTIVE COURSES**

|                                               |                     |                                                         |
|-----------------------------------------------|---------------------|---------------------------------------------------------|
| <b>Professional Elective - I:<br/>(V Sem)</b> | <b>7-3-5-R25E11</b> | <b>Renewable Energy Systems</b>                         |
|                                               | <b>7-3-5-R25E12</b> | <b>High Voltage Engineering</b>                         |
|                                               | <b>7-3-5-R25E13</b> | <b>Electrical Safety</b>                                |
|                                               |                     |                                                         |
| Professional Elective – II<br>(VI Sem)        | 7-3-6-R25E11        | Advanced Control Systems                                |
|                                               | 7-3-6-R25E12        | AI Techniques in Electrical Engineering                 |
|                                               | 7-3-6-R25E13        | Special Electrical Machines                             |
|                                               |                     |                                                         |
| Professional Elective – III<br>(VI Sem)       | 7-3-6-R25E21        | Electrical Distribution Systems                         |
|                                               | 7-3-6-R25E22        | Digital Signal Processing                               |
|                                               | 7-3-6-R25E23        | Restructured Power Systems                              |
|                                               | 7-0-6-R25CE1        | <b>Introduction to Semiconductor Manufacturing</b>      |
|                                               |                     |                                                         |
| Professional Elective – IV<br>(VII Sem)       | 7-3-7-R25E11        | Electric Vehicle Technologies                           |
|                                               | 7-3-7-R25E12        | FACTS and Power Quality                                 |
|                                               | 7-3-7-R25E13        | Machine Learning Applications to Electrical Engineering |
|                                               |                     |                                                         |
| Professional Elective – V<br>(VII Sem)        | 7-3-7-R25E21        | Power System Operation and Control                      |
|                                               | 7-3-7-R25E22        | Power Semiconductor Controlled Drives                   |
|                                               | 7-3-7-R25E23        | Smart Grid Technologies                                 |
|                                               |                     |                                                         |
| Professional Elective – VI<br>(VII Sem)       | 7-3-7-R25E31        | HVDC Transmission                                       |
|                                               | 7-3-7-R25E32        | Energy Auditing and Management                          |
|                                               | 7-3-7-R25E33        | Embedded Systems                                        |



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**POWER SYSTEMS -II****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| V        | 3-0-0 | 7-3-5-01R25 | EE       |

**Pre-Requisites:** Power systems-1, Network Analysis**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Analyze the performance of different transmission lines and different voltage control methods
2. Understand the concepts of substations and overhead line insulators
3. Study and Evaluate power system transients
4. Understand the concepts of Underground Cables
5. Analyze and understand the concepts of Distribution systems

**UNIT-I**

**Performance of transmission lines:** Representation of lines - short transmission lines - medium transmission lines - Nominal  $\pi$  and T representation of long lines by distributed parameters - Equivalent T and  $\pi$  representation of long transmission lines - Evaluation of ABCD parameters of long lines - Ferranti effect.

**UNIT-II**

**Substations:** Number and size - Location and installation - The main equipment in substations-bus bar arrangements - Key diagram of a typical primary substation.

**Overhead line insulators:** Introduction - Types of insulators - Potential distribution over a string of insulators - Methods of equalizing the potential, string efficiency - Testing of insulators.

**UNIT-III**

**Power system transients:** Introduction - Circuit closing transients - Sudden symmetrical short circuit analysis of alternator - Recovery transient due to removal of a short circuit - Travelling waves on transmission line - Surge impedance and wave velocity - Specification of travelling waves - Reflections and refractions of waves - Different types of terminations - Forked line - Successive reflections - Bewley's Lattice Diagram - Attenuation and Distortion - Arcing grounds.

**UNIT-IV**

**Underground Cables:** Introduction - The insulation types - Insulating materials for EHV voltage cables - Classification of cables - Parameters of single core cable - Grading of cables - Capacitance of three core belted cable break down of cables - Heating of cables - dielectric loss and Sheath losses - Current rating of cables.



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**UNIT-V**

**AC Distribution:** Comparison of AC single phase, 3 phase 3 wire and 3 phase 4 wire systems with DC 2 wire - Types of primary distribution systems - Types of secondary Distribution systems - AC distributors fed at one end and at both ends-Kelvin's law - Limitations of Kelvin's law - Load estimation - Selection voltage of primary distribution - Choice of scheme - Size of feeders, power factor correcting methods

**Text Books:**

1. C.L. Wadhwa, "Electrical Power systems" New age publications, 8th edition, 2022.
2. B.R. Gupta, "Power system analysis and design" third edition, Wheeler publishing.
3. William D. Stevenson, "Elements of Power System Analysis" fourth edition, Mc Graw hill international editions.

**Reference Books**

1. C.L. Wadhwa, "Generation Distribution and utilization of Electrical energy", New Age International
2. AR Bergen and Vijay Vittal, "Power system analysis", Pearson education, 2001

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | 2   | 2   | 2   | –   | 1   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO2         | 2   | 2   | 2   | 1   | 1   | 2   | 2   | –   | –   | –    | –    | 1    | 2    | 2    |
| CO3         | 3   | 3   | 2   | 3   | 2   | –   | 1   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO4         | 2   | 2   | 2   | 1   | 1   | 1   | 2   | –   | –   | –    | –    | 1    | 2    | 2    |
| CO5         | 3   | 3   | 3   | 2   | 2   | 2   | 2   | –   | –   | –    | –    | 2    | 3    | 3    |

  
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## LINER CONTROL SYSTEMS

Credits: 3

Assessment: 40 + 60

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| V        | 3-0-0 | 7-3-5-02R25 | EE       |

**Pre-Requisites:** Electrical Circuits and Network Analysis & Engineering Mathematics

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

1. Analyse the concept of physical systems and the modeling of linear-time-invariant systems using transfer function approach.
2. The concept of stability and its assessment for linear-time invariant systems for both analytical and graphical methods.
3. The applications of control systems in Home appliances and Industries.

### UNIT-I

**Introduction:** System representation – Classification of systems – Control system terminology – Types of control Systems: open loop and closed loop systems - Advantages and disadvantages of control systems – Examples of open loop and closed loop control systems – Definition - Transfer function - and limitations – Applications in Control systems.

### UNIT-II

**Mathematical Modeling of physical systems:** Mathematical modeling and transfer function of Electrical Systems – Mechanical Systems and Electro-Mechanical systems – Electrical Analogues – Block diagram analysis and their reduction techniques – Signal flow graph analysis – Introduction to DC and AC servo motors and applications.

### UNIT-III

**Time domain analysis:** Introduction to Standard test input signals – step response of first order and second order systems – Time domain specifications – steady state error – static error coefficients and generalized error coefficients – Problems.

### UNIT-IV

**Stability of control systems:** Concept of stability – Necessary conditions for stability – Characteristic equation and location of roots in s-plane for stability – Routh stability criterion– Routh -Hurwitz stability criterion – Root locus techniques – Rules for construction of root locus diagrams-Problems.



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**UNIT-V**

**Frequency domain analysis:** Introduction to frequency domain – frequency domain specifications – correlation between time domain and frequency domain analysis – Frequency response plots–polar plots–Nyquist Plots–Bode plots–Stability Analysis–Gain margin and Phase margin Problems.

**Text Books:**

1. I.J. Nagrath and M. Gopal, “Control system Engineering”, Wiley Eastern Ltd.
2. A. Nagoorkani, “Control Systems Engineering”, CBS Publishers, New Delhi.
3. Benjamin C. Kuo, “Automatic Control system”, Prentice Hall, 1995.
4. Ch. Chengaiah and G.V Marutheswar, “Control Systems A comprehensive Lab Manual”, B.S Publications, 2017.

**e-References:**

1. Control Systems fundamentals- william S. Levine
2. Control systems, Robotics and Automation –encylo- pedia of Life Support System
3. Control system Theory-Springer link (Link.Springer.com).

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO2         | 3   | 3   | 2   | 3   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO3         | 2   | 2   | 3   | 2   | 2   | 2   | 1   | –   | –   | –    | –    | 2    | 3    | 3    |



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**POWER ELECTRONICS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| V        | 3-0-0 | 7-3-5-03R25 | EE       |

**Pre Requisites:** Analog Electronics**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Understand the differences between signal level and power level devices.
2. Analyze controlled rectifier circuits.
3. Analyze the operation of DC-DC choppers
4. Analyze the operation of Inverters.
5. Analyze the operation of AC-AC Converters.

**UNIT-I**

**Power Semiconductor Devices** - Concept of power electronics, applications, advantages and disadvantages, power diodes, power transistors, power MOSFETS, IGBT and GTO.

**Silicon Controlled Rectifier** - Thyristors-brief description of Thyristor family with symbols, V-I characteristics and applications of SCR. Two transistor model of SCR, SCR turn-ON and turn-OFF methods, switching characteristics, gate triggering circuits, Protection circuits, Design of Snubber circuit, Different commutation techniques of SCR.

**UNIT-II**

**Phase controlled Rectifiers** - Principles of phase control – Half-wave and full- wave controlled rectifiers with resistive, inductive and RLE load– Freewheeling diode operation – Bridge rectifiers for Single phase and three phase Rectifiers–Effect of source inductance– Dual converter–circulation and non-circulating current mode of operation.

**UNIT-III**

**Choppers** – DC Choppers – Principles of operation – control strategies, constant and variable frequency system, current limit control–Types of chopper circuits–Type-A, Type-B and Type-E chopper circuits.

**UNIT-IV**

**Inverters** – Operation and classification of Voltage Source (VSI) and Current Source Inverters (CSI)– Single-phase half-bridge and full-bridge inverter topologies–series and parallel inverters –Three-phase inverters operating in 180° and 120° conduction modes – Introduction to PWM techniques.

**UNIT-V**

**AC voltage controllers** –Principle of integral cycle control - Single phase voltage controller– With R and RL loads – RMS load voltage, current and power factor - wave forms.

**Cyclo-converters**–Principle of operation–Midpoint and Bridge connections – single phase step-up and step down cyclo converters.

**Speed control** – Speed control of DC motors using controlled rectifiers and choppers – Speed control of induction motors using inverters.



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**Text Books:**

1. An introduction to Thyristors and their application – Dr. M. Ramamoorthy – East West press.
2. Power Electronics - Dr. P.S. Bimbhra 2nd edition – Khanna publishers.
3. Power Electronics – M.D. SINGH and K.B. KHANCHANDANI – Tata Mc.Graw Hill publishers.
4. Industrial and Power Electronics – RASHID (3rd Edition)

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b>  | 3   | 2   | 1   | 1   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| <b>CO2</b>  | 3   | 3   | 2   | 2   | 2   | –   | 1   | –   | –   | –    | –    | 2    | 3    | 3    |
| <b>CO3</b>  | 3   | 3   | 2   | 2   | 2   | –   | 1   | –   | –   | –    | –    | 2    | 3    | 3    |
| <b>CO4</b>  | 3   | 3   | 3   | 2   | 2   | –   | 1   | –   | –   | –    | –    | 2    | 3    | 3    |
| <b>CO5</b>  | 3   | 3   | 2   | 2   | 2   | –   | 1   | –   | –   | –    | –    | 2    | 3    | 3    |



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**UTILIZATION OF ELECTRICAL POWER****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| V        | 3-0-0 | 7-3-5-04R25 | EE       |

**Pre-Requisites:** D.C. Machines and Transformers, Induction Motors and Synchronous Machines**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. To provide students basic practical knowledge of illumination and to get general ideas about street lighting, building lighting.
2. To provide students' knowledge about the various electric heating methods and their advantages.
3. To make students to learn electrical welding methods and their advantages
4. To provide students basic practical knowledge of electric drives and to learn the characteristics of different mechanical loads.
5. To provide students' knowledge about the electric traction & their advantages.

**UNIT-I**

**Illumination:** Nature of light, definitions, Laws of illumination, different types of lamps, construction and working of incandescent lamp, fluorescent lamp and discharge lamps, Illumination schemes; indoor and outdoor, Illumination levels. General ideas about street lighting, building lighting.

**UNIT-II**

**Electric Heating:** Advantages of electrical heating, Heating methods: Resistance heating, Induction heating, Electric arc heating, construction and working of arc furnace, Dielectric heating, Infra-red heating, Microwave heating, design problems of resistance heating element.

**UNIT -III**

**Electric Welding:** Advantages of electric welding, Welding methods, Principles of resistance welding, welding equipments used, Principle of electric arc welding, carbon arc, metal arc, hydrogen arc welding methods and their applications. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits.

**UNIT -IV**

**Electric Drives:** Introduction, Advantages of electric drives, Characteristics of different mechanical loads, Types of motors used in electric drive, types of braking, Methods of power transfer, selection of motors for different types of domestic loads.

**UNIT -V**

**Electric Traction:** Advantages of electric traction, Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves, pentagraph, Factors affecting scheduled speed, types of motors used for electric traction, Starting and braking of traction motors.



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**Text Books:**

1. “Art and Science of Utilization of Electrical Energy” by H Partap, Dhanpat Rai & Sons, Delhi.
2. “Utilization of Electrical Energy” by JB Gupta, Kataria Publications, Ludhiana.
3. “Electrical Power System” by Dr. S.L. Uppal and Prof. S. Rao, Khanna Publications, Delhi.
4. “Modern Electric Traction” by H Partap, Dhanpat Rai & Sons, Delhi.
5. “Utilization of Electrical Energy” by OS Taylor, Pitman Publications.
6. “Generation, Distribution and Utilization of Electrical Power” by CL Wadhwa, Wiley Eastern, Ltd., New Delhi

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 2   | 1   | 1   | 2   | 3   | –   | –   | –    | –    | 2    | 2    | 3    |
| CO2         | 3   | 2   | 2   | 1   | 1   | 2   | 2   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO3         | 3   | 2   | 2   | 1   | 1   | 2   | 1   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO4         | 3   | 3   | 3   | 2   | 2   | 2   | 2   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO5         | 3   | 2   | 2   | 1   | 1   | 3   | 3   | –   | –   | –    | –    | 2    | 3    | 3    |



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**PE-I-1 - RENEWABLE ENERGY SYSTEMS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| V        | 3-0-0 | 7-3-5-R25E11 | EE       |

**Pre-Requisites:** Power systems-I, Induction Motors and Synchronous Machines**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Understand the solar radiation, measurements, characteristics of solar PV cell and wind turbines.
2. Develop the models of PV system and wind turbine, and their applications.
3. Analyze the electrical characteristics and operation of various wind-driven electrical generators.
4. Explain the process of fuel cell power generation and its applications
5. Analyze bio-energy generation processes and configure various hybrid energy systems

**UNIT-I**

**Basic characteristics of sunlight** – solar spectrum – insolation specifics– irradiance and irradiation- pyranometer – solar energy statics- Solar PV cell – I-V characteristics –P-V characteristics– fill factor-Modeling of solar cell– maximum power point tracking.

**UNIT-II**

**PV module** – blocking diode and bypass diodes– composite characteristics of PV module – PV array– PV system –PV-powered fan–PV fan with battery backup–PV-powered pumping system –PV powered lighting systems–grid- connected PV systems.

**UNIT-III**

**Wind power generation:** Wind energy, classification of wind turbines – aerodynamic operation of wind turbine, extraction of wind turbine power, wind turbine power curve, horizontal axis wind turbine generator – modes of wind power generation – stand-alone and grid connected system, environmental impacts.

**UNIT-IV**

**Fuel cell system:** Principle of operation of fuel cell, technical parameters of fuel cell, Type of fuel cell – advantages of fuel cell power plants, energy output, efficiency and emf of fuel cell – operating characteristics, applications and environmental impacts.

**UNIT-V**

**BIO-ENERGY** - Energy from Bio-mass -Biogas plants - various types - Industrial wastes - Municipal waste - Burning -plants - Energy from the Agricultural wastes - Applications.

Hybrid energy systems: Need for hybrid systems, types, configuration and coordination, electrical interface – PV-Diesel, Wind-diesel, wind-PV, wind-PV- fuel cell.

  
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**Text Books:**

1. Chetan Singh Solanki, 'Solar Photovoltaics: Fundamentals, Technologies and Applications' PHI Learning Publications, 2nd Edition, 2011.
2. S N Bhadra, S Banerjee and D Kastha, 'Wind Electrical Systems', Oxford University Press, 1st Edition, 2005.
3. G D Rai, 'Non-conventional Energy sources', Khanna Publishers, 5th Edition, 2014.
4. D P Kothari, K C Singal and Rakesh Ranjan, 'Renewable Energy Sources and Emerging Technologies' 2nd Edition, 2012.

**Reference Books:**

1. Roger A. Messenger and Jerry Ventre, 'Photovoltaic Systems Engineering', Taylor and Francis Group Publications, 2nd Edition, 2003.
2. M. Godoy Simoes and Felix A. Farret, 'Alternative Energy Systems: Design and Analysis with Induction Generators', CRC Press, 2nd Edition, 2008
3. Ion Boldea, 'The Electric Generators Handbook- Variable Speed Generators', CRC Press, 2010.
4. Bin Wu, Yongqiang Lang, Navid Zargari, Samir Kouro, 'Power Conversion and Control of Wind Energy Systems', IEEE Press Series on Power Engineering, John Wiley & Sons, 2011.
5. S. Sumathi, L. Ashok Kumar, P. Surekha, 'Solar PV and Wind Energy Conversion Systems', Springer 2015

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 1   | 1   | 1   | 2   | 3   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO2         | 3   | 3   | 3   | 2   | 2   | 2   | 3   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO3         | 3   | 3   | 2   | 2   | 2   | 2   | 3   | –   | –   | –    | –    | 2    | 3    | 3    |
| CO4         | 2   | 2   | 2   | 1   | 1   | 2   | 3   | –   | –   | –    | –    | 2    | 2    | 2    |
| CO5         | 3   | 3   | 3   | 2   | 2   | 3   | 3   | –   | –   | –    | –    | 2    | 3    | 3    |

  
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**PE-I-2- HIGH VOLTAGE ENGINEERING****Credits: 3****Assessments: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| V        | 3-0-0 | 7-3-5-R25E12 | EE       |

**Course Outcomes:** At the end of the course, the student will demonstrate

1. Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
2. Knowledge of generation and measurement of D. C., A.C., & Impulse voltages. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
3. Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

**UNIT-I****Breakdown in solid, liquid and gas insulating materials**

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

**UNIT-II****Generation of High Voltages**

Generation of high voltages, generation of high D. C. and A.C. voltages - Van de Graff Generator, Cockcroft Walton Voltage multipliers, Cascade transformer circuits, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

**UNIT-III****Measurements of High Voltages and Currents**

Peak voltage, impulse voltage and high direct current measurement method, cathode ray Oscillo graphs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

**UNIT-IV****Lightning and Switching Over-voltages**

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, and Surge modifiers.

**UNIT-V**

**High Voltage Testing of Electrical Apparatus and High Voltage Laboratories** Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.



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**Text/Reference Books:**

1. M.S. Naidu and V. Kamaraju, “High Voltage Engineering”, Mc Graw Hill Education, 2013.
2. C. Wadhwa, “High Voltage Engineering”, New Age International Publishers, 2007.
3. D.V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers, 1993.
4. E. Kuffel, W.S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication, 2000.
5. R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons, 2011. Various IS standards for HV Laboratory Techniques and Testing

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | 2   | 2   | 1   | –   | 1   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO2         | 3   | 2   | 2   | 3   | 3   | 2   | 1   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO3         | 3   | 3   | 3   | 2   | 2   | 3   | 2   | –   | –   | –    | –    | 2    | 3    | 3    |



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**PE-I-3- ELECTRICAL SAFETY****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| V        | 3-0-0 | 7-3-5-R25E13 | EE       |

**Pre Requisites:** Power Systems-1**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Understand the need of electrical safety in different locations
2. Understand the need of electrical safety during installation of equipment's
3. Describe the electrical safety in residential, commercial and agricultural installations.
4. Explain the necessity of electrical safety in Hazardous zones
5. Understand electrical safety in distributed systems and usage of Fire extinguishers

**UNIT-I****INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION:**

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

**UNIT-II**

**SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT:** Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

**UNIT-III****ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL**

**INSTALLATIONS:** Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.



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**UNIT-IV**

**ELECTRICAL SAFETY IN HAZARDOUS AREAS:** Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

**UNIT-V**

**ELECTRICAL SAFETY IN DISTRIBUTION SYSTEM:** Total quality control and management – Importance of high load factor – Disadvantages of low power factor – Causes of low P.F. – power factor improvement – equipment – Importance of P.F. improvement.

**Fire Extinguishers:** Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system; CO<sub>2</sub> and Halogen gas schemes; foam schemes.

**Text Books:**

1. Rao, S. and Saluja, H.L., “Electrical Safety, Fire Safety Engineering and Safety Management”, Khanna Publishers, 1988.
2. Pradeep Chaturvedi, “Energy Management Policy, Planning and Utilization”, Concept Publishing Company, 1997.

**Reference Books:**

1. Cooper. WF, “Electrical safety Engineering”, Newnes-Butterworth Company, 1978.
2. John Codick, “Electrical safety hand book”, McGraw Hill Inc., New Delhi, 2000.
3. Nagrath, I.J. and Kothari, D.P., “Power System Engineering”, Tata McGraw Hill, 1998.
4. Wadhwa, C.L., “Electric Power Systems”, New Age International, 2004.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 2   | 2   | 2   | 1   | 1   | 3   | 2   | 3   | –   | –    | –    | 2    | 2    | 2    |
| CO2         | 2   | 2   | 2   | 1   | 1   | 3   | 2   | 3   | –   | –    | –    | 2    | 2    | 2    |
| CO3         | 2   | 2   | 3   | 1   | 1   | 3   | 2   | 3   | –   | –    | –    | 2    | 3    | 3    |
| CO4         | 2   | 3   | 3   | 2   | 1   | 3   | 2   | 3   | –   | –    | –    | 2    | 3    | 3    |
| CO5         | 2   | 2   | 2   | 1   | 2   | 3   | 2   | 3   | –   | –    | –    | 2    | 2    | 3    |

  
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**CONTROL SYSTEMS AND SIMULATION LAB****Credits: 1.5****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| V        | 0-0-3 | 7-3-5-R25P1 | EE       |

**Pre-requisites:** Linear Control Systems**Course Outcomes:** At the end of the course, the student will be able to:

1. Demonstrate feedback controllers
2. Simulate the physical control system for stability studies

**LIST OF EXPERIMENTS**

1. Modeling of Physical Systems (Mechanical and Electrical systems).
2. Block Diagram Reduction of Linear Systems
3. Frequency response analysis of Linear Systems
4. Stability and relative stability analysis of Linear Systems Using Root Locus, Bode and Nyquist plot.
5. Study the effect of P, PD, PI, PID controllers on second order systems.
6. Magnitude and phase plot of Lag and lead compensators.
7. Design of Lag and Lead Compensators for a given system
8. Study the effect of P, PD, PI, PID controllers on DC servomotor system using PLC.
9. To Convert Transfer function of a system in to State Space form and Vice-versa.
10. Steady State Error Constants.
11. Controllability and Observability.
12. Time response analysis of Linear Systems for impulse and step inputs.
13. Determination of transfer function and effect to feedback on DC servo motor.
14. To Determine Speed –Torque Characteristics of an AC Servo motor.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | 2   | 3   | 3   | –   | –   | –   | 1   | 1    | –    | 1    | 3    | 2    |
| CO2         | 3   | 3   | 2   | 3   | 3   | –   | –   | –   | 1   | 1    | –    | 1    | 3    | 2    |


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**POWER ELECTRONICS AND SIMULATION LAB****Credits: 1.5****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| V        | 3-0-0 | 7-3-5-R25P2 | EE       |

**Pre-requisites:** Power Electronics**Course Outcomes:** At the end of the course, the student will be able to:

1. Examine the characteristics of Power electronic devices
2. Analyze the performance of different power converters using trainer kits.
3. Evaluate the performance of different power converters using simulation tools

**LIST OF EXPERIMENTS:**

1. Single-phase Half Controlled Bridge Converter
2. Single-phase Full Controlled Bridge Converter
3. Single-phase AC Voltage Controller
4. Series inverter
5. Modelling and simulation of Single-phase Half controlled Rectifier with R load, RL load, RLE-Load and RL with FD
6. Modelling and simulation of Single-phase half Bridge controlled rectifier with R and RL load.
7. Modelling and simulation of Single-phase Full Bridge controlled rectifier with R and RL load.
8. Modelling and simulation of Speed control of a DC motor using single phase Full Bridge controlled rectifier.
9. Modelling and simulation of Three phase half controlled rectifier with R and RL load.
10. Modelling and simulation of Three phase full controlled rectifier with R and RL load.
11. Modelling and simulation of boost converter.
12. Modelling and simulation of Three phase inverter for 180° & 120° modes of Conduction.
13. Modelling and simulation of Single-phase AC voltage controller with R and RL load.
14. Intelligent power module for speed control of 3-phase induction motor.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | 1   | 3   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO2         | 3   | 3   | 2   | 3   | 3   | 1   | –   | –   | 1   | –    | –    | 2    | 3    | 2    |
| CO3         | 3   | 3   | 2   | 3   | 3   | –   | –   | –   | –   | –    | –    | 2    | 3    | 3    |

  
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**ELECTRICAL CAD****Credits: 2****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| V        | 1-0-2 | 7-3-5-R25S1 | EE       |

Pre-requisites: Electrical Circuits and Engineering Drawing

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

1. Understand the basics and applications of ECAD software.
2. Use basic drawing and editing commands in ECAD.
3. Draw simple electrical symbols and wiring diagrams.
4. Prepare basic electrical layouts such as wiring diagrams, SLDs, and machine drawings.

**LIST OF EXPERIMENTS:**

1. Introduction to ECAD
2. Study of Basic Drawing Commands
3. Drawing of Basic Electrical Symbols
4. Drawing of Single Lamp Wiring
5. Drawing of Two Lamp Wiring
6. Drawing of Godown Wiring (Basic)
7. Drawing of Basic House Wiring
8. Drawing of Simple Single Line Diagram
9. Drawing of Basic Substation Diagram
10. Drawing of Basic Electrical Machine View

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 2   | 1   | 1   | –   | 3   | –   | –   | –   | –   | –    | –    | 2    | 2    | 2    |
| CO2         | 2   | 2   | 2   | –   | 3   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO3         | 3   | 2   | 3   | 1   | 3   | –   | –   | –   | –   | 1    | –    | 2    | 3    | 2    |
| CO4         | 3   | 3   | 3   | 2   | 3   | 1   | –   | –   | 1   | 1    | –    | 2    | 3    | 3    |


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**IKS FOR ELECTRICAL & ELECTRONICS ENGINEERING****Credits: 2****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| V        | 2-0-0 | 7-3-5-R25MK | EE       |

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

**CO1:** Understand the basic concepts of Indian Knowledge Systems (IKS) in science, mathematics, and measurement.

**CO2:** Explain traditional energy concepts and compare them with modern renewable energy systems.

**CO3:** Describe ancient Indian materials and their electrical properties in relation to modern materials.

**CO4:** Understand traditional communication and acoustic systems and relate them to modern electronics and signal concepts.

**CO5:** Apply principles of Indian Knowledge Systems to promote sustainability and innovation in Electrical and Electronics Engineering.

**Unit 1: Foundations of Indian Knowledge Systems in Science**

- Philosophical basis: *Nyaya*, *Vaisheshika*, and logic systems
- Ancient Indian mathematics and astronomy relevant to engineering
- Traditional measurement systems: time, length, and energy
- Relevance of IKS in modern engineering education

**Unit 2: Energy Systems in IKS and Electrical Engineering**

- Traditional concepts of energy (*Agni*, *Prana*)
- Ancient hydraulic and wind-based energy systems
- Principles of sustainable energy in Indian traditions
- Parallels with modern renewable energy systems

**Unit 3: Materials and Electrical Properties**

- Metallurgy in ancient India: copper, zinc, iron, alloys
- Electrical conductivity and material properties in traditional usage
- Corrosion resistance and durability of ancient materials
- Traditional insulators vs. modern dielectric materials

**Unit 4: Communication, Signals, and Electronics**

- Acoustic engineering in temples and musical instruments
- Resonance and harmonics in traditional systems
- Ancient signaling methods and parallels to modern communication
- Waveform analysis of chanting and sound patterns

**Unit 5: Integration of IKS with Modern Electrical & Electronics Engineering**

- Smart grids and distributed systems inspired by traditional models
- Indigenous innovations in town planning and their engineering relevance
- Sustainability lessons from IKS for modern electrical systems
- Applications of IKS principles in electronics and circuit design



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**TEXT BOOKS:**

1. Introduction to Indian Knowledge System: Concepts and Applications – B. Mahadevan et al.
2. Indian Knowledge Systems: A Textbook for UG Students (NEP 2020) – Rohidas Nitonde
3. Ancient Indian Metallurgy – R. Balasubramaniam (for materials and conductivity)
4. AICTE Model Curriculum on IKS for Engineering (official framework)

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 2   | 1   | –   | –   | –   | –   | –   | –   | –   | –    | –    | 2    | 1    | 1    |
| CO2         | 2   | 2   | 1   | –   | –   | 1   | 3   | –   | –   | –    | –    | 2    | 2    | 3    |
| CO3         | 2   | 2   | 1   | 1   | 1   | –   | 2   | –   | –   | –    | –    | 1    | 2    | 2    |
| CO4         | 2   | 2   | 1   | 1   | 1   | –   | –   | –   | –   | 1    | –    | 1    | 2    | 2    |
| CO5         | 3   | 2   | 2   | –   | 1   | 2   | 3   | 2   | 1   | 1    | 1    | 2    | 3    | 3    |



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**B. Tech. (Electrical and Electronics Engineering)**  
**Semester VI (Third Year)**

| Code       |             | Category | Course Title                              | Hours/Week |   |    | Total | Credits | Marks |     |       |
|------------|-------------|----------|-------------------------------------------|------------|---|----|-------|---------|-------|-----|-------|
| Department | University  |          |                                           | L          | T | P  |       |         | CIE   | SEE | Total |
| EE3601C    | 7-3-6-01R25 | EE-PC    | Power System Analysis                     | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3602C    | 7-3-6-02R25 | EE-PC    | Measurements and Instrumentation          | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3603C    | 7-3-6-03R25 | EE-PC    | Micro Processors and Micro Controllers    | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3604E    | 7-3-6-R25E1 | EE-PE    | Professional Elective - II                | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3605E    | 7-3-6-R25E2 | EE-PE    | Professional Elective - III               | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3606E    | 7-3-6-R25O1 | EE-OE    | Open Elective – I (MOOCs)                 | 3          | 0 | 0  | 3     | 3       | 0     | 100 | 100   |
| EE3607L    | 7-3-6-R25P1 | EE-PC    | Microprocessors and Micro Controllers Lab | 0          | 0 | 3  | 3     | 1.5     | 40    | 60  | 100   |
| EE3608L    | 7-3-6-R25P2 | EE-PC    | Measurements and Instrumentation Lab      | 0          | 0 | 3  | 3     | 1.5     | 40    | 60  | 100   |
| EE3609S    | 7-3-6-R25S1 | EE-SC    | Java Programming                          | 1          | 0 | 2  | 3     | 2       | 40    | 60  | 100   |
| EE3610K    | 7-3-6-R25KS | EE-IK    | IKS – MOOCS                               | 2          | 0 | 0  | 2     | 2       | 0     | 100 | 100   |
|            |             |          |                                           | 21         | 0 | 08 | 29    | 25      | 320   | 680 | 1000  |

Students shall undergo summer Industrial Internships for a duration of **six to eight (6-8) weeks** during the summer vacation by completing **45 – 60** hours of work with at least **75%** attendance, to be evaluated and reflected in 7<sup>th</sup> semester.

The students have to choose **open electives** (OE-I, OE-II, OE-III, etc..) from other disciplines or departments. **The student cannot opt for an open elective course offered by his own (parent) department/discipline.**

Students shall ensure that IKS MOOCS and IKS Mandatory courses are not same either in title and/or in syllabi.



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## **ELECTRICAL & ELECTRONICS ENGINEERING**

### **PROFESSIONAL ELECTIVE COURSES**

|                                                       |                     |                                                         |
|-------------------------------------------------------|---------------------|---------------------------------------------------------|
| Professional Elective - I:<br>(V Sem)                 | 7-3-5-R25E11        | Renewable Energy Systems                                |
|                                                       | 7-3-5-R25E12        | High Voltage Engineering                                |
|                                                       | 7-3-5-R25E13        | Electrical Safety                                       |
|                                                       |                     |                                                         |
| <b>Professional Elective – II</b><br><b>(VI Sem)</b>  | <b>7-3-6-R25E11</b> | <b>Advanced Control Systems</b>                         |
|                                                       | <b>7-3-6-R25E12</b> | <b>AI Techniques in Electrical Engineering</b>          |
|                                                       | <b>7-3-6-R25E13</b> | <b>Special Electrical Machines</b>                      |
|                                                       |                     |                                                         |
| <b>Professional Elective – III</b><br><b>(VI Sem)</b> | <b>7-3-6-R25E21</b> | <b>Electrical Distribution Systems</b>                  |
|                                                       | <b>7-3-6-R25E22</b> | <b>Digital Signal Processing</b>                        |
|                                                       | <b>7-3-6-R25E23</b> | <b>Restructured Power Systems</b>                       |
|                                                       | <b>7-0-6-R25CE1</b> | <b>Introduction to Semiconductor Manufacturing</b>      |
|                                                       |                     |                                                         |
| Professional Elective – IV<br>(VII Sem)               | 7-3-7-R25E11        | Electric Vehicle Technologies                           |
|                                                       | 7-3-7-R25E12        | FACTS and Power Quality                                 |
|                                                       | 7-3-7-R25E13        | Machine Learning Applications to Electrical Engineering |
|                                                       |                     |                                                         |
| Professional Elective – V<br>(VII Sem)                | 7-3-7-R25E21        | Power System Operation and Control                      |
|                                                       | 7-3-7-R25E22        | Power Semiconductor Controlled Drives                   |
|                                                       | 7-3-7-R25E23        | Smart Grid Technologies                                 |
|                                                       |                     |                                                         |
| Professional Elective – VI<br>(VII Sem)               | 7-3-7-R25E31        | HVDC Transmission                                       |
|                                                       | 7-3-7-R25E32        | Energy Auditing and Management                          |
|                                                       | 7-3-7-R25E33        | Embedded Systems                                        |



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**POWER SYSTEM ANALYSIS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VI       | 3-0-0 | 7-3-6-01R25 | EE       |

**Pre-Requisites:** Power systems - II**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Analyze symmetrical and unsymmetrical faults.
2. Understand Symmetrical components and analyze sequence networks.
3. Apply the load flow techniques and carry out load flow study of power systems.
4. Study and analyze steady state and transient stability of power systems

**UNIT-I**

**Fault studies:** Per unit system, Introduction to symmetrical fault analysis-short circuit capacity of a bus-The short circuit currents and the reactance of synchronous machines-Internal voltages of loaded machines under transient conditions-Expressions for fault MVA in terms of per unit and percentage quantities-Need for current limiting reactors and their location-selection of circuit breakers.

**UNIT-II**

**Sequence Networks:** Symmetrical Components-phase shift of symmetrical components in Star- Delta transformer banks -Power in terms of symmetrical components - Sequence impedances and sequence networks-Sequence impedances of generators-Sequence impedances of transmission lines-Sequence impedances of transformers.

**Unsymmetrical fault Analysis:** Fault current calculations for single line to Ground fault, Line toLine fault and Double line to Ground fault, open conductor faults.

**UNIT-III**

**Load flow studies:** Need for load flow studies in a power system-Formation of Bus admittance matrix-Classification of types of buses in a power system-Formulation of load flow equations- Gauss-Seidel, iterative method for load flow studies-Treatment of PV bus-Acceleration factors- Newton Raphson method for load flow solution with rectangular and polar coordinates- formulation of load flow equations-Decoupled and fast decoupled load flow.



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**UNIT-IV**

**Stability studies:** Classification of stability studies-The power flow equations of round rotor and salient pole synchronous machine connected to infinite bus through a transmission system under steady state and transient state - Power flow equations of a two-machine system - Power flow equations in terms of ABCD constants-Power angle diagrams-Derivation of swing equation, Inertia constant. steady state stability analysis: Steady state stability and steady state stability limits.

**UNIT-V**

**Transient stability analysis:** General considerations and assumptions-Transient stability and stability limits-Reduction of two finite machine system to one machine system-Solution of swing equation of one machine system by point-by-point method-Digital solution by numerical methods-Equal area criterion-Limitations of equal area criterion- Determination of critical clearing angle. methods for improving power system stability.

**Text Books:**

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
3. Hadi Saadat, "Power System Analysis", Tata McGraw-Hill Education, 2nd Edition, 2002.

**Reference books:**

1. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
2. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
3. Power System Analysis and design by B.R. Gupta, S. Chand publications.

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | 2   | 2   | 2   | 1   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO2         | 3   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO3         | 3   | 3   | 3   | 3   | 3   | 1   | –   | –   | –   | 1    | –    | 2    | 3    | 3    |
| CO4         | 3   | 3   | 2   | 3   | 2   | 1   | –   | –   | –   | –    | –    | 2    | 3    | 2    |

  
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**MEASUREMENTS AND INSTRUMENTATION****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VI       | 3-0-0 | 7-3-6-02R25 | EE       |

**Pre Requisites:** Electrical Circuits**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Understand the basics and working principles of different measuring instruments.
2. Identify Different types of Resistances and suitable bridges for measuring L & C.
3. Select appropriate measuring instruments for measuring various parameters like current, Voltage and Energy.
4. Analyze the working, and performance characteristics of electronic measuring instruments.
5. Study and correlate the significance of different Transducers, oscilloscopes and Data acquisition systems.

**UNIT-I**

**Principles of Measurement** - Basic characteristics and classification of electrical instruments Errors & classification, Deflecting, controlling and damping torques and their mechanisms in indicating instruments

**Measurement of voltage, current and Power** - Permanent Magnet Moving Coil, Moving iron meters Construction and Torque equation and operational errors, Range extension of PMMC and MI instruments as Ammeter and Voltmeter and Dynamometer type instruments.

**UNIT-II**

**DC potentiometers** – Basic slide wire and DC Crompton's Potentiometer

**DC bridges** - Measurement of Resistance: Low Resistance – Kelvin's Double bridge and Potentiometer method. Medium Resistance – Ammeter-Voltmeter and Voltmeter-Ammeter method, Wheatstone Bridge, Substitution and Ohm meter methods. High Resistance - Megger, Loss of charge, Direct Deflection methods and Mega ohms Bridge.

**AC bridges** - Measurement of Self Inductance: Maxwell Inductance, Maxwell Inductance and Capacitance, Hays, Owen's and Anderson bridges.

**Measurement of Capacitance:** De- Sauty's, Modified De- Sauty's and Schering bridges



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### **UNIT-III**

**Instrument Transformers** – Uses, ratios and burden of Instrument Transformers. Current and Potential Transformers: Construction and Working of CT & PT, Ratio and Phase angle errors.

**Measurement of Energy** – Single phase energy meter: Construction, operation and Torque equation.

Measurement of Power in Three phase Circuits, Measurement of Reactive Power.

### **UNIT-IV**

**Measurement of Phase, Frequency and Quality Factor**

Power factor meters – Single phase and three phase electrodynamicometer type power factor meters, Moving iron power factor meters. Synchrosopes: electrodynamicometer, Moving iron type Synchrosopes. Frequency meters: Ratio meter and Saturable core type frequency meters, Q-meters.

**Electronic Instruments-** Digital Voltmeters types and advantages: Flash, Successive approximation, Counter, Ramp, Dual slope integrating types. Millimeters.

### **UNIT-V**

**Measurement of non-electrical quantities:** Linear displacement transducers– LVDT, Piezo-electric transducers, **Strain Guage** Temperature measurement.

**Oscilloscopes-** CRO and components

**Basics of Data Acquisition systems (DAS)** - Analog and Digital DAS, Use of Recorders in digital systems

#### **Text Books:**

1. A. K. Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai & Co.
2. J.B Gupta, A course in “Electrical and Electronic Measurements and Instrumentation”, S.K. Kataria & Sons.
3. H.S Kalsi, “Electronic Instrumentation”, Tata McGraw Hill, New Delhi

#### **Reference Books:**

1. A. D. Helfrick & W. D. Cooper - Modern Electronic Instrumentation and Measurement Techniques.
2. R. K. Rajput - Electrical & Electronics Measurements and Instrumentation.
3. E. O. Doebelin & D. N. Manik - Measurement Systems: Application and Design.
4. John P. Bently, "Principles of Measurement Systems".



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**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| <b>CO \<br/>PO/PSO</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> | <b>PO11</b> | <b>PO12</b> | <b>PSO1</b> | <b>PSO2</b> |
|------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|-------------|
| CO1                    | 3          | 2          | 1          | 1          | 2          | –          | –          | –          | –          | –           | –           | 2           | 3           | 1           |
| CO2                    | 3          | 3          | 2          | 2          | 2          | –          | –          | –          | –          | –           | –           | 2           | 3           | 2           |
| CO3                    | 3          | 3          | 3          | 2          | 2          | 1          | –          | –          | –          | –           | –           | 2           | 3           | 2           |
| CO4                    | 3          | 3          | 2          | 3          | 3          | –          | –          | –          | –          | 1           | –           | 2           | 3           | 2           |
| CO5                    | 3          | 2          | 2          | 3          | 3          | 1          | –          | –          | –          | 1           | –           | 2           | 3           | 3           |



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**MICRO PROCESSORS AND MICRO CONTROLLERS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VI       | 3-0-0 | 7-3-6-03R25 | EE       |

**Pre-Requisites:** Digital Electronics**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Do assembly language programming.
2. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
3. Understand the architecture and features of 8051 microcontroller.

**UNIT-I**

**Development of microprocessors**, 8086 microprocessor – Architecture, Instruction set, Addressing modes, Interrupt system. Minimum mode 8086 system and timings, Maximum mode 8086 system and timings.

**UNIT-II**

**Assembler directives**, Assembly language programs (8086) with Assembler directives for addition, subtraction, multiplication, division etc., sorting and searching, bit manipulation, Programs using look-up tables, Delay subroutines. Stages of software development.

**UNIT-III**

**Data transfer schemes** – Synchronous, Asynchronous, Interrupt driven and DMA type schemes, Programmable interrupt controller (8259) and its interfacing, Programmable DMA controller (8257) and its interfacing, Programmable Interval Timer (8253) and its interfacing, Programmable Communication Interface (8251 USART) and its interfacing.

**UNIT-IV**

**Memory interfacing to 8086** – Interfacing various types of RAM and ROM chips, 8255 PPI and its interfacing, ADC and DAC Interfacing, Data acquisition, Waveform generation, Traffic light controller, Stepper motor control, temperature measurement and control.

**UNIT-V**

**8051 Microcontroller** – Architecture, register set, Instruction set, Interrupt structure, timer and serial port operations, Memory and I/O interfacing, Simple Assembly language programs.



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**Text Books:**

1. A.K. Ray and K.M. Bhurchandi, “Advanced Microprocessors and Peripherals”, TMH.
2. Douglas V. Hall, “Microprocessors and interfacing: Programming and hardware”, TMH, 2<sup>nd</sup> edition.
3. Kenneth J Ayala, “The 8051 Micro Controller Architecture, Programming and Applications”, Pernam International / Thomson Publishers, 2<sup>nd</sup> Edition, 2005.
4. Ajay V. Deshmukh, “Microcontrollers – theory applications”, Tata McGraw-Hill Company.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 2   | 1   | 3   | –   | –   | –   | –   | 1    | –    | 2    | 3    | 2    |
| CO2         | 3   | 3   | 3   | 2   | 3   | 1   | –   | –   | –   | 1    | –    | 2    | 3    | 3    |
| CO3         | 3   | 2   | 2   | 1   | 2   | –   | –   | –   | –   | –    | –    | 2    | 3    | 2    |



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**PE-II-1- ADVANCED CONTROL SYSTEMS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VI       | 3-0-0 | 7-3-6-R25E11 | EE       |

**Pre Requisites:** Linear Control Systems**Course Outcomes:** At the end of this course, students will understand and demonstrate the ability to

1. Analyse the concept of physical systems, the modeling of state space analysis and build the system matrix.
2. Test the system Controllability and Observability for stability analysis.
3. Design the state feedback controller and its applications for stability analysis.
4. Linear and Non-linear control system analysis for stability and applications.

**UNIT-I**

**State variable descriptions:** Introduction – Comparison of advanced control theory and classical control theory – concepts of state, state variables, state vector, state space representation of physical systems in state variable form – physical variables - phase variables and canonical variables.

**UNIT-II**

**Controllability and Observability:** Concept of State of controllability and Observability – Controllability and Observability tests for continuous time systems–corelationship between Controllability and Observability and transfer functions –Duality Principle of Controllability and Observability – Pole placement by state feedback Control design – State observers – Full order and reduced order observers

**UNIT-III**

**Introduction to Design of Control System in State Space:** Definitions involving matrices-Eigen values and Eigen Vectors-Similarity Transformation.

**Time response of linear system:** Introduction – Solution of state equations – Homogenous and Nonhomogeneous – State Transition matrix – Properties of STM – Computation of STM and problems.

**UNIT-IV**

**Controllers:** Introduction to controllers – Need for controllers – Types of Controllers – Proportional, Integral and Derivative Controllers – Transfer function of controllers - PI, PD, PID Controllers – Design of controllers using frequency domain analysis – Comparison of controllers - Applications of controllers



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**UNIT-V**

**Non-linear systems** – Introduction to Non-Linear Systems – common physical non linearities – Behavior of Non-linear Systems - Dead Zone – Saturation - Jump Resonance – Friction etc.

**Describing function of Non linearities** – Dead zone and Saturation – stability analysis of Non-linear control system with respect to describing function analysis.

**Text Books:**

1. K.Ogata, “Modern Control Engineering”, PrenticeHall,2010.
2. A Nagoor Khani, “Advanced Control Theory”, CBS Publications,2020.
3. Benjamin C. Kuo, “Automatic Control system”, PrenticeHall,1995.
4. Advanced control systems theory and applications by yuriy P. Kondrate.

**e-References:**

1. Control systems Theory-Springer link (Link. Springer.com)
2. Automatic control systems by Golnaraghi and kuo-9<sup>th</sup> edition

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | -   | 2   | 2   | -   | -   | -   | -   | -    | -    | -    | 3    | -    |
| CO2         | 3   | 3   | -   | 3   | 2   | -   | -   | -   | -   | -    | -    | -    | 3    | -    |
| CO3         | 2   | 2   | 3   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 2    | 3    |
| CO4         | 2   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -    | -    | -    | 3    | 2    |



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**PE-II-2 - AI TECHNIQUES IN ELECTRICAL ENGINEERING****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VI       | 3-0-0 | 7-3-6-R25E12 | EE       |

**Pre Requisites:**

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

1. Understand feed forward neural networks, feedback neural networks and learning techniques.
2. Understand fuzziness involved in various systems and fuzzy set theory.
3. Develop fuzzy logic control and genetic algorithm for applications in electrical engineering.

**UNIT-I**

**Artificial Neural Networks:** Introduction, Models of Neuron Network-Architectures –Knowledge representation, Artificial Intelligence and Neural networks–Learning process-Error correction learning, Hebbian learning –Competitive learning-Boltzmann learning, supervised learning-Unsupervised learning–Reinforcement Learning-Learning tasks.

**UNIT-II**

**ANN Paradigms:** Multi-layer perceptron using Back propagation Algorithm (BPA), Self –Organizing Map (SOM), Radial Basis Function Network-Functional Link Network (FLN), Hopfield Network.

**UNIT-III**

**Fuzzy Logic:** Introduction –Fuzzy versus crisp, Fuzzy Sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy Cartesian Product, Operations on Fuzzy relations –Fuzzy logic–Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods.

**UNIT-IV**

**Genetic Algorithms:** Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling –Genetic Operators-Cross over-Single site cross over, two points cross over –Multi point cross over Uniform cross over, Matrix cross over-Cross over Rate-Inversion & Deletion, Mutation operator –Mutation –Mutation Rate-Bit-wise operators, Generational cycle-convergence of Genetic Algorithm.

**UNIT-V**

**Applications of AI Techniques:** Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Reactive power control, Speed control of DC and AC Motors.



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**Text Books:**

1. S. Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi, 2003.
2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011.

**Reference Books:**

1. P. D. Wasserman; Neural Computing Theory & Practice, Van Nostrand Reinhold, New York, 1989.
2. Bart Kosko; Neural Network & Fuzzy System, Prentice Hall, 1992
3. D. E. Goldberg, Genetic Algorithms, Addison-Wesley 1999.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1:        | 3   | 3   | 2   | 2   | 3   | –   | –   | –   | –   | –    | –    | 1    | 3    | 2    |
| CO2:        | 3   | 3   | 2   | 2   | 2   | –   | –   | –   | –   | –    | –    | 1    | 3    | 2    |
| CO3:        | 3   | 2   | 3   | 2   | 3   | –   | –   | –   | –   | –    | –    | 1    | 3    | 3    |



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**PE – II -3- SPECIAL ELECTRICAL MACHINES****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VI       | 3-0-0 | 7-3-6-R25E13 | EE       |

**Pre Requisites:** Electrical Machines – I and Electrical Machines – II**Course Outcomes:** At the end of the course, student will be able to

1. Understand field aspects of electrical machines
2. Understand the operation and control of
  - a. Stepper motors
  - b. BLDC motors
  - c. SR motor

**UNIT-I**

**Field aspects of electrical machines:** Review of Maxwell's equations and solution of Laplace's and Poisson's equations. Concept of magnetic vector potential. Eddy current braking. Linear motors: Basic principle of operation and types. End effects & transverse edge effects. Field analysis & Propulsion force; equivalent circuit.

**UNIT-II**

**Stepper motors:** Construction and operation of Stepper Motors: variable reluctance, permanent magnet, hybrid stepper motors, characteristics of stepper motors. Drive Circuits for Stepper motors: Block diagram of stepper motor controller, logic sequence generator, power drivers, current suppression circuits, and acceleration and deceleration circuits.

**UNIT-III**

**Microprocessor control of stepper motors:** microprocessor-based stepper motor controller, PC based stepper motor controller. Micro-stepping Control of Stepper motors: the micro-stepping principle, advantages of micro stepping, design of basic micro-stepping controller. Applications of stepper motor

**UNIT-IV**

**Brushless DC motor:** principle of operation of BLDC motor, square wave permanent magnet brushless motor drives, sine wave permanent magnet Brushless DC motor drives, phasor diagram, torque speed characteristics, controllers for BLDC motors, alternating current drives with PM and synchronous reluctance hybrid motors.

  
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**UNIT-V**

**Switched Reluctance Motor Drives:** Types of SR motors, principle of operation, static torque production, energy conversion loop, dynamic torque production. Converter Circuits, Control of SR motors: current regulation, commutation, torque speed characteristics, shaft position sensing.

**Text Books:**

1. “V.V. Athani, “Stepper Motors Fundamentals, Applications, and Design”, New Age.
2. TJE Miller, “Brushless Permanent-Magnet and Reluctance Motor Drives” Clarendon Press, Oxford

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b>  | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    |
| <b>CO2</b>  | 3   | 3   | -   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    |
| <b>CO3</b>  | 2   | 2   | 3   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 2    | 3    |



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**PE-III-1- ELECTRICAL DISTRIBUTION SYSTEMS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VI       | 3-0-0 | 7-3-6-R25E21 | EE       |

**Pre-Requisites:** Power systems-1**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Understand the basics of Distribution systems
2. Understand different Distribution Transformers & feeders
3. Understand the basics of Substations
4. Understand the working of Protective devices and coordination
5. Acquire the knowledge of power factor and voltage control

**UNIT-I**

**Introduction to distribution systems:** The role of computers in distribution system planning. Load modeling and characteristics. Coincidence factor, contribution factor and loss factor. Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics.

**UNIT-II**

**Distribution Transformers & feeders** – Distribution transformer types, regulation and efficiency. Design considerations of distribution feeders – Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.

**UNIT-III**

**Substations** – Introduction – types of substations - main equipments in substations - Busbar Arrangements- Key diagram of a typical primary substation - Rating of a distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

**UNIT-IV**

**Protective devices and coordination** – Objectives of distribution system protection, Types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of fuses, circuit reclosures, line Sectionalizers, and circuit breakers. Coordination of protective devices General coordination procedure.

**UNIT-V**

**Power factor improvement** – Capacitive compensation for power-factor control – Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and Switched), power factor correction, capacitor allocation.

**Voltage control** – Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.



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**Text Books:**

1. “Electric power Distribution system Engineering “– by Turan Gonen, Mc Graw-Hill book company.
2. V. Kamaraju, Electrical Power Distribution Systems, Tata Mc Graw Hill Publishing Company, 2nd edition, 2010.
3. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    |
| CO2         | 3   | 3   | -   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    |
| CO3         | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    |
| CO4         | 3   | 3   | -   | 2   | 2   | -   | -   | -   | -   | -    | -    | -    | 3    | -    |
| CO5         | 3   | 2   | 2   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    |



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**PE-III-2- DIGITAL SIGNAL PROCESSING****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VI       | 3-0-0 | 7-3-6-R25E22 | EE       |

**Pre-Requisites:** Signals and Systems**Course Outcomes:**

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

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
2. Analyse discrete-time systems using z-transform.
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms. Design digital filters for various applications.

**UNIT-I****Discrete-time signals and systems**

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

**UNIT-II****Z-transform**

Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

**UNIT-III****Discrete Fourier Transform**

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

**UNIT-IV****Design of Digital filters**

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

**UNIT-V****Applications of Digital Signal Processing**

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.



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**Text/Reference Books:**

1. S. K. Mitra, "Digital Signal Processing: A Computer based approach", McGraw Hill,
2. A.V. Oppenheim and R. W. Schaffer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | -   | 2   | 2   | -   | -   | -   | -   | -    | -    | -    | 3    | -    |
| CO2         | 3   | 3   | -   | 2   | 2   | -   | -   | -   | -   | -    | -    | -    | 3    | -    |
| CO3         | 3   | 2   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 2    | -    |
| CO4         | 2   | 2   | 3   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | 2    | 3    |



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**PE-III-3- RESTRUCTURED POWER SYSTEMS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VI       | 3-0-0 | 7-3-6-R25E23 | EE       |

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

1. Understand the concepts of Restructuring of Power Industry
2. Understand the basics of Transmission Congestion Management
3. Understand the concepts of Locational Marginal Prices and Financial Transmission Rights
4. Understand the basics of Ancillary Service Management
5. Understand different pricing techniques of Transmission Network

**UNIT I****INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY** Introduction:

Deregulation of power industry, restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models

**UNIT II**

**TRANSMISSION CONGESTION MANAGEMENT** Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

**UNIT III****LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS**

Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality -Simultaneous feasibility test and revenue adequacy – FTR issuance process: FTR auction, FTR allocation — Flow gate rights – FTR and market power

  
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**UNIT IV**

**ANCILLARY SERVICE MANAGEMENT** Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service

**UNIT V**

**PRICING OF TRANSMISSION NETWORK** Transmission pricing – Principles – Classification – Rolled in transmission pricing methods – Marginal transmission pricing paradigm - Composite pricing paradigm – Merits and demerits of different paradigm.

**Text Books / References:**

1. Sally Hunt,” Making competition work in electricity”, John Willey and Sons Inc. 2002
2. Steven Stoft,” Power system economics: designing markets for electricity”, John Wiley & Sons, 2002.
3. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, “Restructured electrical power systems: operation, trading and volatility” Pub., 2001
4. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Bollen,” Operation of restructured power systems”, Kluwer Academic Pub., 2001.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | -   | -   | -   | 2   | 2   | -   | -   | -    | -    | -    | 2    | -    |
| CO2         | 3   | 3   | -   | 2   | 2   | -   | -   | -   | -   | -    | -    | -    | 3    | -    |
| CO3         | 3   | 3   | -   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    |
| CO4         | 2   | 2   | -   | -   | -   | 2   | 2   | -   | -   | -    | -    | -    | 2    | -    |
| CO5         | 3   | 2   | 2   | -   | 2   | -   | -   | -   | -   | -    | 3    | -    | 2    | 2    |

  
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**PE-III - 4 - INTRODUCTION TO SEMICONDUCTOR MANUFACTURING****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code (7-0-1-01R25) | Branches                         |
|----------|-------|---------------------------|----------------------------------|
| VI       | 3-0-0 | 7-0-6-R25CE1              | CH,CE,EE,EC,ME,CS (All Branches) |

**Course Overview:**

This course deals with semiconductor materials, semiconductor wafer manufacturing and characterization, semiconductor device manufacturing techniques, characterization and advanced processing tools, semiconductor ecosystem and applications.

This course prepares the students to apply their knowledge for designing the processes and manufacturing the equipment and tools for semiconductor device manufacturing in India under the National Semiconductor Mission Programme.

**Course Objective(s):**

- To explain the physics of semiconductor materials and devices.
- To discuss the processes involved in semiconductor manufacturing.
- To understand the ecosystem of semiconductor manufacturing.
- To get knowledge of safety aspects in the semiconductor industry.
- To design systems and equipment for semiconductor manufacturing.

**UNIT – 1:****Semiconductor materials (Si, Ge, GaAs, GaN, SiC):**

Electrical classification of solids (metals, semiconductors and insulators), intrinsic and extrinsic semiconductors, crystal structure and defects, band gap and Fermi level, doping effects on electrical conduction in semiconductors, direct and indirect bandgap semiconductors.

**UNIT – 2:****Semiconductor wafer manufacturing and characterization:**

Thermal and chemical processes involved in converting pure sand into electronic grade polycrystalline silicon, pure silicon crystal growth from polysilicon, silicon wafer fabrication and polishing.

**UNIT – 3:****Thin film fabrication and characterization:**

Vacuum-based thin film deposition techniques for metals, semiconductors and dielectrics; Physical Vapour Deposition (PVD); Chemical Vapour Deposition (CVD); analytical characterization techniques (XRD, SEM, TEM, XPS etc.); plasma, lasers and ion beams for semiconductor manufacturing.



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**UNIT – 4:****Semiconductor Device Manufacturing Techniques:**

Introduction to IC-chip manufacturing, oxidation, lithography, etching, doping, diffusion, ion-implantation and metallization, realization of on-chip resistor, diode, capacitor and inductor, bonding and packaging.

**UNIT – 5:****Semiconductor ecosystem, safety and applications:**

Clean room aspects, gas handling systems in semiconductor manufacturing, safety aspects in device fabrication (electrical, chemical and vacuum), clean water and pure chemical requirements, CMOS-based IC chips for computers and mobiles, semiconductor-based solar cells and displays, lab-grown diamonds for semiconductor applications.

**Textbooks:**

1. Sze SM and Lee MK, *Semiconductor Devices: Physics and Technology*, 3rd Edition, Wiley India (2016).
2. Swami Nathan P, *Semiconductor Materials, Devices and Fabrication*, Wiley (2019)

**References:**

1. Neaman D, *Semiconductor Physics and Devices*, 4th Edition, McGraw Hill (2017).
2. MKS Handbook: *Semiconductor Devices and Process Technology*, 2nd Edition (2017).
3. Gandhi S.K, *VLSI Fabrication Principles: Silicon and Ga-As*, 2nd Edition, Wiley (2008).

**Course Outcomes: After completing this course, students will be able to**

1. Understand the basic properties and behavior of semiconductor materials used in electronic devices.
2. Learn how semiconductor wafers are manufactured from raw materials to finished silicon wafers.
3. Gain knowledge of thin-film deposition methods and basic material characterization techniques.
4. Understand the main steps involved in semiconductor device and IC fabrication processes.
5. Become familiar with the semiconductor manufacturing ecosystem, safety practices, and major applications of semiconductor devices.

**Mapping of course outcomes with program outcomes:**

| PO/<br>CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1       | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | 3    | 2    |
| CO2       | 3   | 2   | -   | 2   | -   | -   | -   | -   | -   | -    | -    | 1    | 3    | 1    |
| CO3       | 2   | 2   | -   | 3   | 3   | -   | -   | -   | -   | -    | -    | 1    | 2    | 2    |
| CO4       | 2   | 2   | 3   | 2   | 2   | -   | -   | -   | -   | -    | -    | 1    | 1    | 1    |
| CO5       | 1   | -   | -   | -   | -   | 3   | 2   | 2   | 2   | 1    | -    | 2    | 2    | 2    |

  
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**MICRO PROCESSORS AND MICRO CONTROLLERS LAB****Credits: 1.5****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VI       | 0-0-3 | 7-3-6-R25P1 | EE       |

**Pre-Requisites:** Micro Processors and Micro Controllers**Course Outcomes:** At the end of the course, students will be able to:

1. Demonstrate program proficiency using the various instructions of the 8086microprocessor.
2. Demonstrate program proficiency using the various instructions of the 8051microcontroller
3. Design systems for different applications by interfacing external devices

**List of Experiments Using 8086 and 8051 Microprocessors****8086 Microprocessor Experiments**

1. To perform arithmetic operations on 8-bit numbers using 8086
  - a) Addition of two 8-bit numbers
  - b) Subtraction of two 8-bit numbers
2. To perform multiplication and division on 8-bit numbers using 8086
  - a) Multiplication of two 8-bit numbers
  - b) Division of two 8-bit numbers
3. To perform arithmetic operations on 16-bit numbers using 8086
  - a) Addition of two 16-bit numbers
  - b) Subtraction of two 16-bit numbers
4. To perform multiplication and division on 16-bit numbers using 8086
  - a) Multiplication of two 16-bit numbers
  - b) Division of two 16-bit numbers
5. To perform Boolean operations using 8086
  - a) OR operation
  - b) AND operation
  - c) NOT operation
  - d) XOR operation

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6. To find elements in an array using 8086
  - a) Smallest number in an array
  - b) Largest number in an array
7. To sort an array using 8086
  - a) Sorting in ascending order
  - b) Sorting in descending order
8. To perform string operations using 8086
  - a) Finding the length of a string
  - b) Reversing a string
9. To generate number sequences using 8086
  - a) Arithmetic progression
  - b) Geometric progression
10. To generate series and perform summation using 8086
  - a) Fibonacci series
  - b) Sum of first 'n' natural numbers

#### 8051 Microcontroller Experiments (Basic Arithmetic Operations)

11. To perform addition of two numbers using 8051 microcontroller
12. To perform subtraction of two numbers using 8051 microcontroller
13. To perform multiplication of two numbers using 8051 microcontroller
14. To perform division of two numbers using 8051 microcontroller.

#### Interfacing Experiments Using 8086

15. To interface 8086 microprocessor with I/O devices

#### CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | -   | 2   | 3   | -   | -   | -   | 2   | -    | -    | -    | 3    | -    |
| CO2         | 3   | 2   | -   | 2   | 3   | -   | -   | -   | 2   | -    | -    | -    | 3    | -    |
| CO3         | 2   | 3   | 3   | 2   | 3   | -   | -   | -   | 3   | 1    | -    | -    | 2    | 3    |

  
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**MEASUREMENTS AND INSTRUMENTATION LAB****Credits: 1.5****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VI       | 0-0-3 | 7-3-6-R25P2 | EE       |

**Pre-Requisites:** Electrical and Electronics Measurements**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. Analyze measurement data and errors using statistical methods.
2. Measure electrical quantities using bridge methods and instruments.
3. Perform range extension and calibration of measuring instruments.
4. Analyze instrument transformers and AC/three-phase measurements.
5. Measure temperature and displacement using RTD and LVDT.

**LIST OF EXPERIMENTS:**

1. Statistical Error Analysis.
2. a. Range Extension of Ammeter.  
b. Range Extension of Voltmeter.
3. Measurements of medium resistance by Wheatstone Bridge.
4. Measurement of current-by-current transformer.
5. Measurement of coil parameters by 3 Ammeter and 3 Voltmeter method
6. Calibration of low power-factor wattmeter.
7. Calibration of single-phase Energy meter.
8. Measurement of three-phase reactive power.
9. Measurement of temperature by RTD (Resistance Temperature Detector).
10. Measurement of displacement by LVDT (Linear variable Differential Transformer).
11. Measurement of low resistance by kelvins double bridge.
12. Measurement of inductance by Anderson bridge.
13. Measurement of unknown inductance by Maxwell bridge.
14. Measurement of capacitance by Desauty's bridge.


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**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| <b>CO1</b>  | 3   | 3   | -   | 3   | 2   | -   | -   | -   | 2   | -    | -    | -    | 3    | -    |
| <b>CO2</b>  | 3   | 2   | -   | 2   | 3   | -   | -   | -   | 2   | -    | -    | -    | 3    | -    |
| <b>CO3</b>  | 3   | 2   | 2   | 3   | 2   | -   | -   | -   | 2   | 1    | -    | -    | 2    | 2    |
| <b>CO4</b>  | 3   | 3   | -   | 2   | 2   | -   | -   | -   | 2   | -    | -    | -    | 3    | -    |
| <b>CO5</b>  | 3   | 2   | 2   | 2   | 3   | -   | -   | -   | 2   | -    | -    | -    | 2    | 3    |



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**JAVA PROGRAMMING****Credits: 2****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VI       | 1-0-2 | 7-3-6-R25S1 | EE       |

**Pre Requisites:** Basics of JAVA**Course Outcomes:** At the end of the course, the student will be able to:

1. Understand the Java programming environment and basic syntax.
2. Write Java programs using control structures and operators.
3. Apply built-in data structures to solve programming problems.
4. Develop object-oriented programs using classes and inheritance.

**LIST OF EXPERIMENTS:**

1. Introduction to Java Programming
2. Arithmetic and Logical Operations
3. Number as a String and Number to String
4. Fibonacci Series and Factorial of a number
5. Sum of the squares and Even, Odd, Sum & Count
6. Initialization of Array and Matrix Multiplications
7. Area & Volume and Binary Addition.
8. Pattern of Stars and Largest & Frequency of Number
9. Power Series & Student Details
10. Leap Year or Not and Display Calendar

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 2   | -   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | 1    | -    |
| CO2         | 2   | 2   | 3   | 2   | 3   | -   | -   | -   | 2   | 1    | -    | -    | 1    | 2    |
| CO3         | 2   | 3   | 2   | 2   | 3   | -   | -   | -   | 2   | -    | -    | -    | 2    | 2    |
| CO4         | 2   | 2   | 3   | 2   | 2   | -   | -   | -   | 2   | 1    | -    | -    | 1    | 3    |



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**B. Tech. (Electrical and Electronics Engineering)**  
**Semester VII (Fourth Year)**

| Code       |             | Category | Course Title                     | Hours/Week |   |    | Total | Credits | Marks |     |       |
|------------|-------------|----------|----------------------------------|------------|---|----|-------|---------|-------|-----|-------|
| Department | University  |          |                                  | L          | T | P  |       |         | CIE   | SEE | Total |
| EE3701C    | 7-3-7-01R25 | EE-PC    | Power System Protection          | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3702E    | 7-3-7-R25E1 | EE-PE    | Professional Elective – IV       | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3703E    | 7-3-7-R25E2 | EE-PE    | Professional Elective – V        | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3704E    | 7-3-7-R25E3 | EE-PE    | Professional Elective - VI       | 3          | 0 | 0  | 3     | 3       | 40    | 60  | 100   |
| EE3705E    | 7-3-7-R25O1 | EE-OE    | Open Elective – II (MOOCs)       | 3          | 0 | 0  | 3     | 3       | 0     | 100 | 100   |
| EE3706E    | 7-3-7-R25O2 | EE-OE    | Open Elective – III (MOOCs)      | 3          | 0 | 0  | 3     | 3       | 0     | 100 | 100   |
| EE3707L    | 7-3-7-R25P1 | EE-PC    | Power Systems and Simulation Lab | 0          | 0 | 2  | 2     | 1       | 40    | 60  | 100   |
| EE3708L    | 7-3-7-R25S1 | EE-SC    | Internet of Things               | 1          | 0 | 2  | 3     | 2       | 40    | 60  | 100   |
| EE3709I    | 7-0-7R25CS  | EE-SI    | Summer Industrial Internship     | 0          | 0 | 0  | 0     | 2       | 100   | 0   | 100   |
|            |             |          |                                  | 19         | 0 | 04 | 23    | 23      | 340   | 560 | 900   |



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## **ELECTRICAL & ELECTRONICS ENGINEERING**

### **PROFESSIONAL ELECTIVE COURSES**

|                                         |                     |                                                                |
|-----------------------------------------|---------------------|----------------------------------------------------------------|
| Professional Elective - I:<br>(V Sem)   | 7-3-5-R25E11        | Renewable Energy Systems                                       |
|                                         | 7-3-5-R25E12        | High Voltage Engineering                                       |
|                                         | 7-3-5-R25E13        | Electrical Safety                                              |
|                                         |                     |                                                                |
| Professional Elective – II<br>(VI Sem)  | 7-3-6-R25E11        | Advanced Control Systems                                       |
|                                         | 7-3-6-R25E12        | AI Techniques in Electrical Engineering                        |
|                                         | 7-3-6-R25E13        | Special Electrical Machines                                    |
|                                         |                     |                                                                |
| Professional Elective – III<br>(VI Sem) | 7-3-6-R25E21        | Electrical Distribution Systems                                |
|                                         | 7-3-6-R25E22        | Digital Signal Processing                                      |
|                                         | 7-3-6-R25E23        | Restructured Power Systems                                     |
|                                         | 7-0-6-R25CE1        | Introduction to Semiconductor Manufacturing                    |
|                                         |                     |                                                                |
| Professional Elective – IV<br>(VII Sem) | <b>7-3-7-R25E11</b> | <b>Electric Vehicle Technologies</b>                           |
|                                         | <b>7-3-7-R25E12</b> | <b>FACTS and Power Quality</b>                                 |
|                                         | <b>7-3-7-R25E13</b> | <b>Machine Learning Applications to Electrical Engineering</b> |
|                                         |                     |                                                                |
| Professional Elective – V<br>(VII Sem)  | <b>7-3-7-R25E21</b> | <b>Power System Operation and Control</b>                      |
|                                         | <b>7-3-7-R25E22</b> | <b>Power Semiconductor Controlled Drives</b>                   |
|                                         | <b>7-3-7-R25E23</b> | <b>Smart Grid Technologies</b>                                 |
|                                         |                     |                                                                |
| Professional Elective – VI<br>(VII Sem) | <b>7-3-7-R25E31</b> | <b>HVDC Transmission</b>                                       |
|                                         | <b>7-3-7-R25E32</b> | <b>Energy Auditing and Management</b>                          |
|                                         | <b>7-3-7-R25E33</b> | <b>Embedded Systems</b>                                        |



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**POWER SYSTEM PROTECTION****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VII      | 3-0-0 | 7-3-7-01R25 | EE       |

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

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of faults in a network.
3. Understand the protection schemes for different power system components.
4. Understand the basic principles of digital protection.
5. Understand system protection schemes, and the use of wide-area measurements.

**UNIT-I**

**Protection against over voltages:** Causes of over voltages-over voltages due to lightning – Rod gaps-Horn Gaps-Expulsion type and valve type lightning arresters-lightning arrester calculations- ground wires-counter poises-surge absorbers and surge diverters. Basics of Insulation coordination- Power system earthing.

**UNIT-II**

**Fuses:** Definitions, characteristics, types, HRC fuses.

**Circuit breakers:** Introduction - Formation of Arcs in CBs - arc interruption theories - Definitions - Current chopping - Classification of circuit breakers - Oil circuit breakers- Air blast circuit breaker - SF6 circuit breaker-Vacuum circuit breaker - Testing of circuit breakers.

**UNIT-III**

**Protective Relaying fundamentals:** Introduction – Need for protective systems in a power system – Zones of protection - Primary and backup protection – definition and functional characteristics of a protective relay – operating principles of various electromagnetic relays.

**UNIT-IV**

**Types of Protective Relays:** Overcurrent relays – Directional overcurrent relays – applications of over current relays. Distance relays: the universal torque equation – impedance, reactance and mho relays - differential relays – percentage differential relays – Static relays.

**UNIT-V**

**Generator Protection:** Protection against stator faults, against rotor faults and against abnormal conditions.

**Transformer Protection:** Buchholz relay, differential protection, percentage differential protection.

**Busbar protection:** - Frame leakage protection scheme



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**Text Books:**

1. Badri Ram & D.N. Vishwakarma – Power system protection and switch gear., TMH publishing Company Ltd. 1995.
2. C.L. Wadhwa – Electrical power systems, Wiley Eastern Ltd.
3. B. Ravindranath & M. Chander, power system protection & switch gear., Wiley Eastern Ltd.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \<br>PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1            | 3   | 2   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | 1    | 2    | –    |
| CO2            | 3   | 3   | –   | 2   | 1   | –   | –   | –   | –   | –    | –    | –    | 3    | –    |
| CO3            | 3   | 2   | 2   | –   | 2   | 1   | 1   | –   | –   | –    | –    | –    | 3    | 2    |
| CO4            | 2   | 2   | –   | 1   | 3   | –   | –   | –   | –   | –    | –    | 1    | 3    | –    |
| CO5            | 2   | 2   | 1   | 2   | 3   | 1   | 1   | –   | –   | 1    | –    | 1    | 3    | 1    |



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**PE-IV - 1- ELECTRIC VEHICLE TECHNOLOGIES****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E11 | EE       |

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

1. Understand the basics of electric vehicles, technical characteristics and properties of batteries and also to design battery pack.
2. Know the ratings and requirements of electrical machines.
3. Apply the regenerative braking and sizing of motors.
4. Configure and design the components of hybrid electric vehicles.

**UNIT I**

**Electric Vehicles:** Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

**UNIT II**

**Battery:** Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

**UNIT III**

**DC & AC Electrical Machines:** Motor and Engine rating, Requirements, DC machines, three phase A.C machines, Induction machines, permanent magnet machines, switched reluctance machines.

**UNIT IV**

**Electric Vehicle Drive Train:** Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

**UNIT V**

**Hybrid Electric Vehicles:** Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.



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**Text book:**

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.  
James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

**Reference Books:**

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000 <http://nptel.ac.in/courses/108103009/>

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 2   | –   | 2   | –   | 2   | –   | –   | –    | –    | 1    | 2    | 3    |
| CO2         | 3   | 2   | 1   | –   | 2   | –   | 1   | –   | –   | –    | –    | –    | 3    | 2    |
| CO3         | 2   | 3   | 2   | 1   | 2   | –   | 2   | –   | –   | –    | –    | –    | 3    | 2    |
| CO4         | 2   | 2   | 3   | 1   | 2   | 1   | 2   | –   | 1   | 1    | 1    | 1    | 2    | 3    |



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**PE-IV – 2- FACTS AND POWER QUALITY****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E12 | EE       |

**Course Outcomes:**

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

1. Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2. Understand the working principles of FACTS devices and their operating characteristics.
3. Understand the basic concepts of power quality.
4. Understand the working principles of devices to improve power quality.

**UNIT-I****Transmission Lines and Reactive Power Compensation (10 hours)**

AC Transmission System. Uncompensated and Compensated transmission lines. Introduction to Active and Passive Compensations. Types of Compensations.

**UNIT-II****Flexible AC Transmission Controllers (FACTS) (12 hours)**

Introduction to FACTS devices: Description and Characteristics - Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Fault Current Limiter.

Principle of Operation of STATCOM - Unified Power Flow Controller (UPFC) - Interline Power Flow Controller.

**UNIT-III****Application of FACTS (6 hours)**

Application of FACTS devices for power system problems - Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.



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**UNIT-IV****Power Quality Problems in Distribution Systems (8 hours)**

Introduction to Power Quality - Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Waveform Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment:

**UNIT-V****Custom Power Devices (10 hours)**

Introduction to CPD - Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems, Voltage Sag/Swell mitigation: – Working Principle and Control Strategies of Dynamic Voltage Restorer, DSTATCOM, Unified Power Quality Conditioner (UPQC).

**Text/References**

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.
2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.
4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.
5. Math H. J. Bollen., "Understanding Power Quality Problems", IEEE Press,, 2003
6. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 1   | –   | 2   | –   | 1   | –   | –   | –    | –    | –    | 3    | 1    |
| CO2         | 3   | 2   | 2   | 1   | 3   | –   | 1   | –   | –   | –    | –    | 1    | 3    | 2    |
| CO3         | 3   | 2   | –   | –   | 1   | 1   | 2   | –   | –   | –    | –    | –    | 2    | –    |
| CO4         | 2   | 2   | 2   | 1   | 3   | 1   | 2   | –   | –   | –    | –    | 1    | 3    | 2    |



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### PE-IV – 3- MACHINE LEARNING APPLICATIONS TO ELECTRICAL ENGINEERING

**Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E13 | EE       |

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

1. Demonstrate proficiency in applying machine learning algorithms to solve real-world problems in electrical engineering
2. Integrate machine learning principles effectively into electrical engineering applications,
3. Enhance problem-solving skills by successfully addressing complex issues in electrical engineering through machine learning.

#### UNIT-I

**Introduction to Machine Learning:** Definition and types of machine learning, Historical perspective, Basic concepts: supervised learning, unsupervised learning, reinforcement learning

#### UNIT-II

**Fundamentals of Electrical Engineering Relevant to ML:** Overview of electrical circuits and systems, Signal processing basics, Introduction to control systems

#### UNIT-III

**Data Preprocessing and Feature Engineering:** Data cleaning and handling missing values, Feature scaling and normalization, Feature extraction and selection

#### UNIT-IV

**Machine Learning Algorithms for Electrical Engineering Applications:** Regression and classification algorithms, Decision trees and ensemble methods, Neural networks and deep learning, Support vector machines, Clustering algorithms for pattern recognition

#### UNIT-V

**Case Studies and Applications in Electrical Engineering:** Power system optimization using ML, Fault detection and diagnostics in electrical systems, Smart grid applications, Signal processing with ML, Control system optimization and adaptive control using ML

#### **Text book:**

1. C. Aldrin Renold and Sumathi S., Pattern Recognition and Machine Learning, Wiley India, 2015.
2. S. Rajasekaran and G. Aghila, Machine Learning: An Algorithmic Perspective, Chapman and Hall/CRC, 2018
3. Chandra Shekhar Yadav, S. Ramakrishnan, and U. Rajendra Acharya, Machine Learning: Concepts, Methodologies, Tools and Applications, Springer 2018.

#### **Reference Books:**

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2010.
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press 2012.

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**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \<br>PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1            | 2   | 3   | 1   | 2   | 3   | –   | 1   | –   | –   | –    | –    | 2    | 3    | 2    |
| CO2            | 2   | 2   | 3   | 2   | 3   | 1   | 1   | –   | 1   | 1    | –    | 2    | 3    | 3    |
| CO3            | 3   | 3   | 2   | 2   | 3   | 1   | 1   | –   | 1   | 1    | 1    | 2    | 3    | 2    |



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**PE-V - 1- POWER SYSTEM OPERATION AND CONTROL****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E21 | EE       |

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

1. Understand the economic operation, economic dispatch, and unit commitment of power systems.
2. Analyze voltage control and frequency regulation methods.
3. Understand stability issues and reactive power compensation.

**UNIT-I**

**Economic operation of power systems:** Introduction – Load Curves – operating cost of a thermal plant – Economic dispatch neglecting losses and no generation limits –Economic dispatch including losses - derivation of loss formula – Hydro-Thermal scheduling.

**UNIT-II**

**Unit commitment and optimal power flow constraints of unit commitment problem –** Solution methods of unit commitment – priority list methods – Dynamic programming approach to solve the unit commitment problem - optimal power flow solution – Elementary treatment of optimal power flow with and without constraints

**UNIT-III**

**Load frequency control:** The load frequency control problem – Basic P-f and Q-V control loops of a synchronous generator – Governor model- prime mover model – Generator model – Load model – concept of Single & Multi area power systems – Block diagrams representation of an isolated single area power system – steady state and dynamic responses of uncontrolled and proportional plus integral control of single area power system – load frequency control of two-area power system – Tie line bias control.

  
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**UNIT-IV**

**Automatic voltage regulator** – introduction - modeling of amplifier, exciter, Generator and sensor – A simplified AVR block diagram – Excitation system stabilizer – Rate feedback and PID controller – automatic excitation generation control with system – placement and optimal feed- back design.

**UNIT-V**

**Voltage stability and reactive power control**- voltage stability problems in a power system – over flow of reactive power control – control of reactive power flow on a line – load compensation - specification of load compensator – uncompensated and compensated transmission lines.

**Text Books:**

1. “Power system analysis” by Hadi Saadat, Tata Mc Grawhill International.
2. “Modern power system analysis” by J. Nagarath & DP Kothari, Tata Mc Grawhill second edition
3. “Power system analysis and design” by B.R. Gupta wheeler publishing
4. “Electrical energy system theory” by O.I. Elgerd Tata Mc Grawhill Ltd second edition.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | 2   | 1   | 2   | –   | 1   | –   | –   | –    | 1    | –    | 3    | 2    |
| CO2         | 3   | 3   | 1   | 2   | 2   | –   | 1   | –   | –   | –    | –    | –    | 3    | 1    |
| CO3         | 3   | 2   | 2   | 2   | 2   | 1   | 2   | –   | –   | –    | –    | –    | 3    | 2    |



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**PE-V - 2- POWER SEMICONDUCTOR CONTROLLED DRIVES****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E22 | EE       |

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

1. Understand the fundamental concepts of electrical drives.
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

**UNIT-I**

**Electrical Drives** – An introduction – Electrical Drives, Advantages of Electrical Drives, parts of electrical drives – Electrical motor, power modulators, sources, control unit, choice of electrical drives, status of dc and ac drives.

**Dynamics of Electrical Drives** – Fundamental Torque equations, speed torque convention and multi quadrant operation, Equivalent values of drive parameters – Loads with rotational motion, loads with translational motion, measurement of moment of inertia. Components of load torques, Nature and classification of load torques, calculation of time and energy loss in transient operation, steady state stability, load equalization.

**UNIT-II**

**Control of electrical drives** – Modes of operation, speed control and drive classifications closed loop control of drives.

**D.C. Motor drives** – Starting, Braking, speed control - Armature voltage control, Ward Leonard drives, controlled rectifier fed DC drives – Single phase and 3-phase fully controlled and half controlled converter fed separately excited D.C. Motor, Chopper Controlled DC drives. (separately excited motor).

**UNIT-III**

**Induction Motor Drives:** Review of three phase I.M., analysis and performance. Operation with unbalanced source voltages and single phasing, analysis of I.M. fed from non-sinusoidal voltage supply. Starting, Braking, methods



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**UNIT-IV**

**Speed control methods of IM**, v/f controlled induction motors, controlled current and controlled slip operation, PWM inverter drives, multi-quadrant drives and field-oriented control, slip power control, single phase I.M. Close loop control of I.M. Drives.

**UNIT-V**

**Synchronous motor drives:** cylindrical rotor wound field motor, Salient pole wound field motor, Synchronous reluctance motor, Hysteresis synchronous motor, Operation from fixed frequency supply, starting, braking, synchronous motor, variable speed drives, starting large synchronous machines.

**Energy Conservation in electrical drives** – Losses in electrical drive system, measures of energy conservation in electrical drives, use of efficient converters, energy efficient operation of drives, improvement of p.f., improvement of quality of supply, maintenance of motors.

**Text Books:**

1. G.K.Dubey – Fundamentals of Electrical drives.
2. Vedam Subrahmanyam - Electrical drives – Concepts and applications.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | –   | –   | 1   | –   | –   | –   | –   | –    | –    | –    | 3    | –    |
| CO2         | 3   | 3   | 1   | 1   | 2   | –   | 1   | –   | –   | –    | –    | –    | 3    | 2    |
| CO3         | 3   | 2   | 2   | 1   | 3   | –   | 1   | –   | –   | –    | –    | 1    | 3    | 2    |



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**PE-V - 3- SMART GRID TECHNOLOGIES****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E23 | EE       |

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

1. Understand smart grids and analyze the smart grid policies and developments in smart grids.
2. Develop concepts of smart grid technologies and their applications.
3. Analyze micro grids, distributed generation systems, the effect of power quality in smart grid and understand latest developments in ICT for smart grid.

**UNIT – I**

**Introduction to Smart Grid:** Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

**UNIT – II**

**Smart Grid Technologies-I:** Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

**UNIT – III**

**Smart Grid Technologies-II:** Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

**UNIT – IV**

**Micro grids and Distributed Energy Resources:** Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.



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**UNIT – V**

**Power Quality Management in Smart Grid:** Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

**Information and Communication Technology for Smart Grid:** Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

**Text Books:**

1. Ali Keyhani, Mohammad N. Marwali, Min Dai “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley
2. Clark W.Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press

**Reference Books:**

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley
2. Jean Claude Sabonnadière, Nouredine Hadjsaïd, “Smart Grids”, Wiley Blackwell 19
3. Peter S. Fox Penner, “Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities”, Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, “Microgrids and Active Distribution Networks.” Institution of Engineering and Technology, 30 Jun 2009
5. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press 6. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability: 1”, Artech House Publishers July 2011.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 2   | 3   | 1   | –   | 2   | 2   | 2   | –   | –   | 1    | –    | 2    | 2    | 1    |
| CO2         | 2   | 2   | 3   | 1   | 3   | 1   | 2   | –   | 1   | 1    | –    | 2    | 3    | 3    |
| CO3         | 3   | 3   | 2   | 2   | 3   | 1   | 2   | –   | 1   | 1    | –    | 2    | 3    | 2    |



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**PE-VI - 1- HVDC TRANSMISSION****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E31 | EE       |

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

1. Differentiate between AC and DC transmission, their advantages and applications
2. Analyze HVDC converters and converter bridge characteristics
3. Understand the particulars of converters and HVDC system control.
4. Identify Converter faults and protection carried.
5. Understand reactive power control, harmonics and filters.

**UNIT-I****DC Power Transmission Technology:**

Introduction, Comparison of AC DC transmission, Converter station, Description of DC Transmission systems, Components of a HVDC system. Choice of voltage level, Modern trends in DC transmission.

**UNIT-II****Analysis of HVDC Converters:**

Pulse number, Choice of converter configuration, valve rating. Transformer, simplified analysis of graetz circuit with and without overlap (2 and 3 valve conduction mode) rectifier and inverter waveforms, converter bridge characteristics

**UNIT-III****Converter and HVDC System Control:**

Principle of DC Link control, Converter control characteristics, system and control hierarchy, firing angle control, converter and excitation angle control, starting and stopping of DC Link, Power control

**UNIT-IV****Converter Faults and protection:**

Converter Faults, Protection against over currents, over voltages in converter station, surge arresters, protection against over voltages, Smoothing reactor, DC Line, Transient over-voltages in DC line, protection of DC line, DC breakers.

**UNIT-V**

**Reactive power control:** Reactive power requirements in steady state, Sources of reactive power, static var systems. Harmonics and Filters: Generation of Harmonics, Design of AC Filters, DC Filters, Carrier frequency and RI noise.



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**Text Books:**

1. K R Padiyar, "HVDC Transmission Systems"
2. S. Rao, "EHV AC and HVDC Transmission engineering and Practice"
3. J.Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd.,1983.
4. E.W.Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience,1971.

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 1   | –   | 1   | –   | 1   | –   | –   | –    | –    | –    | 2    | 1    |
| CO2         | 3   | 3   | 1   | 2   | 3   | –   | 1   | –   | –   | –    | –    | –    | 3    | 2    |
| CO3         | 3   | 2   | 2   | 2   | 3   | –   | 1   | –   | –   | –    | –    | 1    | 3    | 2    |
| CO4         | 3   | 3   | 1   | 2   | 2   | 1   | 1   | –   | –   | –    | –    | –    | 3    | 1    |
| CO5         | 3   | 2   | 2   | 1   | 3   | –   | 2   | –   | –   | –    | –    | 1    | 3    | 2    |



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**PE-VI - 2- ENERGY AUDITING AND MANAGEMENT****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E32 | EE       |

**EE3704E.ii****3 Credits****Sessional Marks: 40****3L:0T:0P****End Examination Marks: 60**

**Pre-Requisites:** D.C. Machines and Transformers, Induction Motors and Synchronous Machines, Power systems-1

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

1. Understand energy audit of industries and management of energy systems
2. Analyze the methods of improving efficiency of electric motors, power factor and design a good illumination system
3. Evaluate and analyze economic aspects of energy saving equipment

**UNIT-I**

**Energy Management:** Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manager, Qualities and functions, language, Questionnaire – check list for top management.

**UNIT-II**

**Basic Principles of Energy Audit:** Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

**UNIT-III**

**Energy Efficient Motors:** Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, variable duty cycle systems, RMS hp-voltage variation-voltage unbalance- over motoring- motor energy audit.



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**UNIT-IV**

**Power Factor Improvement, Lighting and Energy Instruments:** Power factor – methods of improvement, location of capacitors, pf with nonlinear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

**UNIT-V**

**Economic Aspects and Analysis:** Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

**Text Books**

1. “Energy management”, W.R. Murphy and G. McKay Butter worth, Heinemann publications.
2. “Energy management”, Paul o’ Callaghan, Mc-graw Hill Book company-1st edition, 1998

**References:**

1. “Energy efficient electric motors”, John.C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995
2. “Energy management hand book”, W.C.Turner, John wiley and son
3. “Energy management and good lighting practice: fuel efficiency- booklet”, 12-EEO

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 2   | 1   | –   | 2   | 1   | 3   | –   | –   | –    | 1    | 1    | 2    | 1    |
| CO2         | 3   | 3   | 2   | 1   | 2   | –   | 3   | –   | –   | –    | –    | –    | 3    | 2    |
| CO3         | 2   | 2   | 2   | –   | 1   | –   | 2   | –   | –   | –    | 3    | –    | 2    | 2    |



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**PE-VI - 3- EMBEDDED SYSTEMS****Credits: 3****Assessment: 40 + 60**

| Semester | L-T-P | Course Code  | Branches |
|----------|-------|--------------|----------|
| VII      | 3-0-0 | 7-3-7-R25E33 | EE       |

**Pre-Requisites:** Microprocessors and Micro Controllers**Course Outcomes:** At the end of this course, students will demonstrate the ability to

1. To provide an overview of Design Principles of Embedded System.
2. To provide clear understanding about the role of firmware.
3. To understand the necessity of operating systems in correlation with hardware systems.
4. To learn the methods of interfacing and synchronization for tasking.

**UNIT - I**

**Introduction to Embedded Systems:** Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

**UNIT - II**

**Typical Embedded System:** Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

**UNIT - III**

**Embedded Firmware:** Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

**UNIT - IV**

**RTOS Based Embedded System Design:** Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

**UNIT - V**

**Task Communication:** Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.



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**Text Books**

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

**References:**

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \<br>PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1            | 3   | 2   | 2   | –   | 2   | –   | –   | –   | –   | –    | –    | 1    | 2    | 2    |
| CO2            | 3   | 2   | 1   | 1   | 3   | –   | –   | –   | –   | –    | –    | 1    | 3    | 2    |
| CO3            | 2   | 2   | 1   | 1   | 2   | –   | –   | –   | –   | –    | –    | 1    | 2    | 1    |
| CO4            | 3   | 3   | 2   | 2   | 3   | –   | –   | –   | 1   | 1    | –    | 1    | 3    | 2    |



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**POWER SYSTEMS AND SIMULATION LAB****Credits: 1****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VII      | 0-0-2 | 7-3-7-R25P1 | EE       |

**Course Outcomes:** At the end of the course, the student will be able to:

1. Understand formation of Y-Bus and load flow analysis methods.
2. Analyze Faults, Economic Load Dispatch, and Load Frequency Control in power systems.
3. Study the working and characteristics of protective relays and fuses.
4. Implement microcontroller-based protection for current and voltage faults.

**LIST OF EXPERIMENTS:**

1. Formation of Y-Bus using Bus Inspection Method.
2. Load Flow Analysis by Using Gauss-Siedal Method.
3. Load Flow Analysis by Using Newton-Raphson Method.
4. Fault Analysis.
5. Economic Load Dispatch.
6. Load Frequency Control.
7. Microcontroller-Based Over Current Relay.
8. Microcontroller-Based Over/Under voltage Relay.
9. Electromechanical type Earth fault relay.
10. Percentage Differential Relay.
11. Study of Characteristics of Fuse.

**CO-PO-PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | –   | 2   | 3   | –   | 1   | –   | –   | –    | –    | –    | 3    | –    |
| CO2         | 3   | 3   | 1   | 2   | 3   | –   | 1   | –   | –   | –    | 1    | –    | 3    | 2    |
| CO3         | 3   | 2   | 1   | 2   | 2   | 1   | 1   | –   | –   | –    | –    | –    | 3    | 1    |
| CO4         | 3   | 3   | 2   | 3   | 3   | 1   | 1   | –   | 1   | 1    | –    | 1    | 3    | 2    |


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**INTERNET OF THINGS****Credits: 2****Assessment: 40 + 60**

| Semester | L-T-P | Course Code | Branches |
|----------|-------|-------------|----------|
| VII      | 1-0-2 | 7-3-7-R25S1 | EE       |

**Course Outcomes:** At the end of the course, the student will be able to:

1. Control different electrical and electronics applications using Arduino
2. Control different electrical and electronics applications using Raspberry Pi

**LIST OF EXPERIMENTS:**

1. Study of IoT concepts, design methodology, and applications.
2. Study of sensors, actuators, and microcontroller platforms.
3. Design and implementation of a gas leakage detection system.
4. Design of an automatic plant watering system.
5. Design of a water level monitoring system.
6. Implementation of an automatic street light system.
7. Design of a traffic light controller system.
8. Development of a smart parking system.
9. Design of an anti-theft or intrusion detection system.
10. Implementation of a bi-directional visitor counter.
11. Design of a distance and level measurement system.
12. Development of an environmental monitoring system.
13. Design of a smart waste management system.
14. Implementation of motor and relay control system.
15. Design of a smart safety or emergency alert system.

**CO–PO–PSO Mapping Matrix: (3 – High, 2 – Moderate, 1 – Low, – No mapping)**

| CO \ PO/PSO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1         | 3   | 3   | 2   | 3   | 3   | –   | –   | –   | 2   | 1    | –    | 1    | 3    | 2    |
| CO2         | 3   | 3   | 2   | 3   | 3   | –   | –   | –   | 2   | 1    | –    | 1    | 3    | 2    |



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**B. Tech. (Electrical and Electronics Engineering)**  
**Semester VIII (Fourth Year)**

| Code       |             | Category | Course Title                            | Hours/Week |   |    | Total | Credits | Marks |     |       |
|------------|-------------|----------|-----------------------------------------|------------|---|----|-------|---------|-------|-----|-------|
| Department | University  |          |                                         | L          | T | P  |       |         | CIE   | SEE | Total |
| EE3801PI   | 7-0-8-R25PS | EE-PWSI  | Project Work & Full Semester Internship | 0          | 0 | 24 | 24    | 12      | 50    | 50  | 100   |
|            |             |          |                                         | 0          | 0 | 24 | 24    | 12      | 50    | 50  | 100   |

In the final semester, the student should mandatorily undergo full semester internship and parallelly he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship report and its completion certificate in the department. Student is permitted to submit report on the work carried out during the internship as project report provided the internship work is in the discipline of his B.Tech. Program. Internship programs offered by AICTE/APSSDC/NSDC/SWAYAM PLUS /Any State or Central Government organizations involving Industry experts and approved by the concerned BoS/Head/Head of the Institution are also considered equivalent to full semester Internship provided it involves 90 – 120 hours of work. The Internship work area can be in his own discipline or inter-disciplinary (One discipline being his own) or other discipline also. The project work shall be either in the discipline of his own or inter-disciplinary.



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**EXIT OPTIONS FOR B. TECH ELECTRICAL & ELECTRONICS ENGINEERING**

**Two months internship in industry or bridge courses mentioned below of 6 to 8 credits on NPTEL – SWAYAM Platform**

| Semester     | Exit Option     | Credits | Additional Credits for exit students | List of exit courses                                                                                                                                                                                                                                                    |
|--------------|-----------------|---------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sem I & II   | U.G Certificate | 40      | 6-8                                  | <ol style="list-style-type: none"> <li>1. Network Analysis</li> <li>2. Electrical Machines – I</li> <li>3. Electrical Machines – II</li> <li>4. Analog Electronic Circuits</li> <li>5. Digital Electronics</li> </ol>                                                   |
| Sem III & IV | U.G Certificate | 42      | 6-8                                  | <ol style="list-style-type: none"> <li>1. Control Engineering</li> <li>2. Fundamentals of Power Electronics</li> <li>3. Power System Analysis</li> <li>4. Microprocessors and Microcontrollers</li> <li>5. Electrical Measurement and Electronic Instruments</li> </ol> |



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