**Department of of Electrical & Electronics Engineering (EEE)**

**GIFT, Bhubaneswar.**

*Affilated to BPUT, Rourkrla, Odisha*

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|  | **3rd Semester** |  |  |  | **4th Semester** |  |  |
|  **Code** | **Subjects** | **L-T-P Credit** | **Code** | **Subjects** | **L-T-P Credit** |
|  | **Theory** |  |  |  | **Theory** |  |  |
| BSCM1205 Mathematics – III | 3-1-0 | 4 | PCEC4205 Electromagnetic Fields & Waves | 3-0-0 | 3 |
| BSMS1213 Materials Science & Engineering | 3-0-0 | 3 | BSCP1207 Physics of Semiconductor Devices | 3-0-0 | 3 |
|  | OR |  |  |  | OR |  |  |
| BSCP1207 Physics of Semiconductor Devices |  |  | BSMS1213 Materials Science & Engineering |  |  |
| HSSM3204 Engg. Economics and Costing | 3-0-0 | 3 | HSSM3205 Organizational Behaviour | 3-0-0 | 3 |
|  | OR |  |  |  | OR |  |  |
| HSSM3205 Organizational Behaviour |  |  | HSSM3204 Engg. Economics and Costing |  |  |
| BEES2211 Network Theory | 3-1-0 | 4 | PCEE4203 Electrical Machines-I | 3-1-0 | 4 |
| BECS2212 C++ & Object Oriented | 3-0-0 | 3 | PCEE4204 Electrical & Electronics | 3-0-0 | 3 |
|  | Programming |  |  |  | Measurement |  |  |
| PCEC4201 Analog Electronics Circuit | 3-1-0 | 4 | PCEC4202 Digital Electronics Circuit | 3-1-0 | 4 |
|  | **Theory Credits** |  | **21** |  | **Theory Credits** |  | **20** |
|  | **Practical/Sessional** |  |  |  | **Practical/Sessional** |  |  |
| BEES7211 Network & Devices Lab. | 0-0-3 | 2 | PCEE7203 Electrical Machines Lab-I | 0-0-3 | 2 |
|  |  |  |  |  |  |
| BECS7212 C++ & Object Oriented | 0-0-3 | 2 | PCEE7204 Electrical & Electronics | 0-0-3 | 2 |
|  | Programming Laboratory |  |  |  | Measurement Laboratory |  |  |
| PCEC7201 Analog Electronics Circuit Lab. | 0-0-3 | 2 | PCEC7202 Digital Electronics Circuit Lab. | 0-0-3 | 2 |
|  |  |  |  | HSSM7203 Communication & Interpersonal | 0-0-3 | 2 |
|  |  |  |  |  | skills for Corporate Readiness |  |  |
|  |  |  |  |  | Laboratory |  |  |
|  | **Practical/Sessional Credits** |  | **06** |  | **Practical/Sessional Credits** |  | **08** |
|  |  |  |  |  |  |
|  | **TOTAL SEMESTER CREDITS** | **27** |  | **TOTAL SEMESTER CREDITS** | **28** |
|  |  |  |  |  |  |
|  | **TOTAL CUMULATIVE CREDITS** | **83** |  | **TOTAL CUMULATIVE CREDITS** | **111** |
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BSCM1205 **Mathematics – III**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:**1 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 4

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| CO1: Apply knowledge of 1st and 2nd order partial differential equations to solve engineering and real life problems. |
| CO2: Apply knowledge of linear and non-linear partial differential equations to solve/operate complex problems. |
| CO3: Identify and analyze complex problems using complex analysis like Laplace equation, complex integration etc. |
| CO4:  Apply knowledge of Power series to summarize complex problems. |
| CO5: Apply knowledge to evaluate Taylors series, residue integration method to solve complex problems. |
| CO6: Implement their knowledge into Power series, Taylors series, residue integration method to solve complex problems in Engineering |

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**Module-1(18 hours)**

Partial differential equation of first order, Linear partial differential equation, Non-linear partial differential equation, Homogenous and non-homogeneous partial differential equation with constant co-efficient, Cauchy type, Monge’s method, Second order partial differential equation The vibrating string, the wave equation and its solution, the heat equation and its solution, Two dimensional wave equation and its solution, Laplace equation in polar, cylindrical and spherical coordinates, potential.

**Module-II** **(12 hours)**

Complex Analysis:

Analytic function, Cauchy-Riemann equations, Laplace equation, Conformal mapping,

Complex integration: Line integral in the complex plane, Cauchy’s integral theorem, Cauchy’s integral formula, Derivatives of analytic functions

**Module –III** **(10 hours)**

Power Series, Taylor’s series, Laurent’s series, Singularities and zeros, Residue integration method, evaluation of real integrals.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**Text books:**

1. E. Kreyszig,” Advanced Engineering Mathematics:, Eighth Edition, Wiley India Reading Chapters: 11,12(except 12.10),13,14,15
2. B.V. Ramana, “ Higher Engineering Mathematics”, McGraw Hill Education, 2008 Reading chapter: 18

**Reference books:**

1. E.B. Saff, A.D.Snider, “ Fundamental of Complex Analysis”, Third Edition, Pearson Education, New Delhi
2. P. V. O’Neil, “Advanced Engineering Mathematics”, CENGAGE Learning, New Delhi

BSMS1213 **Material Science and Engineering**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| CO 1: Prepare lists of different types of manufacturing of new materials or modify the existing materials.  |
| CO 2: Distinguishes materials like Superconductor materials, Magnetic materials, Optical materials, Polymeric materials, Ceramics materials, by studying material science. |
| CO 3: Analyze about materials like Composites, SMART materials, Nano phase materials, by studying material science. |
| CO4: Classify engineering materials used in Engineering studies. |
| CO5: Evaluate engineering properties of materials, selection of materials, Mechanical properties of materials. |
| CO6: Create new Products by using different Mechanical properties of materials and their testing procedure. |

**MODULE-I** **(11 Hours)**

Introduction, Classification of Engineering Materials, Engineering properties of materials, Selection of Materials Mechanical Properties of Materials: Tensile strength, Stress–strain behaviour, Ductile and brittle material, Impact test, Toughness, Hardness test, Fatigue and fatigue test, Creep and Creep test, Fracture

**MODULE-II** **(13 Hours)**

Electrical and Electronic materials: Electrical conductivity, Thermal conductivity, Free electron theory, Energy band concept of conductor, insulator & semiconductor.

Superconductor materials: Principles of superconductivity, zero resistivity, Critical magnetic field and critical current density, Type I & II superconductors, Applications of superconductors

Dielectric Materials: Microscopic displacement of atoms and molecules in an external DC electric field, Polarization and dielectric constant, Dielectric susceptibility, polarization mechanisms, Temperature and frequency dependence of dielectric constant, Dielectric breakdown, Ferroelectric materials, Piezoelectrics, pyroelectrics and ferroelectrics, Dielectric materials as electrical insulators

Magnetic Materials: Concept of magnetism – Diamagnetic, Paramagnetic, Ferromagnetic materials, Hysteresis, Soft & hard magnetic materials, Ferrite

**MODULE-III** **(11 Hours)**

Optical materials: optical properties – scattering, refraction, reflection, transmission & absorption, Laser – principles and applications, Optical fibres – principles and applications

Polymeric materials: Types of polymers, Mechanism of polymerization, Mechanical behaviour of polymers, Fracture in polymers, Rubber types and applications, Thermosetting and thermoplastics, Conducting polymers

Composite Materials: Microcomposites & Macrocomposites, fibre reinforced composites, Continuous fibre composites, Short fibre composites, Polymer matrix composites, Metal-matrix composites, Ceramic-matrix composites, Carbon-carbon Composites, Hybrid composites.

Ceramics: Types, structure, properties and application of ceramic materials

Other materials: Brief description of other materials such as Corrosion resistant materials, Nano phase materials, Shape memory alloy, SMART materials

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 2 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 1 |

**Text Books:**

1. Material Science for Engineers, James F. Shackelford & Madanapalli K Muralidhara, Pearson Education
2. Materials Science and Engineering, W.D.Callister, Wiley and Sons Inc.

**Reference Books**

1. Materials Science by M.S. Vijaya , G.Rangarajan, Tata MacGraw Hill
2. Materials Science by V. Rajendra, A. Marikani, Tata MacGraw Hill
3. Materias Science for Electrical and Electronic Engineers, I.P.Jones, Oxford University Press
4. Elements of Material Science and Engineering, L.H.Van Vlack, Addison Wesley
5. The Science and Engineering of Materials, Donald R. Askeland and Pradeep P Phule, Thomson Learning (India Edition)
6. Materials Science and Engineering, V.Raghavan, Prentice Hall of India Pvt.Ltd.
7. Materials Science and Engineering in SI units, W.F.Smith, J.Hashemi and R.Prakash, Tata MacGraw Hill
8. Engineering Materials, Properties and Selection, Kenneth G. Budinski and Michael K. Budinski, Prentice Hall of India
9. Material Science & Engineering, Vijaya M. S., Rangarajan G, Tata McGraw Hill.
10. Material Science & Enginnering, S.K.Tripathy, A.K.Padhy & A. Panda, Scitech publication.

BSCP 1207 **Physics of Semiconductor Devices**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| CO 1: Learnt about the atomic structure ,energy levels, formation of energy bands, classification of solids, crystal structure of Silicon and etc. |
| CO 2: got idea about intrinsic & extrinsic semiconductor, quantum state, doping concentration, Fermi energy, no. of charge carriers present in conduction band & valence band. |
| CO 3: define mobility, drift current, diffusion current, Einstein relation, building block of pn diode, Calculation of field & potential in depletion layer. |
| CO 4: It has helped to define transistor, modes of operation of BJT, Ebers moll equations. |
| CO 5: understood about contact of metal with semiconductor, MOS capacitor, MOS transistor, and CMOS technology & also how to get high speed electronic equipment. |
| CO6: demonstrate the method of getting high speed electronic equipment. |

**Module-I** **(10 Hours)**

1. **Introduction to the quantum theory of solids**: Formation of energy bands, The k-space diagram (twoand three dimensional representation), conductors, semiconductors and insulators.
2. **Electrons and Holes in semiconductors:** Silicon crystal structure, Donors and acceptors in the bandmodel, electron effective mass, Density of states, Thermal equilibrium, Fermi-Dirac distribution function for electrons and holes, Fermi energy. Equilibrium distribution of electrons & holes: derivation of *n* and *p* from D(E) and f(E), Fermi level and carrier concentrations, The *np* product and the intrinsic carrier concentration. General theory of *n* and *p*, Carrier concentrations at extremely high and low temperatures: complete ionization, partial ionization and freeze-out. Energy-band diagram and Fermi-level, Variation of EF with doping concentration and temperature.
3. **Motion and Recombination of Electrons and Holes:** Carrier drift: Electron and hole mobilities,Mechanism of carrier scattering, Drift current and conductivity.

**Module II** **(11 Hours)**

1. **Motion and Recombination of Electrons and Holes (continued):** Carrier diffusion: diffusion current,Total current density, relation between the energy diagram and potential, electric field. Einstein relationship between diffusion coefficient and mobility. Electron-hole recombination, Thermal generation.
2. **PN Junction:** Building blocks of the pn junction theory: Energy band diagram and depletion layer of a pnjunction, Built-in potential; Depletion layer model: Field and potential in the depletion layer, depletion-layer width; Reverse-biased PN junction; Capacitance-voltage characteristics; Junction breakdown: peak electric field. Tunneling breakdown and avalanche breakdown; Carrier injection under forward bias-Quasi-equilibrium boundary condition; current continuity equation; Excess carriers in forward-biased pn junction; PN diode I-V characteristic, Charge storage.
3. **The Bipolar Transistor:** Introduction, Modes of operation, Minority Carrier distribution, Collectorcurrent, Base current, current gain, Base width Modulation by collector current, Breakdown mechanism, Equivalent Circuit Models - Ebers -Moll Model.

**Module III** **(12 Hours)**

1. **Metal-Semiconductor Junction:** Schottky Diodes: Built-in potential, Energy-band diagram, I-Vcharacteristics, Comparison of the Schottky barrier diode and the pn-junction diode. Ohmic contacts: tunneling barrier, specific contact resistance**.**
2. **MOS Capacitor:** The MOS structure, Energy band diagrams, Flat-band condition and flat-band voltage,Surface accumulation, surface depletion, Threshold condition and threshold voltage, MOS C-V characteristics, Qinv in MOSFET.
3. **MOS Transistor:** Introduction to the MOSFET, Complementary MOS (CMOS) technology, V-ICharacteristics, Surface mobilities and high-mobility FETs, JFET, MOSFET Vt, Body effect and steep retrograde doping, pinch-off voltage,

**PO Matrix:**

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| 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 2 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 2 | 2 | 3 |

**Text Books:**

1. Modern Semiconductor Devices for Integrated Circuits,ChenmingCalvinHu,PearsonEducation/Prentice Hall, 2009.
2. Semiconductor Physics and Devices, 3rd Edition, Donald A. Neamen, Tata McGraw Hill Publishing Company Limited, New Delhi.

**Reference Books:**

1. Fundamentals of Semiconductor Devices, M.K. Achuthan and K.N. Bhatt, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Solid State Electronics Devices, 6th Edition, Ben. G. Stretman and Sanjay Banarjee, Pearson Education, New Delhi.
3. Physics of Semiconductor Devices, 3rd Edition, S.M. Sze and Kwok K. Ng, Wiley India Pvt. Limited, New Delhi.
4. Physics of Semiconductor Devices, 2nd Edition, Dillip K. Roy, University Press (India) Pvt. Ltd., Hyderabad.
5. Solid State Electronics Devices, D.K. Bhattacharya and Rajnish Sharma, Oxford University Press, New Delhi.

HSSM3204 **Engineering Economics & Costing**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| CO 1:Students will be able to gain good understanding of general concepts of micro and macroeconomics including theory of demand, Law of demand, elasticity of demand etc. |
| CO 2: work out or calculate various accountancy and costing related calculations such as: simple and compound interest, cash flow and funds flow diagrams etc. |
| CO 3: evaluate engineering projects in terms of their present and future worth, Internal Rate of return etc.  |
| CO 4: understand cost sheets and also gain fair idea about banking structures and various financial systems |
| CO 5: prepare cost sheets and also gain fair idea about banking structures and various financial systems |
| CO 6: prepare cost sheets and also gain fair idea about banking structures and its schemes to assist Engineering projects.  |

**Module-I:** **(12 hours)**

Engineering Economics – Nature and scope, General concepts on micro & macro economics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand,

Law of supply and elasticity of supply. Determination of equilibrium price under perfect competition (Simple numerical problems to be solved). Theory of production, Law of variable proportion, Law of returns to scale.

**Module-II:** **(12 hours)**

Time value of money – Simple and compound interest, Cash flow diagram, Principle of economic equivalence. Evaluation of engineering projects – Present worth method, Future worth method, Annual worth method, internal rate of return method, Cost-benefit analysis in public projects. Depreciation policy, Depreciation of capital assets, Causes of depreciation, Straight line method and declining balance method.

**Module-III:** **(12 hours)**

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis-Linear approach. (Simple numerical problems to be solved)

Banking: Meaning and functions of commercial banks; functions of Reserve Bank of India. Overview of Indian Financial system.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Books:**

1. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India.
2. D.M. Mithani, Principles of Economics. Himalaya Publishing House

**Reference Books** :

1. Sasmita Mishra, “Engineering Economics & Costing “, PHI
2. Sullivan and Wicks, “ Engineering Economy”, Pearson
3. R.Paneer Seelvan, “ Engineering Economics”, PHI
4. Gupta, “ Managerial Economics”, TMH
5. Lal and Srivastav, “ Cost Accounting”, TMH

HSSM 3205 **Organizational Behaviour**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| CO 1: Define various aspects of individual behavior such as Learning, perceptions, Motivations etc., |
| CO 2: Appreciate the role of Communication, Effective team building principles, Leadership development mechanisms for achieving the goal at individual as well organizational level. |
| CO 3: Differentiate the nature of conflicts and compare various mechanisms for conflict resolution. |
| CO 4: Explain importance of organizational culture and effectiveness thereof. |
| CO 5: Analyze working principles of Human Resource Management and various functions |
| CO 6: Summarize different aspects on International organizational Behavior, International Business trends, Individual and Interpersonal Behavior in Global Perspective. |

**Module I :**

The study of Organizational Behaviour : Definition and Meaning, Why Study OB Learning – Nature of Learning, How Learning occurs, Learning and OB.

Foundations of Individual Behaviour : Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB.

Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation – Nature and Importance, Herzberg’s Two Factor Theory, Maslow’s Need Hierarchy Theory, Alderfer’s ERG Theory, Evaluations.

**Module II :**

Organizational Behaviour Process : Communication – Importance, Types, Gateways and Barriers to Communication, Communication as a tool for improving Interpersonal Effectiveness, Groups in Organizations – Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision-making Managerial Implications, Effective Team Building. Leadership-Leadership & Management, Theories of Leadership-Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Follower ship, How to be an effective Leader, Conflict-Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA).

**Module-III :**

Organization : Organizational Culture – Meaning and Definition, Culture and Organizational Effectiveness. Introduction to Human Resource Management-Selection, Orientation, Training and Development, Performance Appraisal, Incentives Organizational Change – Importance of Change, Planned Change and OB techniques. International Organisational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

**PO Matrix:**

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| 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 2 | 3 | 3 |

**Text Books :**

1. Keith Davis, Organisational Behaviour, McGraw-Hill.
2. K.Aswathappa, Organisational Behaviour, Himalaya Publishing House.

**Reference Books :**

1. Stephen P. Robbins, Organisational Behaviour, Prentice Hall of India
2. Pradip N. Khandelwal, Organizational Behaviour, McGraw-Hill, New Delhi.
3. Uma Sekaran, “Organizational Behaviour”, TATA McGraw-Hill, New Delhi.
4. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma” Organizational Behaviour” , TATA McGraw- Hill.
5. D.K. Bhattachayya, “Organizational Behaviour”, Oxford University Press
6. K.B.L.Srivastava & A.K.Samantaray, “Organizational Behaviour” India Tech
7. Kavita Singh, “Organizational Behaviour”, Pearson

BEES2211 **Network Theory**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 1 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 4

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| CO 1:  Evaluate  the basic  theorems  and elements of electrical network to solve complex problem. |
| CO 2:  Explain steady state and transient behavior of Electrical circuits |
| CO 3:   Analyze the property of two ports network, coupled circuit and resonance |
| CO 4:  Demonstrate Laplace transform, Fourier series and can apply to get response of circuits. |
| CO 5: Create new network by Synthesize different network. |
| CO 6: Explain different types of filters used in electrical network. |

**MODULE- I** **(14 Hrs)**

1. NETWORK TOPOLOGY: Graph of a network, Concept of tree, Incidence matrix, Tie-set matrix, Cut-set matrix, Formulation and solution of network equilibrium equations on loop and node basis.
2. NETWORK THEOREMS & COUPLED CIRCUITS: Substitution theorem, Reciprocity theorem, Maximum power transfer theorem, Tellegen’s theorem, Millman’s theorem, Compensation theorem, Coupled Circuits, Dot Convention for representing coupled circuits, Coefficient of coupling, Band Width and Q-factor for series and parallel resonant circuits.

**MODULE- II** **(13 Hrs)**

1. LAPLACE TRANSFORM & ITS APPLICATION: Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Application of Laplace transform: Circuit Analysis (Steady State and Transient).
2. TWO PORT NETWORK FUNCTIONS & RESPONSES: z, y, ABCD and **h**-parameters, Reciprocity and Symmetry, Interrelation of two-port parameters, Interconnection of two-port networks, Network Functions, Significance of Poles and Zeros, Restriction on location of Poles and Zeros, Time domain behaviour from Pole-Zero plots.

**MODULE- III** **(13 Hrs)**

1. FOURIER SERIES & ITS APPLICATION: Fourier series, Fourier analysis and evaluation of coefficients, Steady state response of network to periodic signals, Fourier transform and convergence, Fourier transform of some functions, Brief idea about network filters (Low pass, High pass, Band pass and Band elimination) and their frequency response.
2. NETWORK SYNTHESIS: Hurwitz polynomial, Properties of Hurwitz polynomial, Positive real functions and their properties, Concepts of network synthesis, Realization of simple R-L, R-C and L-C functions in Cauer-I, Cauer-II, Foster-I and Foster-II forms.

**Beyond Syllabus:**

Three Phase Circuits: Analysis of unbalanced loads, Neutral shift, Symmetrical components, Analysis of

unbalanced system, power in terms of symmetrical components.

**PO Matrix:**

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| 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Book:**

1. Network Theory – P K Satpathy, P Kabisatpathy, S P Ghosh and A K Chakraborty – Tata McGraw Hill, New Delhi.

**Reference Book(s):**

1. Network Analysis – M E Van Valkenburg – Pearson Education.
2. Network Synthesis – M E Van Valkenburg – Pearson Education.
3. Network Analysis and Synthesis – Franklin F. Kuo – Wiley Student Edition.
4. Fundamentals of Electric Circuits – Alexander & Sadiku – Tata McGraw Hill.
5. Linear Circuits Analysis and Synthesis – A Ramakalyan – Oxford University Press.
6. Problems & Solutions in Electric Circuit Analysis – Sivananda & Deepa – Jaico Book.
7. Network Theory, Smarajit Ghosh, PHI.

7

BECS2212 **C++ & Object Oriented Programming**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| CO 1:  Realize the object oriented view of the real world problems, |
| CO 2: Implement polymorphism and inheritance for solving various generic problems, |
| CO3:  Analyze the Knowledge about Inheritance, Polymorphism, File Handling and Template. |
| CO4:  Evaluate complex problems on static polymorphism such as function overloading and virtual function. |
| CO5:  Apply the Knowledge about dynamic polymorphism such as function overloading and virtual function. |
| CO6:  Create new solutions on complex issues by Appling static and dynamic polymorphism such as function overloading and virtual function. |

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**Module I** **(08 hrs)**

Introduction to object oriented programming, user defined types, structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.

**Module II** **(16 hrs)**

Abstraction mechanism: Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references.

Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors.

Polymorphism: Binding, Static binding, Dynamic binding, Static polymorphism: Function

Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.

Operator Overloading: This pointer, applications of this pointer, Operator function, member and non member operator function, operator overloading, I/O operators.

Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration.

**Module III** **(08 hrs)**

Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.

Template: template classes, template functions.

Namespaces: user defined namespaces, namespaces provided by library.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Books:**

1. Object Oriented Programming with C++ - E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ - Ashoke N. Kamthane, Pearson Education

**Reference Books:**

1. Big C++ - Wiley India
2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
3. C++ and Object Oriented Programming – Jana, PHI Learning.
4. Object Oriented Programming with C++ - Rajiv Sahay, Oxford
5. Mastering C++ - Venugopal, McGraw-Hill Education (India)

PCEC4201 **Analog Electronics Circuit**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 1 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 4

|  |
| --- |
| CO1:   Identify and will be able to understand fundamentals of BJT,FET, MOSFET. |
| CO2:   Analyze different types of amplifier and their design. |
| CO3:    Compute various circuits by using power amplifiers |
| CO4:     Identify the hardware components of a personal computer |
| CO5:     Understand the hardware components of a personal computer |
| CO6:   The  assemble the hardware components of a personal computer |

**MODULE – I** **(12 Hours)**

1. **MOS Field-Effect Transistor:** Principle and Physical Operation of FETs and MOSFETs. P-Channel and N-Channel MOSFET, Complimentary MOS, V-I Characteristics of E- MOSFETS and

D-MOSFETS, MOSFETS as an Amplifier and a Switch (4 Hrs)

1. **Biasing of BJTs:** Load lines (AC and DC), Operating Points, Fixed Bias and Self Bias, DC Bias

with Voltage Feedback, Bias Stabilization, Design Operation. (4 Hrs)

1. **Biasing of FETs and MOSFETs:** Fixed Bias Configuration and Self Bias Configuration, Voltage

Divider Bias and Design (4 Hrs)

**MODULE – II** **(17 Hours)**

1. **Small Signal Analysis of BJTs:** Small-Signal Equivalent-Circuit Model, Graphical Determinationof h-parameters Small Signal Analysis of CE, CC, CB Amplifier with and without RE. Effect of RS

and RL on CE Amplifier, Emitter Follower, Analysis of Cascade, Darlington Connection and Current Mirror Circuits using BJTs. (6 Hrs)

1. **Small Signal Analysis of FETs:** Small-Signal Equivalent-Circuit Model, Small Signal Analysis of

CS, CD, CG Amplifier with and without RS. Effect of RSIG and RL on CS Amplifier, Analysis of Source Follower and Cascaded System using FETs. (6 Hrs)

1. **High Frequency Response of FETs and BJTs:** Low and High Frequency Response of BJTs andFETs, The Unit gain – frequency (ft), Frequency Response of CS Amplifier, Frequency Response of CE Amplifier, Multistage Frequency Effects, Miller Effect Capacitance, Square Wave Testing.(5 Hrs)

**MODULE – III** **(12 hours)**

1. **Feedback and Oscillators:** Feedback Concepts, Four Basic Feedback Topologies, PracticalFeedback Circuits, Feedback Amplifier Stability using Nyquist Plot, Basic Principle of Sinusoidal

Oscillator, Wein-Bridge, Phase Shift and Crystal Oscillator Circuits. (4 Hrs)

1. **Operational Amplifier:** Ideal Op-Amp, Differential Amplifier, Op-Amp Parameters, Slew rate, Non-inverting Configurations, Effect of Finite Open-loop and Closed-loop Gain, Differentiator and

Integrator, Instrumentation amplifier, µA 741-Op-Amp . (5 Hrs)

1. **Power Amplifier:** Classifications, Class-A and Class-B Amplifier Circuits, Transfer Characteristics,

Power Dissipation and Conversion Efficiency of Power Amplifiers.

 (3 Hrs)

**Beyond Syllabus-**

Basic analysis of difference amplifier, Simulation of analog circuits i.e., different single and cascaded amplifier circuits, difference amplifier circuits and validating the

Theoretical parameters using PSpice and MULTISIM. Analysis op-amp IC circuits using LF411 and µA 741, Signal Generators using OPAMP: Square, triangle and ramp Generator circuits using opamps - Effect of slew rate on waveform generationintroduction to analog simulation OPAMP as nonlinear element: comparator, Voltage controlled oscillator (VCO). Concept of Schmitt triggers circuit and sample/hold circuit using operational amplifier Basic analysis of difference amplifier, Simulation of analog circuits i.e., different single and cascaded amplifier circuits, difference amplifier circuits and validating the

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theoretical parameters using PSpice and MULTISIM. Analysis op-amp IC circuits using LF411 and µA 741, Signal Generators using OPAMP: Square, triangle and ramp Generator circuits using opamps - Effect of slew rate on waveform generationintroduction to analog simulation OPAMP as nonlinear element: comparator, Voltage controlled oscillator (VCO). Concept of Schmitt triggers circuit and sample/hold circuit using operational amplifier

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Books:**

1. Electronic Devices and Circuits theory, 9th/10th Edition, R.L. Boylestad and L.Nashelsky (Selected portions of Chapter 4, 5, 6, 7, 8, 9, 10, 11, 12, and 14), Pearson Education, New Delhi.
2. Microelectronics Circuits, 5th Edition, International Student Edition Sedra and Smith (Selected portion of Chapter 2,4, 5, 6, 8, 13, and 14), Oxford University Press, New Delhi.
3. Electronic Devices and Circuits, 3rd Edition, Jimmie J. Cathey adapted by Ajay Kumar Singh, Tata McGraw Hill Publishing Company Ltd., New Delhi. **(*For Problem Solving*)**

**Reference Books:**

1. Electronics Circuits Analysis and Design, 3rd Edition, Donald A. Neamen, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Milliman’s Electronics Devices and Circuits, 2nd Edition, J. Milliman, C. Halkias, S. Jit., Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. Integrated Electronics: Analog and Digital Circuits and Systems, J. Milliman, C. Halkias, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Microelectronic Circuits: Analysis and Design, India Edition, M.H. Rashid, PWS Publishing Company, a division of Thomson Learning Inc.

BEES7211 **Network and Devices Lab**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3  **Credits:** 2

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| --- |
| CO1:   Apply different theorms to electrical networks. |
| CO2:   Analyze the transient response of electrical circuits with DC excitation. |
| CO3:  Understand and evaluate different parameters of a two port network. |
| CO4:  Analyze the frequicy response of all active and passive filters. |
| CO5:  Compile the Resonance of electrical Circuit to find the solution of different complex networks. |

**Select any 8 experiments from the list of 10 experiments**

1. Verification of Network Theorems (Superposition, Thevenin, Norton, Maximum Power Transfer).
2. Study of DC and AC Transients.
3. Determination of circuit parameters: Open Circuit and Short Circuit parameters.
4. Determination of circuit parameters: Hybrid and Transmission parameters.
5. Frequency response of Low pass and High Pass Filters.
6. Frequency response of Band pass and Band Elimination Filters.
7. Determination of self-inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit.
8. Study of resonance in R-L-C series circuit.

Experiment Beyond Syllabus-

1. Study of resonance in R-L-C parallel circuit.
2. Spectral analysis of a non-sinusoidal waveform.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

BECS7212 **C++ & Object Oriented Programming Lab**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 2

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| --- |
| CO 1: Implement class and object concept for solving a problem. |
| CO2: Evaluate Inheritance and it’s various types for solving a problem using object oriented paradigm. |
| CO3 : Analyze different function in operator overloading.  |
| CO4 : Compare different types of Static polymorphism such as: function overloading and virtual functions. |
| CO5 : Reconstruct a new network by using Dynamic polymorphism such as: function overloading. |

1. Programs on concept of classes and objects.(1 class)
2. Programs using inheritance.(1 class)
3. Programs using static polymorphism.(1 class)
4. Programs on dynamic polymorphism.(1 class)
5. Programs on operator overloading.(1 class)
6. Programs on dynamic memory management using new, delete operators.(1 class)
7. Programs on copy constructor and usage of assignment operator.(1 class)
8. Programs on exception handling .(1 class)

Experiments beyond Syllabus-

1. Programs on generic programming using template function & template class.(1 class)
2. Programs on file handling.(1 class)

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
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PCEC7201 **Analog Electronics Circuit Lab**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3 hr/ Week **Credits:** 2

|  |
| --- |
| CO1:   Design amplifier of desired gain using BJT . |
| CO2:   Generalized amplifier of desired gain using FET for problem solving. |
| CO3:   Analyze various oscillatory circuits to generate at desired frequency of oscillation. |
| CO4:   Evaluate by using amplifier having desired bandwidth. |
| CO5:   Modify adder and differentiator circuit using opamp. |

***List of Experiments***

1. BJT bias circuit – Design, assemble and test.
2. JEET/MOSFET bias circuits – Design, assemble and test.
3. Design, assemble and test of BJT common-emitter circuit – D.C and A.C performance: Voltage gain, input impedance and output impedance with bypassed and un-bypassed emitter resistor.
4. Design, assemble and test of BJT emitter-follower – D.C and A.C performance: A.C. voltage gain, input impedance and output impedance.
5. Design, assemble and Test of JFET/MOSFET common-source and common-drain amplifiers – D.C and A.C performance: Voltage gain, input impedance and output impedance.
6. Frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response.
7. Differential amplifiers circuits: D.C bias and A.C operation without and with current source.
8. Study of Darlington connection and current mirror circuits.
9. OP-Amp Frequency Response and Compensation.
10. Application of Op-Amp as differentiator, integrator, square wave generator.

Experiments Beyond Syllabus-

1. Square wave testing of an amplifier.
2. R.C phase shift oscillator/Wien-Bridge Oscillator using OP-Amp/Crystal Oscillator.
3. Class A and Class B Power Amplifier.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
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**4th Semester**

PCEC4205 **Electromagnetic Fields and Waves**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| --- |
| CO1:   Identifying of Maxwell’s equations and be able to manipulate and apply them to problems. |
| CO2 Formulate and analyze problems involving lousy media with planar boundaries using uniform plane waves. |
| CO3 Derive steady state transmission line equations to the design of simple distributed circuit components. |
| CO4 Analyze and design basic microwave circuits using microwave network parameters. |
| CO5 Evaluate simple antennas derive fundamental antenna parameters starting from Maxwell’s equations . |
| CO6 : Reorganizes fundamental antenna parameter in the design of rudimentary wireless communications systems. |

**MODULE – I** **(11 Hours)**

1. **Vectors and Fields:** Vector Algebra, Cartesian Coordinate System, Scalar and Vector Fields,Sinusoidally Time-Varying Fields, Electric Field, Magnetic Field.
2. **Maxwell’s Equations in Integral Form:** Line Integral, Surface Integral, Faradays Law, Ampere’sCircuital Law, Gauss’s Law for Electric Field, Gauss’s Law for Magnetic Field.
3. **Maxwell’s Equations in Differential Form:** Faradays Law, Ampere’s Circuital Law, Curl and Stoke’sTheorem, Gauss’s Law for Electric Field, Gauss’s Law for Magnetic Field, Divergence and Divergence Theorem.

**MODULE – II** **(11 Hours)**

1. **Wave Propagation in Free Space:** Infinite Plane Current Sheet, Magnetic Field Adjacent to theCurrent Sheet, Successive Solution of Maxwells’s Equations, Wave Equation and Solution, Uniform Plane Waves, Poynting Vector and Energy Storage.
2. **Wave Propagation in Material Media:** Conductors and Dielectrics, Magnetic Materials, WaveEquation and Solution, Uniform Plane Waves in Dielectrics and Conductors, Boundary Conditions, Reflection and Transmission of Uniform Plane Waves.

**MODULE – III** **(10 Hours)**

1. **Transmission Line Analysis:** Gradient and Electric Potential, Poisson’s and Laplace’s Equations,Low Frequency Behavior via Quasistatics, Short Circuited Line and Frequency Behavior.
2. **Wave Guide Principles:** Uniform Plane Wave Propagation in an Arbitrary Direction, TransverseElectric Waves in a Parallel-Plate Waveguide, Dispersion and Group Velocity, Rectangular Waveguide and Cavity Resonator, Reflection and Refraction of Plane Waves, Dielectric Slab Guide.

**Beyond Syllabus-**

Field: Scalar Field and Vector Field. Or related advanced topics as decided by the concerned faculty

teaching the subject.

Nature of current and current density, the equation of continuity. Or related advanced topics as

decided by the concerned faculty teaching the subject.

Energy in Magnetic Field Or related advanced topics as decided by the concerned faculty teaching the

subject.

General Wave Equation, Plane wave in dielectric medium, free space, a conducting medium, a good

conductor and good dielectric, Polarization of wave. Or related advanced topics as decided by the

concerned faculty teaching the subject.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Book(s):**

1. Fundamentals of Electromagnetics for Engineering, First Impression – 2009, N. N. Rao, Pearson Education, New Delhi.
2. Introduction to Electromagnetic Fields, 3rd Edition, Clayton R. Paul, Keith W. Whites and Syed A. Nasar, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Electromagnetics, 2nd Edition, Joseph A. Edminister, adapted by Vishnu Priye, Tata McGraw Hill Publishing Company Ltd., New Delhi. **(*For Problem Solving*)**

**Reference Book(s):**

1. Elements of Engineering Electromagnetics, 6th Edition, N. N. Rao, Pearson Education, New Delhi.
2. Electromagnetic Waves and Radiating Systems, 2nd Edition, E.C. Jordan and K.G. Balman, Pearson Education, New Delhi.
3. Engineering Electromagnetics, 7th Edition, William H. Hayt, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Electromagnetic Field Theory Fundamentals, B.S. Guru and H.R. Hiziroglu, PWS Publishing Company, a division of Thomson Learning Inc.
5. Elements of Electromagnetics, Mathew N.O. Sadiku, Oxford University Press, New Delhi.

PCEE4203 **Electrical Machines- I**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 1 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 4

|  |
| --- |
| CO1: Define working principle & characteristics of D.C. machines. |
| CO2: Analyze the working principle & characteristics of A.C. machines. |
| CO3: Applying his knowledge to design single phase Transformer in day to day life |
| CO4: Evaluate the amount of Current in different connections of three phase transformer. |
| CO5: Calculate the efficiency of transformer without loading. |
| CO6:Control the speed of D.C. motor by Matching with output load. |

**MODULE- I** **(12 Hrs)**

1. GENERAL PRINCIPLES OF DC MACHINES: Armature Windings (Simplex Lap and Simplex Wave), Methods of Excitation, Expression for EMF Induced and Torque Developed in the Armature, Counter Torque and Counter or Back EMF, Armature Reaction, Commutation, Brush Shift and its Effects, Interpoles, Compensationg Windings.
2. DC GENERATOR CHARACTERISTICS: Characteristics for Separately Excited DC Generator (No-Load and Load), Conditions for Self Excitation, Critical Resistance and Critical Speed, Characteristics for Self Excited DC Shunt Generator (No-Load and Load), Voltage Regulation, Parallel Operation of DC Shunt Generators and DC Series Generators.

**MODULE- II** **(13 Hrs)**

1. DC MOTOR CHARACTERISTICS: Characteristic for Speed~Armature Current, Torque~Armature Current and Speed~Torque of (i) Separately Excited DC Motor, (ii) DC Shunt Motor, (iii) DC Series Motor, and (iv) DC Compound Motor, Comparison Between Different types of DC Motors and their Application.
2. DC MOTOR STARTING and PERFORMANCE: Necessity of a Starter, Starting of DC Shunt, Series and Compound Motors, Precautions During Starting of DC Series Motor, Speed Control of DC Shunt and Series Motors, Classification of Losses, Efficiency Evaluation from Direct and Indirect Methods (i) Brake Test (Direct method), (ii) Swinburne’s Test (Indirect method), (iii) Regenerative/Hopkinson’s Test (Indirect method).

**MODULE- III** **(15 Hrs)**

1. SINGLE PHASE TRANSFORMERS: Constructional Features, EMF Equation, Turns Ratio, Phasor Diagrams at No-Load and Load Conditions, Equivalent Circuit, Determination of Parameters From Tests (Polarity Test, Open Circuit Test and Short Circuit Test, Back to Back test), Voltage Regulation, Per Unit Calculation, Losses and Efficiency, Auto Transformers and their application.
2. THREE PHASE INDUCTION MACHINES: Constructional Features of Squirrel Cage Rotor type and Slip Ring/Wound Rotor type of Induction Motors, Principle of Operation, Concept of Slip, Slip Speed, Equivalent Circuit and Phasor Diagram, No-Load and Blocked Rotor tests, Determination of Parameters, Slip~Torque Characteristics and Effect of Rotor resistance on it, Losses and Efficiency. Starting of Squirrel Cage Rotor type and Slip Ring/Wound Rotor type of Induction Motors, Speed Control of Induction Motors, Cogging, Crawling and Electrical Braking of Induction Motors, Brief Idea on Induction Generators.

Beyond syllabus-

3-winding transformer or related advanced topics as decided by the concerned faculty teaching the subject.

Brief Idea on Induction Generators,Different types of brakingor related advanced topics as decided by the concerned faculty teaching the subject.

Qualitative explanation for origin of harmonic current and voltage and its suppression. Inrush of switching currents, magnetizing current wave form or related advanced topics as decided by the concerned faculty teaching the subject.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Book :**

1. Electric Machines – D P Kothari and I J Nagrath – Tata McGraw Hill.

**Reference Book(s):**

1. The Performance and Design of DC Machines – A E Clayton.
2. Theory and Performance of AC Machines – M G Say
3. Electrical Machinery – P S Bimbhra – Khanna Publishers.
4. Electrical Machines –P.K.Mukherjee & S.Chakravorti–Dhanpat Rai Publications.
5. Electric Machinery – Fitzgerald, Charles Kingsley Jr., S. D. Umans – Tata Mc Graw Hill.
6. Electric Machinery And Transformers – Guru & Hiziroglu – Oxford University Press.
7. Electric Machines – Charles Hubert – Pearson Education.

PCEE4204 **Electrical and Electronics Measurement**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

|  |
| --- |
| CO1: Define working principle, construction & application of different electrical measuring instruments |
| CO2: Compare the error between theoretical & practical value. |
| CO3: Demonstrate different electronic instruments for measuring basic parameters. |
| CO4: Evaluate the output Power of a three phase power by using two wattmeters |
| CO5: study of DC and AC bridge. |
| CO6: Categorized different calibration of indicating type of instrument with the help of different methods. |

**MODULE- I** **(14 Hrs)**

1. INTRODUCTION: (a) *Measurement and Error*: Definition, Accuracy and Precision, Significant Figures, Types of Errors. (b) *Standards of Measurement*: Classification of Standards, Electrical Standards, IEEE Standards.
2. MEASUREMENT OF RESISTANCE, INDUCTANCE and CAPACITANCE: (a) *Resistance*: Measurement of Low Resistance by Kelvin’s Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Resistance of Insulating Materials, Portable Resistance Testing set (Megohmmeter), Measurement of Insulation Resistance when Power is ON, Measurement of Resistance of Earth Connections. (b) *Inductance*: Measurement of Self Inductance by Ammeter and Voltmeter, and AC Bridges (Maxwell’s, Hay’s, & Anderson Bridge), Measurement of Mutual Inductance by Felici’s Method, and as Self Inductance. (c) *Capacitance*: Measurement of Capacitance by Ammeter and Voltmeter, and AC Bridges (Owen’s, Schering & Wien’s Bridge), Screening of Bridge Components and Wagnor Earthing Device.

**MODULE- II** **(14 Hrs)**

1. GALVANOMETER: Construction, Theory and Principle of operation of D’Arsonval, Vibration (Moving Magnet & Moving Coil types), and Ballistic Galvanometer, Influence of Resistance on Damping, Logarithmic decrement, Calibration of Galvanometers, Galvanometer Constants, Measurement of Flux and Magnetic Field by using Galvanometers.
2. AMMETER and VOLTMETER: Derivation for Deflecting Torque of; PMMC, MI (attraction and repulsion types), Electro Dynamometer and Induction type Ammeters and Voltmeters.
3. POTENTIOMETER: Construction, Theory and Principle of operation of DC Potentiometers (Crompton, Vernier, Constant Resistance, & Deflectional Potentiometer), and AC Potentiometers (Drysdale-Tinsley & Gall-Tinsley Potentiometer).
4. MEASUREMENT OF POWER, ENERGY, FREQUENCY and POWER FACTOR: Measurement of single phase and three phase power by wattmeter, Construction, Theory and Principle of operation of (a) Electro-Dynamometer and Induction type Wattmeters, (b) Single Phase and Polyphase Induction type Watt-hour meters, (c) Frequency Meters, and (d) Power Factor Meters.

**MODULE- III** **(14 Hrs)**

1. CURRENT TRANSFPRMER and POTENTIAL TRANSFOMER: Construction, Theory, Characteristics and Testing of CTs and PTs.
2. ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAAMETERS: Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters (Block Diagrams only), Q-meter.
3. OSCILLOSCOPE: Block Diagrams, Delay Line, Multiple Trace, Oscilloscope Probes, Oscilloscope Techniques, Introduction to Analog and Digital Storage Oscilloscopes, Measurement of Frequency, Phase Angle, and Time Delay using Oscilloscope.
4. COUNTERS and ANALYZERS: Introduction to Wave, Harmonic Distortion and Spectrum Analyzers, Frequency Counters, Computer Controlled Test Systems: Testing an Audio Amplifier.

**Beyond Syllabus:**

 Measuring instruments: Absolute and secondary instrument, indicating and recording instrument. Text Book-1- Ch-XVII.Or related advanced topics as decided by the concerned faculty teaching the subject.

Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer (LVDT), Capacitive Transducers, Peizo-Electric transducers, Optical Transducer, Torque meters, inductive torque transducers, electric tachometers, photoelectric tachometers, Hall Effect Transducer. (Text Book-2- Ch-11.1 to 11.6).Or related advanced topics as decided by the concerned faculty teaching the subject.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Book(s) :**

1. Electrical Measurements and Measuring Instruments – Golding & Widdis – 5th Edition, Reem Publication (*For sections 2 to 6: Selected Portions from Ch.-VI, VII, IX, XIX, XX, XXI & XXII*).
2. Modern Electronic Instrumentation and Measurement Techniques – Helfrick & Cooper – Pearson Education (*For sections 1, 7 to 9: Selected Portions from Ch.-1, 3, 6, 7, 9, 10, and 13*).

**Reference Book(s):**

1. A Course in Electrical and Electronic Measurements and Instrumentation – A K Sawhney – Dhanpat Rai & Co.
2. Elements of Electronic Instrumentation and Measurement – Joshep Carr – 3rd Edition, Pearson Education.
3. Electronic Instrumentation – H C Kalsi – 2nd Edition, Tata McGraw Hill.
4. Electronic Measurement and Instrumentation – Oliver & Cage – Tata McGraw Hill.

PCEC4202 **Digital Electronics Circuit**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 1 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 4

|  |
| --- |
| CO1:    Differentiate between combinational and sequential circuit operation. |
| CO2:    Design a counter having a specified count sequence using state diagrams and state table |
| CO3:    Analyze HDL for all digital circuits. |
| CO4:    Evaluate and draw layout of various digital circuit. |
| CO5:    Construct digital circuits, use standard laboratory instrumentation to verify the operation of the circuits. |
| CO6:   Apply his knowledge on PC-based electronic circuit simulation software. |

**MODULE – I (11 Hours)**

**1.** **Number System:** Introduction to Binary Numbers, Data Representation, Binary, Octal, Hexadecimaland Decimal Number System and their Conversion. (2 Hours)

1. **Boolean Algebra and Logic Gates:** Basic Logic Operation and Identities, Algebraic Laws, NOR andNAND Gates, Useful Boolean Identities, Algebraic Reduction, Complete Logic Sets, Arithmetic Operation using 1’s and 2`s Compliments, Signed Binary and Floating Point Number Representation.

(4 Hours)

**3.** **Combinational Logic Design:** Specifying the Problem, Canonical Logic Forms, Extracting CanonicalForms, EX-OR Equivalence Operations, Logic Array, K-Maps: Two, Three and Four variable K-maps, NAND and NOR Logic Implementations. (5 Hours)

**MODULE – II (15 Hours)**

1. **Concepts in VHDL:** Basic Concepts, Using a Hardware Description Language, Defining Module inVHDL, Structural and Combinational Modelling, Binary Words, Libraries, Learning VHDL. (4 Hours)
2. **CMOS Logic Circuits:** Voltages as Logic Variables, Logic Delay Times: Output Switching Times,Propagation Delay, Fan-In and Fan-out, Extension to other Logic Gate.

C-MOS Electronics, MOSFETS, The NOT Function in C-MOS: Complimentary Pairs and the C-MOS Invertors, Logic Formation Using MOSFETS: the NAND and NOR Gate, C-MOS Logic Connection, Complex Logic Gates in C-MOS: 3-input Logic Gates, A general 4-input Logic Gate, Logic Cascades.

(6 Hours)

1. **Introduction to VLSI:** Introduction, Lithography and Patterning, MOSFET Design Rules, BasicCircuit Layout, MOSFET Arrays and AOI Gates, Cells, Libraries, and Hierarchical Design, Floor Plans

and Interconnect Wiring. (5 Hours)

**MODULE – III (16 hours)**

1. **Logic Components:** Concept of Digital Components, An Equality Detector, Line Decoder,Multiplexers and De-multiplexers, Binary Adders, Subtraction and Multiplication. (5 Hours)
2. **Memory Elements and Arrays:** General Properties, Latches, Clock and Synchronization, Master-Slave and Edge-triggered Flip-flops, Registers, RAM and ROMs, C-MOS Memories. (6 Hours)

**Sequential Network:** Concepts of Sequential Networks, Analysis of Sequential Networks: SingleState and Multivariable Networks, Sequential Network Design, Binary Counters, Importance of machine. (5 Hours)

**Beyond Syllabus-**

Basic hardware description language: Introduction to Verilog/VHDL programming language, Verilog/VHDL program of logic gates, adders, Substractors, Multiplexers, Comparators, Decoders flip-flops, counters, Shift resistors.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**Text Books:**

1. A First Course in Digital System Design: An Integrated Approach, India Edition, John P. Uyemura, PWS Publishing Company, a division of Thomson Learning Inc.
2. Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.
3. Digital Design, Robert K. Dueck, CENGAGE Learning**.**

**Reference Books:**

1. Digital Principles and Applications, 6th Edition, Donald P. Leach, Albert Paul Malvino and Goutam Saha, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Digital Fundamentals, 5th Edition, T.L. Floyd and R.P. Jain, Pearson Education, New Delhi.
3. Digital Electronics, Principles and Integrated Circuit, Anil K. Jain, Wiley India Edition.
4. Digital Design, 3rd Edition, Moris M. Mano, Pearson Education.

PCEE7203 **Electrical Machines Lab-I**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 3

|  |
| --- |
| CO1: Determine the critical resistance and critical speed from no load test of a DC shunt generator |
| CO2: Control the Speed of DC shunt motor by armature control and flux control method |
| CO3: Conduct parallel operation of single phase transformers. |
| CO4:. Analyze the Efficiency by Open Circuit and Short Circuit test on single phase transformer |
| CO5: Perform back to back test on two numbers of transformer and find out the varous losses. |

**Select any 8 experiments from the list of 10 experiments**

1. Determination of critical resistance & critical speed from no load test of a DC shunt generator.
2. Plotting of external and internal characteristics of a DC shunt generator.
3. Speed control of DC shunt motor by armature voltage control and flux control method.
4. Determination of efficiency of DC machine by Swinburne’s Test and Brake Test.
5. Determination of efficiency of DC machine by Hopkinson’s Test.
6. Determination of Efficiency and Voltage Regulation by Open Circuit and Short Circuit test on single phase transformer.
7. Polarity test and Parallel operation of two single phase transformers.
8. Back-to Back test on two single phase transformers.

**Experiment Beyond Syllabus-**

1. Determination of parameters of three phase induction motor from No load Test and Blocked Rotor Test.
2. Determination of Efficiency, Plotting of Torque-Slip Characteristics of Three Phase Induction motor by Brake Test.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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PCEE7204 **Electrical and Electronics Measurement Lab**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/Week **Credits:** 2

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| --- |
| CO1:  Recognize and measure resistance, inductance and capacitance using   Kelvin’s Double Bridge. |
| CO2: Understand the operation of spectrum analyzer. |
| CO3: Apply his knowledge to measure the iron loss from B-H Curve . |
| CO4: Analyze and measure the power and power factor in 3-phase & 1-Phase AC circuit. |
| CO5: Evaluate a problem relating to measure three phase power using two wattmeter. |

**Select any 8 experiments from the list of 10 experiments**

1. Measurement of Low Resistance by Kelvin’s Double Bridge Method.
2. Measurement of Self Inductance and Capacitance using Bridges.
3. Study of Galvanometer and Determination of Sensitivity and Galvanometer Constants.
4. Calibration of Voltmeters and Ammeters using Potentiometers.
5. Testing of Energy meters (Single phase type).
6. Measurement of Iron Loss from B-H Curve by using CRO.
7. Measurement of R, L, and C using Q-meter.
8. Measurement of Power in a single phase circuit by using CTs and PTs.

**Experiment Beyond Syllabus**-

1. Measurement of Power and Power Factor in a three phase AC circuit by two-wattmeter method.
2. Study of Spectrum Analyzers.

**PO Matrix:**

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**PSO MATRIX:**

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| 3 | 3 | 2 |

PCEC7202 **Digital Electronics Circuit Lab**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/Week  **Credits:** 2

|  |
| --- |
| CO1:    Verify the truth table of basic gates, universal gates and exclusive gates. |
| CO2:   Implement various Boolean Expression using universal gates. |
| CO3:   Design various combinational and sequential circuit operations like latch and flip-flop. |
|   CO4:   Analyze and write HDL code for various combinational circuit |
| CO5:   Perform test on various combinational and sequential circuit operations like latch and flip-flop. |

***List of Experiments:***

***(Atleast 10 experiments should be done, Experiment No. 1 and 2 are compulsory and out of the balance 8 experiments atleast 3 experiments has to be implemented through both Verilog/VHDL and hardware implementation as per choice of the student totaling to 6 and the rest 2 can be either through Verilog/VHDL or hardware implementation.)***

1. Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates, use of Universal NAND Gate.
2. Gate-level minimization: Two level and multi level implementation of Boolean functions.
3. Combinational Circuits: design, assemble and test: adders and subtractors, code converters, gray code to binary and 7 segment display.
4. Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number of Gates.
5. Design with multiplexers and de-multiplexers.
6. Flip-Flop: assemble, test and investigate operation of SR, D & J-K flip-flops.
7. Shift Registers: Design and investigate the operation of all types of shift registers with parallel load.
8. Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallel load.
9. Memory Unit: Investigate the behaviour of RAM unit and its storage capacity – 16 X 4 RAM: testing, simulating and memory expansion.
10. Clock-pulse generator: design, implement and test.

**Experiment beyond syllabus-**

1. Parallel adder and accumulator: design, implement and test.
2. Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce a 8-bit product.
3. Verilog/VHDL simulation and implementation of Experiments listed at Sl. No. 3 to 12.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
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HSSM7203 **Communication & Interpersonal skills for**

**Corporate Readiness Lab.**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 2

|  |
| --- |
| CO1: Analyze a complex problem and make students prepared to confidently face the challenges in the corporate or the business world. |
| CO2: Evaluate and pass through a smooth transition from a student to an early career professional in the corporate world. |
| CO3: Make them acclimatized with the duties and responsibilities of a professional entering into an initial employment, prove their mettle for sustainability and improve upon their etiquettes and conduct after getting the employment. |
| CO4:- Prove their mettle for sustainability and improve upon their etiquettes and conduct after getting the employment. |
| CO5: Apply the techniques of preparing CV, writing Job Application, Interviews, Techniques of GD, Memos, Welcoming New Entrants, expressing competent and equipped for day to day transactions. |

This course will focus on communication in professional (work-related) situations of the kind that BPUT graduates may expect to encounter on entering the professional domain.

Some typical forms of work-related communication, oral or written, are listed below. Practice activities for all four skills can be designed around these or similar situations.

1. Gaining entry into an organization
2. Preparing job-applications and CVs
3. Facing an interview
4. Participating in group discussion (as part of the recruitment process)

2 In-house communication

1. Superior/ Senior subordinate / junior ( individual / group)
	* 1. Welcoming new entrants to the organization, introducing the workplace culture etc.
		2. Briefing subordinates / juniors : explaining duties and responsibilities etc.
		3. Motivating subordinates / juniors (‘pep talk’)
	1. Instructing/ directing subordinates/ juniors
	2. Expressing / recording appreciation, praising / rewarding a subordinate or junior
	3. Reprimanding / correcting / disciplining a subordinate/junior (for a lapse) ; asking for an explanation etc.
2. Subordinate / Junior Superior / Senior
3. Responding to the above
4. Reporting problems / difficulties / deficiencies
5. Offering suggestions

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 3 | 3 | 3 |

**PSO MATRIX:**

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**BIJU PATNAIK UNIVERSITY OF TECHNOLOGY ,**

**ORISSA**

**ELECTRICAL & ELECTRONICS ENGINEERING (EEE)**

|  |  |  |  |  |  |  |  |
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|  | **5th Semester** |  |  |  | **6th Semester** |  |  |
| **Code** | **Subjects** | **L-T-P** | **Credit** | **Code** | **Subjects** | **L-T-PCredit** |
|  | **Theory** |  |  |  | **Theory** |  |  |
| HSSM3303 Environmental Engineering & Safety |  |  | HSSM3302 Optimization in Engineering |  |  |
|  | OR | 3-0-0 | 3 |  | OR | 3-0-0 3 |
| HSSM3302 Optimization in Engineering |  |  | HSSM3303 Environmental Engineering & Safety |  |  |
| PCEC4303 Control Systems Engineering | 3-0-0 | 3 | PCEL4303 Microprocessor & Microcontrollers | 3-0-0 | 3 |
| PCEL4301 Power Electronics | 3-0-0 | 3 | PCEC4304 Digital Signal Processing | 3-0-0 | 3 |
| PCEL4302 Electrical Machines-II | 3-1-0 | 4 | PCEE4304 Communication Engineering | 3-0-0 | 3 |
|  | ***Professional Elective-I (Any one)*** | 3-0-0 | 3 |  | ***Professional Elective-II (Any one)*** | 3-0-0 | 3 |
| PEEL5302 | Renewable Energy Systems |  |  | PEME5305 Robotics & Robot Applications |  |  |
| PEEL5301 | Sensors and Transducers |  |  | PEEE5301 Optoelectronics Devices & Instrumentation |  |
| PEEC4301 Advanced Electronic Circuits |  |  | PEEL5303 | Electric Drives |  |  |
|  | ***Free Elective-I (Any one)*** | 3-0-0 | 3 |  | ***Free Elective-II (Any one)*** | 3-0-0 | 3 |
| FESM6301 Numerical methods |  |  | PEEC4304 ComputerNetworks& Data Communication |  |
| FEEC6301 Data Base Management Systems |  |  | PCCS4304 Operating Systems |  |  |
| PCCS4301 Computer Organization |  |  | FEEE6301 Industrial Process Control and Dynamics |  |
| PCIT4303 | Java Programming |  |  |  |  |  |  |
|  | **Theory Credits** | **19** |  | **Theory Credits** | **18** |
|  | **Practical/ Sessional** |  |  |  | **Practical/ Sessional** |  |  |
| PCEC7303 Control & Instrumentation Lab. | 0-0-3 | 2 | PCEL7303 | Microprocessor & Microcontroller Lab | 0-0-3 | 2 |
| PCEL7301 Power Electronics Lab. | 0-0-3 | 2 | PCEC7304 Digital Signal Processing Lab. | 0-0-3 | 2 |
| PCEL7302 Electrical Machines Lab-II | 0-0-3 | 2 | PCEE7304 Communication Engineering Lab. | 0-0-3 | 2 |
|  | **Practical/ Sessional Credits** | **06** |  | **Practical/ Sessional Credits** | **06** |
|  |  |  |  |  |  |
|  | **TOTAL SEMESTER CREDITS** | **25** |  | **TOTAL SEMESTER CREDITS** | **24** |
|  | **TOTAL CUMULATIVE CREDITS** | **136** |  | **TOTAL CUMULATIVE CREDITS** | **160** |

**5th Semester**

HSSM3303 **ENVIRONMENTAL ENGINEERING &**

**SAFETY** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

|  |
| --- |
| CO1: Develop the basic concept about Ecological concept, Environmental law, Water treatment, Noise pollution and its control. |
| CO2: Implement his idea on Waste water treatment, Air pollution and its control, solid waste management, Hazardous waste management. |
| CO3: Analyze the basic knowledge about Occupational safety and Health acts. |
| CO4: Develop the basic knowledge about Safety procedure, Types of Accidents, Safety management. |
| CO5: Apply his basic knowledge about management for personal protective equipment. |
| CO6:   Demonstrate different types of Accidents occurs and their Safety management & personal protective equipment. |

**Module – I**

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain,

Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, EU, US and Indian Environmental Law. Chemistry in

Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution-Noise standards, measurement and control. Water Treatment: water quality standards and parameters, Ground water. Water treatment processes, Pre-treatment of water, Conventional process, Advanced water treatment process.

**Module – II**

(a)Waste Water Treatment: DO and BOD of Waste water treatment process, pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

(b)Air Pollution : Air pollution and pollutants, criteria pollutants, Acid deposition, Global climate change –greenhouse gases, non-criteria pollutants, air pollution meteorology, Atmospheric dispersion. Industrial Air Emission Control. Flue gas desulphurization, NOx removal, Fugitive emissions.

(c) Solid waste, Hazardous waste management, Solid Waste Management, Source classification and composition of MSW: Separation, storage and transportation,

Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing,

**Module – III**

Occupational Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error and Hazard Analysis. Hazard Control Measures in integratednsteel industry, Petroleum Refinery, L.P.G. Bottling, Pharmaceutical industry. Fire

Prevention – Detection, Extinguishing Fire, Electrical Safety, Product Safety. Safety

Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Gas Cylinders, Hydro Carbons and Wastes. Personal Protective Equipments.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 2 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 2 | 2 |

**Text Book :**

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely,
2. Environmental Engineering by Prof B.K. Mohapatra, Seven Seas Publication, Cuttack
3. Industrial Safety Management, L. M. Deshmukh, Tata McGraw Hill Publication.

**Reference Books**

1. Environmental Engineering by Arcadio P. Sincero & Gergoria A. Sincero PHI Publication
2. Principles of Environmental Engineering and Science, M. L. Davis and S. J. Masen, McGraw Hill International Edition, 2004
3. Environmental Science, Curringham & Saigo, TMH,
4. Man and Environment by Dash & Mishra
5. An Introduction to Environmental Engineering and Science by Gilbert M. Masters & Wendell P. Ela - PHI Publication.
6. Industrial Safety Management and Technology, Colling. D A – Prentice Hall, New

Delhi.

HSSM3302 **OPTIMIZATION IN ENGINEERING** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

|  |
| --- |
| CO1: Identify Engineering Optimization problems. |
| CO2: Analyze Engineering Optimization problems,clasification of optimization algorithm. |
| CO3: Develop the basic concept about Transportation problems and Assignment problems and integer programming. |
| CO4: Evaluate constrained optimization with equality constrain. |
| CO5: Create idea about Queuing models. |
| CO6: Explains constrained optimization with inequality constrain. |

**Unit-I** **(10 Hours)**

Idea of Engineering optimization problems, Classification of optimization algorithms,

Modeling of problems and principle of modeling.

**Linear programming:** Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method , Sensitivity analysis in linear programming

**Unit-II** **(10 Hours)**

**Transportation problems:** Finding an initial basic feasible solution by NorthwestCorner rule, Least Cost rule, Vogel’s approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method

**Assignment problems:** Hungarian method for solution of Assignment problems

**Integer Programming:** Branch and Bound algorithm for solution of integerProgramming Problems

**Queuing models:** General characteristics, Markovian queuing model, M/M/1 model,

Limited queue capacity, Multiple server, Finite sources, Queue discipline.

**Unit-III** **(10 Hours)**

**Non-linear programming:** Introduction to non-linear programming. **Unconstraint optimization:** Fibonacci and Golden Section Search method.

**Constrained optimization with equality constraint:** Lagrange multiplier, Projectedgradient method

**Constrained optimization with inequality constraint:** Kuhn-Tucker condition,

Quadratic programming

Introduction to Genetic Algorithm.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 |

**PSO MATRIX:**

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| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**Recommended text books**

1. A. Ravindran, D. T. Philips, J. Solberg, *“ Operations Research- Principle and* *Practice*”, Second edition, Wiley India Pvt Ltd
2. Kalyanmoy Deb, “ *Optimization for Engineering Design*”, PHI Learning Pvt Ltd

**Recommended Reference books:**

1. **S**tephen G. Nash, A. Sofer,*“ Linear and Non-linear Programming*”, McGraw Hill
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis,” *Engineering Optimization*”, Second edition, Wiley India Pvt. Ltd
3. H.A.Taha,A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, “*Operations Research*”, Eighth Edition, Pearson Education
4. F.S.Hiller, G.J.Lieberman, *“ Operations Research*”, Eighth Edition, Tata McDraw Hill
5. P.K.Gupta, D.S.Hira, “*Operations Research*”, S.Chand and Company Ltd.

PCEC4303 **CONTROL SYSTEM ENGINEERING** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

|  |
| --- |
| CO 1: Differentiate open loop and closed loop control system and representation of different mechanical and electrical system into block diagram. |
| CO 2: Analyze 1st and 2nd order system in time domain using different technique like root locus, RH criteria etc. |
| CO 3:  Evaluate 1storder system in frequency domain using different technique like Bode Plot, Nyquist Plot etc. |
| CO 4:  Analyze 2nd order system in frequency domain using different technique like Polar Plot, Nyquist Plot etc. |
| CO 5:  Evaluate problems arising on Bode Plot, Polar Plot, Nyquist Plot etc. |
| CO 6: analyze proportional integral derivative controler in linear time invariant system. |

***Module-I :*** ***(12 Hours)***

Introduction to Control Systems : Basic Concepts of Control Systems, Open loop and closed loop systems, Servo Mechanism/Tracking System, Regulators, Mathematical

Models of Physical Systems: Differential Equations of Physical Systems: Mechanical Translational Systems, Mechanical Acceloroments, Retational systems, Gear Trains, Electrical Systems, Analogy between Mechanical and electrical quantity, Thermal systems, fluid systems, Derivation of Transfer functions, Block Diagram Algebra, Signal flow Graphs, Mason’s Gain Formula. Feedback characteristics of Control

Systems: Effect of negative feedback on sensitivity, bandwidth, Disturbance, linearizing effect of feedback, Regenerative feedback.

Control Components : D.C. Servomotors, A.C. Servomotors, A.C. Tachometer,

Synchros, Stepper Motors.

***Module-II :*** ***(15 Hours)***

Time response Analysis : Standard Test Signals : Time response of first order systems to unit step and unit ramp inputs. Time Response of Second order systems to unit step input, Time Response specifications, Steady State Errors and Static Error Constants of different types of systems. Generalised error series and Generalised error coefficients, Stability and Algebraic Criteria, concept of stability, Necessary conditions of stability, Hurwitz stability criterion, Routh stability criterion, Application of the Routh stability criterion to linear feedback system, Relative stability by shifting the origin in s-plane.

Root locus Technique: Root locus concepts, Rules of Construction of Root locus, Determination of Roots from Root locus for a specified open loop gain, Root contours, Systems with transportation lag. Effect of adding open loop poles and zeros on Root locus.

***Module-III :*** ***(13 Hours)***

Frequency Response Analysis : Frequency domain specifications, correlation between Time and Frequency Response with respect to second order system, Polar plots, Bode plot. Determination of Gain Margin and Phase Margin from Bode plot.

Stability in frequency domain : Principle of argument, Nyquist stability criterion, Application of Nyquist stability criterion for linear feedback system.

Closed loop frequency response : Constant M-circles, Constant N-Circles, Nichol’s chart.

Controllers : Concept of Proportional, Derivative and Integral Control actions, P, PD, PI, PID controllers. Zeigler-Nichols method of tuning PID controllers.

**Beyond Syllabus:**

1. Control System and Components: Modeling of Steppermotor, AC & DC Servomotor, Synchros, AC Tachometer with selected problems.](Text Book-1-Ch 4.3, 4.4) Or any related topic as decided by the concerned faculty member teaching the subject.

2. Sensitivity of the Roots of the Characteristics Equation (Text Book-1-Ch- 7.6)] Or any

related topic as decided by the concerned faculty member teaching the subject.

3. Closed loop frequency response: Constant M circles, Constant N-Circles, Nichol’s chart.

(Text Book-2-Ch-)] Or any related topic as decided by the concerned faculty member

teaching the subject.

4. Tuning Rules for PID controllers.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

***Text Books :***

1. Modern Control Engineering by K. Ogata, 5th edition PHI.
2. Control Systems Engg. by I.J. Nagrath and M.Gopal, 5th Edition, New Age International Publishers (2010).
3. Modern Control Systems by Richard C.Dorf and Robert H. Bishop, 11th Ed (2009), Pearson

***Reference Books :***

1. Design of Feedback Control Systems by R.T. Stefani, B. Shahian, C.J. Savator, G.H. Hostetter, Fourth Edition (2009), Oxford University Press.
2. Control Systems (Principles and Design) by M.Gopal 3rd edition (2008), TMH.
3. Analysis of Linear Control Systems by R.L. Narasimham, I.K. International Publications
4. Control Systems Engineering by S.P. Eugene Xavier and J. Josheph Cyril Babu, 1st Edition (2004), S. Chand Co. Ltd.
5. Problems and solutions in Control System Engineering by S.N. Sivanandam and S.N. Deepa, Jaico Publishing House.

PCEL4301 **POWER ELECTRONICS** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| --- |
| CO1: Understand the fundamental principles and applications of power electronics circuits |
| CO2: Conversant with the operating principle of semiconductor power electronic switches and its switching techniques. |
| CO3: Proficiency in the usage of power electronic converters to design inverters and rectifiers |
| CO4: Analyze UPS,SMPS and Battery chargers |
| CO5: Evaluate complex problems on Electronic Ballast,Static VAR compensator. |
| CO6: Understand about UPS,SMPS,Battery chargers,Electronic Ballast,Static VAR compensators |

**Module-1** **12 Lecturers**

1. Power semiconductor devices: Switching and V-I characteristic of devices

Thyristor family: SCR, TRIAC,GTO,RCT,MCT, and Transistor Family: BJT, IGBT, and MOSFET. Ch:(1.3, 1.4 , 4.2.2, 4.2.3, 4.3.2, 4.6, 4.10, 7.2, 7.4,7.5).

1. (a) Triggering Methods: SCR: UJT and R-C triggering scheme, Power Transistor:

MOSFET Gate drive, BJT base drive, IGBT gate drive, Isolation of gate and

|  |  |
| --- | --- |
| base drive. | Ch: (17.2, 17.3,17.4, 17.5). |

1. Protection of Devices: SCR: Over voltage, over current, dv/dt, di/dt, Gate Protection. Transistor: protection of power BJT, IGBT and power MOSFET,

|  |  |
| --- | --- |
| dv/dt & di/dt limitation. | Ch: (18.4, 18.5, 18.6, 18.7, 18.8, 4.8, 7.9, 7.10) |
| **Module-2** | **12 Lectures** |  |
| 3(a). AC to DC converter: Un controlled Diode | rectifier : Single phase half wave |
| and full wave rectifiers with R-L and R -L-E load ,3 phase bridge rectifier with |
| R-L and R-L-E load |  | Ch: (3.2, 3.3, 3.4, 3.5, 3.8) |
| Controlled rectifiers : Principle of phase controlled converter operation, single |
| phase full converter with | R-L and R-L-E load,3 phase full converter with R-L |
| and R-L-E load ,single phase semi converter with R-L and R-L-E load, 3 |
| phase semi converter with R-L and R-L-E load. |
|  |  | Ch: (10.2, 10.3, 10.6, 10.9, 10.10) |
| Single phase PWM rectifier, Three phase PWM rectifier. |
|  |  | Ch: (10.8.3, 10. 8.4, 10.8.5) |
| 3(b).AC –AC converter : AC voltage controller: Single phase bi-directional |
| controllers with R and | R-L load, single phase cycloconverters, ac-voltage |
| controllers with PWM control. | Ch: (11.4, 11.5, 11.9.1, 11.10) |
| **Module 3** | **12 Lectures** |  |

3(c). DC to DC converter: Classification: First quadrant, second quardrant, first and second quardrant, third and fourth quardrant, fourth quardrant converter.

Switching mode regulators: Buck regulators, Boost regulators, Buck-Boost regulators, Cuk regulators, Isolated Types: Fly Back Converters, Forward

|  |  |
| --- | --- |
| converters, Push | Pull Converters, Bridge Converter. |
|  |  |  | Ch: (5.7,5.8.1,5.8.2,5.8.3,5.8.4) |
| 3(d) DC to AC converter: Inverters: PWM inverters, Single phase Bridge |
| Inverters, 3-Phase Inverters-180 deg. conduction, 120 deg. conduction. |
| voltage control | of 3-Phase | Inverters: Sinusoidal | PWM , space vector |
| modulation, Current Source | Inverter, | Zero Current Switching resonant |
| inverters, Zero Voltage Switching resonant inverter. Ch: (6.4, 6.5, 6.8.1, |
| 6.8.4, 6.10, 8.8, 8.9) |  |  |  |
| 4. Applications: UPS, SMPS, Battery | Chargers, | Electronic | Ballast, Static VAR |
| Compensator. | Ch: (14.2.1, 14.2.2, 14.2.3, 14.2.4,14.2.6, 13.6.4) |
| Beyond Syllabus-1. Two-Transistor Model of SCR, V-I characteristics of RCT, MCT, |  |

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
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**Text Books:**

1.Power Electronics: Circuits,Devices and Applications by M H Rashid, 3rd Edition, Pearson

**Reference Books:**

1. Power Electronics: Principles and Applications by J. Vithayathil, TMH Edition
2. Power Converter Circuits by W Shepherd and L Zhang, CRC, Taylor and Francis, Special Indian Edition.
3. Power Electronics: Converters , Applications, and Design by Mohan, Undeland and Robbins, Wiley Student Edition.

PCEL4302 **ELECTRICAL MACHINES-II** (3-1-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| --- |
| CO1: Understand the construction and types of windings used in synchronous generators |
| CO2: Appreciate the performance of Three Phase Synchronous generators under loaded and unloaded condition |
| CO3: Imbibe the techniques, skills, and application of modern engineering tools for the control of brushless alternator |
| CO4: Analyze synchronization of three phase alternator.  |
| CO5: Implement his knowledge on load sharing in parallel operation of three phase alternators.  |
| CO6: Analyze operation of steady state synchronous motor  |

**MODULE-I [15 HOURS] 1. Three Phase Synchronous Generators (5 hours)**

Synchronous Generator Construction (both Cylinderical Rotor and Salient Pole type), The Speed of Rotation of a Synchronous Generator, Induced voltage in A.C. Machines, The Internal Generated Voltage of a Synchronous Generator, The

Effect of Coil Pitch on A.C. Machines, Distributed Windings in A.C. Machines, The Rotating Magnetic Field, The Equivalent Circuit of a Synchronous Generator

(Armature Reaction Reactance, Synchronous Reactance and Impedance).

**[Chapman: Ch. 5.1, 5.2, 4.4, 5.3, B.1, B.2, 4.2, 5.4]**

1. **Cylindrical Rotor type Three Phase Synchronous Generators (4+2=6 hours)**
	1. The Phasor Diagram of a Synchronous Generator, Power and Torque in Synchronous Generators (Power Angle Equation and Power Angle Characteristic),

Measuring Synchronous Generator Model Parameters (Open Circuit and Short Circuit Tests and Determination of Synchronous Impedance and Reactance, The

Short Circuit Ratio), Voltage Regulation and Speed Regulation. **[Chapman: Ch.**

**5.5, 5.6, 5.7, 4.8] (4 hours)**

(b) Zero Power Factor characteristic, Potier Reactance, Voltage Regulation by Synchronous Impedance Method, Potier Reactance (Zero Power Factor = ZPF)

Method. **[M.G.Say: Selected Portions of Ch.10.2, 10.3, 10.4, 10.15] (2 hours)** **3. Salient Pole type Three Phase Synchronous Generators (3+1=4 hours)**

Two Reaction Concept, Development of the Equivalent Circuit of a Salient Pole type Three Phase Synchronous Generator (Direct axis and Quadrature axis Reactances, Phasor Diagram for various load power factors,), Torque and Power

Equations of Salient Pole Synchronous Generator (Power Angle Equation and

Power Angle Characteristic with stator resistance neglected). **[Chapman: Appendix**

**C.1, C.2] (3 hours)**

Slip Test for determination of Direct axis and Quadrature axis Reactances.

**[M.G.Say: Ch.10.15]** **(1hour)**

**MODULE-II** **[12 HOURS]**

**4. Parallel operation of Three Phase A.C. Synchronous Generators (4 hours)**

The Conditions Required for Paralleling, The General Procedure for

Paralleling Generators, Frequency - Real Power and Voltage – Reactive Power Characteristics of a Three Phase Synchronous Generator, Operation of Generators in Parallel with large Power Systems, Operation of generators in parallel with other

Generators of the same size. **[Chapman: Ch.5.9]**

**5. Three Phase Synchronous Motors** **(8 hours)**

Basic Principles of Motor operation, Steady State Synchronous Motor

operation, Starting Synchronous Motors, Synchronous Generators and Synchronous

Motors, Synchronous Motor Ratings. **[Chapman: Ch.6.1, 6.2, 6.3, 6.4, 6.5]**

**MODULE-III** **[13 HOURS]**

**6. Three Phase Transformers (5+3=8 hours)**

Constructional features, Three-Phase Transformer connections, The per unit system for Three Phase Transformer, Transformer Ratings and Related problems,

Two Single-Phase Transformers connected in Open Delta (V-Connection) and their rating, T-Connection (Scott Connection) of Two Single-Phase Transformers to convert Three-Phase balanced supply to Two-Phase balanced supply.**[Chapman:**

**Ch.2.10, 2.11, 2.12] (5 hours)**

Transformer Three phase Connections: Various Phase Displacements (0o, 180o,+30o and -30o), Connection Diagrams and Phasor Diagrams of various Vector

Groups (Yy0, Dd0, Dz0, Yy6, Dd6, Dz6, Yd1, Dy1, Yz1, Yd11, Dy11, Yz11), Parallel operation of three phase transformers. **[M.G.Say: Ch.5.9, 5.15] (3 hours)**

**7. Single Phase and Special Purpose Motors (5 hours)**

The Universal Motor, Introduction to Single Phase Induction Motors, Starting of Single Phase Induction Motors, Speed Control of Single Phase Induction Motors,

The Circuit Model of a Single Phase Induction Motor, Other types of Motors: Reluctance Motors, Stepper Motors. **[Chapman: Ch.10.1, 10.2, 10.3, 10.4, 10.5, 10.6]**

**Beyond Syllabus-**

Constructional features, Brush Shift and its Effects, Interpoles, Compensating Windings or

related advanced topics as decided by the concerned faculty teaching the subject**.**

Braking of Dc motor, Application, Zero Power Factor characteristic, Potier Reactance,

Voltage Regulation by Potier Reactance (Zero Power Factor = ZPF) Method or related

advanced topics as decided by the concerned faculty member teaching the subject.

Operation of Generators in Parallel with large Power Systems, Operation of generators in

parallel with other Generators of the same size or related advanced topics as decided by the

concerned faculty member teaching the subject.

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**PO Matrix:**

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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**TEXT BOOKS**:

1. Stephen J. Chapman-‘Electric Machinery and Fundamentals’- McGraw Hill International Edition, (Fourth Edition), 2005.
2. M.G.Say-‘Alternating Current Machines’, English Language Book Society (ELBS)

/Longman, 5th Edition, Reprinted 1990.

**REFERENCE BOOKS:**

1. P.C.Sen-‘Principles of Electric Machines and Power Electronics’-2nd Edition, John Wiley and Sons, Wiley India Reprint, 2007.
2. B.S.Guru & H.R.Hiziroglu-‘Electric Machinery & Transformers’-3rd Ed-Oxford Press, 2010.

**Professional Elective-I**

PEEL5302 **RENEWABLE ENERGY SYSTEMS** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| CO1: Summarize the importance, scope and potential of renewable energy sources for future scope energy demand. |
| CO2: Develop a fundamental background for solving numerical problems & research. |
| CO3: Analyze the applications of non-conventional energy sources |
| CO4 :Evaluate MPPT in solar PV system. |
| CO5 :Analyze Wind Energy and use of wind turbine. |
| CO6: Demonstrate and implement their knowledge for developing hybrid energy system. |

**Module I** **(5 Hours)**

**Introduction:** Fossil fuel based systems Impact of fossil fuel based systems, Nonconventional energy – seasonal variations and availability, Renewable energy – sources and features, Hybrid energy systems, Distributed energy systems and dispersed generation (DG)

**Module II:** **(20 Hours)**

**Solar Photovoltaic systems**: Operating principle, Photovoltaic cell concepts, Cell,module, array, Series and parallel connections, Maximum power point tracking, Applications, Battery charging, Pumping, Lighting, Peltier cooling

Solar processes and spectral composition of solar radiation; Radiation flux at the Earth’s surface. Solar collectors. Types and performance characteristics. Applications

**Wind Energy:** Wind energy conversion; efficiency limit for wind energy conversion,types of converters, aerodynamics of wind rotors, power ~ speed and torque ~ speed characteristics of wind turbines, wind turbine control systems; conversion to electrical power: induction and synchronous generators, grid connected and self excited induction generator operation, constant voltage and constant frequency generation with power electronic control, single and double output systems, reactive power compensation; Characteristics of wind power plant. Applications:

**Module III** **(15 hours)**

**Biomass Power:** Operating principle, Combustion and fermentation, Anaerobicdigester. Wood gassifier, Pyrolysis, Applications, Bio gas, Wood stoves, Bio diesel,

Combustion engine. Application,

**Hybrid Systems**

Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles

Beyond Syllabus-

**PO Matrix:**

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**PSO MATRIX:**

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**Beyond Syllabus:**

Breif idea About DFIG in WES, Geo- thermal power plant.

**Text Books:**

1. D. P. Kothari, K. C. Singal, R. Ranjan, *Renewable Energy Sources and*

*Emerging Technologies*, Prentice Hall of India, New Delhi, 2008.

1. B.H.Khan, Non-Conventional Energy Resources, Tata McGrawHill, 2009
2. S. N. Bhadra, D. Kastha, S. Banerjee, *Wind Electrical Systems*, Oxford Univ. Press, New Delhi, 2005.

**Reference Books:**

1. S. A. Abbasi, N. Abbasi, Renewable Energy Sources and Their Environmental Impact, Prentice Hall of India, New Delhi, 2006.

PEEC4301 **ADVANCED ELECTRONIC CIRCUIT**

(3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

**CO1:**  Students will able to design amplifier of desired gain using BJT and FET.

**CO2:**  Students will able to design various oscillatory circuits to generate at desired frequency of oscillation.

**CO3:**  Students will able to design amplifier having desired bandwidth.

**CO4:**  Students will able to design adder, differentiator and integrator circuit using opamp.

**MODULE-I** **(10 Hours)**

1: Active Filters :Active Filters, Frequency response of Major Active filters, First order low-pass Butterworth filter: Filter Design, Frequency Scaling, Second-order low-pass Butterworth filter: First-order high-pass Butterworth filter, Second-order high-pass Butterworth filter, Band-pass filters: Wide band-pass Filter, Narrow Band -Pass Filter, Band-reject filters: Wide Band-Reject Filter, Narrow Band-Reject Filter, All-Pass filter.

1. Oscillators: Oscillators: Oscillator Principles, Oscillator Types, Quadrature Oscillator, Saw tooth wave generator, Voltage-controlled oscillator.
2. Comparators: Comparators: basic comparator, zero-crossing detector, Schmitt trigger, comparator characteristics, limitations of Op-Amp as comparators, voltage limiters.

**MODULE-II** **(14 Hours)**

1. Bistable Multivibrator: Bi-stable Multi-vibrator, fixed-bias bi-stable multi-vibrator, Loading, self-biased transistor binary, commutating capacitors, Triggering the binary, Unsymmetrical Triggering of the bistable multivibrator, Triggering Unsymmetrically through a Unilateral Device, Symmetrical Triggering, Triggering of a Bistable Multi Symmetrically without the Use of Auxiliary Diodes, Schmitt Trigger Circuit (Emitter-coupled Bistable Multivibrator).
2. Monostable and Astable Multivibrator: Monostable Multivibrator, Gate Width of a Collector-Coupled Monostable Multivibrator, Waveforms of the Collector-Coupled Monostable Multivibrator, Emitter-Coupled Monostable Multivibrator, Triggering of the Monostable Multivibrator. Astable Collector-Coupled Multivibrator, Emitter-coupled Astable multivibrator.
3. Wideband amplifiers: Wideband amplifiers: The Hybrid-π , High-frequency, Small-signal, Common-emitter Model, RC-Coupled Amplifier, Frequency Response of a Transistor Stage-The Short-Circuit Current Gain, Current Gain with Resistive Load, Transistor Amplifier Response taking Source Impedance into Account, Transient Response of a Transistor Stage, Cascaded C E Transistor Stages, Rise-time Response of Cascaded Stages, Shunt Compensation of a Transistor Stage in a Cascade, Rise Time of Cascaded Compensated Stages, Low frequency Compensation.

**MODULE-III** **(12 Hours)**

1. Negative Resistance Switching Devices: Voltage Controllable Negative resistance devices, Tunnel Diode operation and characteristics, Monostable Astable, Bistable circuits using tunnel diode, Voltage controlled Negative Resistance Switching Circuits.
2. Voltage and Current Time Base Generators: Time-Base Generators, General features of a Time-base signal, Methods of generating a voltage time-base waveform, Exponential sweep circuit, Miller and bootstrap time base generators-Basic principles, Transistor miller time base generator, Transistor bootstrap time base generator, Current Time-Base Generators, A Simple Current sweep, Linearity Correction through adjustment of driving waveform, Transistor current time base generator.
3. Specialized IC Applications: IC 555 Timer: IC 555 Timer as a Monostable Multivibrator and its applications, IC 555 Timer as Astable Multivibrator and its applications. Phase Locked Loop: Operating principle of PLL, Phase detectors, Exclusive-OR phase detector, Monolithic phase detector, Instrumentation Amplifier and its applications.

**PO Matrix:**

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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
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**Text Books:**

1. Pulse, Digital and switching Waveforms, Second Edition - Jacob Millman, Herbert Taub and Mothiki S Prakash Rao (TMH Publication).

(Selected portion from Chapter 3, 8, 9, 10, 11, 12 and 13)

1. OP-Amps and Linear Integrated Circuits- Ramakant A. Gayakwad (PHI Publication). (Selected portion from Chapter 7, 8 and 9)
2. Pulse & Digital Circuits by K.Venkata Rao, K Rama Sudha & G Manmadha Rao, Pearson Education, 2010. (Selected portions)

**Reference Books:**

1. OP-Amps and Linear Integrated Circuits - Robert F. Coughlin, Frederick F. Driscoll (Pearson Education Publication).
2. Pulse and Digital Circuits by A. Anand Kumar, PHI.

**Free Electives - II**

FEEC6301**Database Management System** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0  **Credits:** 3

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| --- |
| CO 1: Analyze the basic concepts and architecture associated with DBMS |
| CO 2 : Evaluate normalization steps in database design and removal of data anomalies |
| CO 3 : Describe the characteristics of database transactions. |
| CO 4 : Summarize the characteristics of database transactions and how they affect database integrity. |
| CO 5 : Categorized the characteristics of database transactions and how they affect database integrity and consistency. |
| CO 6 : Create, maintain and manipulate a relational database using SQL. |

**Module I : (10 hours)**

Database System Architecture - Data Abstraction, Data Independence, Data

Definitions and Data Manipulation Languages. Data models - Entity Relationship(ER), Mapping ER Model to Relational Model, Network .Relational and

Object Oriented Data Models, Integrity Constraints and Data Manipulation

Operations.

**Module II : (12 hours)**

Relation Query Languages, Relational Algebra and Relational Calculus, SQL. Relational Database Design: Domain and Data dependency, Armstrong's Axioms,

Normal Forms, Dependency Preservation, Lossless design. Query Processing Strategy.

**Module III: (10 hours)**

Transaction processing: Recovery and Concurrency Control. Locking and Timestamp based Schedulers.

Database Recovery System: Types of Data Base failure & Types of Database Recovery, Recovery techniques

**PO Matrix:**

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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3.00 | 3.00 | 3.00 |

**Text Books:**

1. Database System Concepts by Sudarshan, Korth (McGraw-Hill Education )
2. Fundamentals of Database System By Elmasari & Navathe- Pearson Education

**References Books:**

1. An introduction to Database System – Bipin Desai, Galgotia Publications
2. Database System: concept, Design & Application by S.K.Singh (Pearson Ed)
3. Database management system by leon &leon (Vikas publishing House).
4. Fundamentals of Database Management System – Gillenson, Wiley India
5. Database Modeling and Design: Logical Design by Toby J. Teorey, Sam S.

Lightstone, and Tom Nadeau, 4th Ed., 2005, Elsevier India Publications, New Delhi

PCEC7303 **Control and Instrumentation Laboratory**(0-0-3)

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 2

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| CO1: Observe the time response of a second order process with P, PI and PID control and apply PID control to servomotor |
| CO2: Analyze characteristics of a relay and analyze the relay control system |
| CO3: Evaluate and plot the displacement-voltage characteristics of the given LVDT |
|  CO4:Design the stepper motor and its application. |
|  CO5:Distinguish resistance -voltage characteristics of thermistor. |

**List of Experiment :**

**Control: (Any five)**

1. Study of a dc motor driven position control system
2. Study of speed torque characteristics of two phase ac servomotor and determination of its transfer function
3. Obtain the frequency response of a lag and lead compensator
4. To observe the time response of a second order process with P, PI and PID control and apply PID control to servomotor
5. To determine the transfer function of a system(network) using transfer function analyser.
6. To study and validate the controllers for a temperature control system
7. To study the position control system using Synchros

**Instrumentation:(Any five)**

1. Measurement of unknown resistance, inductance and capacitance using bridges
2. To plot the displacement-voltage characteristics of the given LVDT
3. Measurement of temperature-voltage characteristics of J-type thermocouple
4. Use a strain gauge to plot the curve between strain applied to a beam and the output voltage
5. Study of resistance-voltage characteristics of Thermistors
6. To study on the interface of PLC with PC for data acquisition applications
7. Measurement of speed by using magnetic pick up.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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PCEL7301 **Power Electronics laboratory** (0-0-3)

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 2

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| --- |
| CO1:Understand the characteristics of different semiconductor switches used in power electronic systems |
| CO2: Analyze different triggering circuit of semiconductor devices |
| CO3: Analyze, design and apply different power electronic converters, chopper circuits. |
| CO4: Create different power electronic converters, chopper circuits in motor drives |
| CO5: Evaluate operation of different isolated converter. |

**List of Experiment : (any ten)**

1. Study of the V-I characteristics of SCR, TRIAC and MOSFET.
2. Study of the V-I characteristics of UJT
3. To measure the latching and holding current of a SCR
4. (a)Study of the synchronized UJT triggering circuit.

(b) Study of the cosine controlled triggering circuit

1. Study of the single phase half wave controlled rectifier and semi converter circuit with R and R-L Load
2. Study of single phase full wave controlled rectifier circuits(mid point and Bridge type) with R and R-L Load
3. Study of three phase full wave controlled rectifier circuits(Full and Semi converter) with R and R-L Load
4. Study of the forward converter (Buck converter) and flyback converter(boost converter) operation.
5. Study of the single phase pwm voltage source inverter.
6. Study the performance of three phase VSI with PWM control.
7. Study the performance of single phase AC Voltage controller with R and R-L Load
8. Study of the resonant inverter.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
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**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

PCEL7302 **Electrical Machines laboratory-II** (0-0-3)

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 2

|  |
| --- |
| CO1: Conduct tests on different AC electrical machines. |
| CO2: Analyze the operation of electric machines under different loading conditions |
| CO3: Evaluate the synchronization process of two alternators. |
| CO4: Perform the test of parallel operation of two alternators. |
| CO5: Measure losses and efficiency of different types of machines. |

**List of Experiment: (any ten)**

1. Determination of the voltage regulation of an alternator by zero power factor (zpf) method
2. Determination of the V and inverted V curves of a synchronous motor
3. Speed control of a three phase induction motor using variable frequency drives
4. Determination of parameters of synchronous machine
5. Positive sequence reactance
6. Negative sequence reactance
7. Zero sequence reactance
8. Determination of power angle characteristics of an alternator
9. Determination of parameter of a single phase induction motor and study of
10. Capacitor start induction motor
11. Capacitor start and capacitor run induction motor
12. Universal motor
13. Shaded pole motor
14. Study of parallel operation of two alternators
15. Measurement of direct and quadrature axis reactance of a salient pole synchronous machine
16. Measurement of transient and sub transient reactance of a salient pole alternator
17. Performance of grid connected induction generator.
18. Three phase transformer connections ( Star, Delta and Scott).
19. Determination of voltage regulation of alternator by synchronous impendence method.

**PO Matrix:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**6th Semester**

PCEL4303 **MICROPROCESSOR & MICRO**

**CONTROLLERS**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
|  CO1: Identify the basic element and functions of microprocessor |
| CO2: Describe the architecture of microprocessor and its peripheral devices |
| CO3: Demonstrate fundamental understanding on the operation between the microprocessor and its interfacing devices. |
| CO4: Evaluate fundamental understanding on the operation between the microprocessor and microcontroller. |
| CO5:Creat program in 8086. |
| CO6: Apply the programming techniques in developing the assembly language program for microprocessor And Microcontroller application. |

**MODULE - I** (10 hours)

**Microprocessor Architecture:** Microprocessor and Microcomputer Architecture, Pins &Signals, Register Organization, Timing & Control Module, 8085 Instruction Timing & Execution.

**Assembly Language Programming of 8085:** Instruction set of 8085, Memory & I/OAddressing, Assembly language programming, Stack & Subroutines.

Interfacing EPROM & RAM Memories: 2764 & 6264, 8085 Interrupts **(Book 1:** Ch.1,2,3,4 & 7)

**MODULE – II** (15 hours)

**8086 Microprocessor: Architectures, Pin Diagrams and Timing Diagrams:** Register

Organisation, Architecture, Signal Description, Physical Memory Organisations, Bus Operation, I/O Addressing Capability, Special Processor Activities, Minimum Mode System and Timings, Maximum Mode System and Timings

**8086 Instruction Set and Assembler Directives:** Machine Language Instruction

Formats, Addressing Modes, Instruction Set, Assembler Directives and Operators

**Assembly Language Programming with 8086: M**achine Level Programs, MachineCoding the Programs ,Programming with an Assembler

**Special Architectural Features and Related Programming:** Stack, Interrupts and

Interrupt Service Routines, Interrupt Cycle,Non Maskable Interrupt, Maskable Interrupt,

Interrupt Programming, Passing Parameters to Procedures, Handling Programs of Size More than 64k,MACROS, Timings and Delays

**Basic Peripherals and Their Interfacing with 8086:** Semiconductor MemoryInterfacing, Dynamic RAM Interfacing, Interfacing I/O Ports, PIO 8255],Modes of

Operation of 8255, Interfacing Analog to Digital Data Converters, Interfacing Digital to

Analog to Converters, Stepper Motor Interfacing ,

**Special Purpose Programmable Peripheral Devices and Their Interfacing**

Programmable Interval Timer 8253, Programmable Interrupt Controller 8259A, The Keyboard/Display Controller 8279, Programmable Communication Interface

8251USART

**DMA, Floppy Disk and CRT Controllers**

DMA Controller 8257,DMA Transfers and Operations, Programmable DMA Interface

8237, Floppy Disk Controller 8272, CRT Controller 8275

**80386 Microprocessor:** Introduction, Architecture, Pins & Signals, Memory System, Registers,Memory Management, Paging Technique, Protected Mode Operation.

(Book- 2: Ch.1.1 to 1.9, ch.2.1 to 2.4,ch.3.1 to 3.3, ch.4.1 to 4.10,ch.5.1 to 5.8,ch.6.1 to 6.4, ch.7.1 to 7.5, ch.10.1 to 10.3, 10.7,10.9)

**MODULE –III (15 HOURS)**

**8051 Microcontrollers:** Microcontrollers and embedded processors, Overview of the

8051 family

**8051 Hardware Connection:** Pin description of the 8051

**8051 Assembly Language Programming:** Inside the 8051, Assembly, ProgrammingAssembling and Running an 8051 Program, The Program Counter and ROM Space in the 8051

8051 data types and Directives, PSW Register, register Banks and Stack

**Jump, loop, and Call Instructions:** Loop and Jump Instructions, Call Instructions,Time Delay for Various 8051 chips

**8051 I/O Port Programming:** I/O Programming, I/O Bit Manipulation Programming, **8051 Addressing Modes:** Immediate and register Addressing Modes, Accessingmemory using various Addressing Modes, Bit Addresses for I/O and RAM

**Arithmetic & Logic Instructions and Programs:** Arithmetic Instructions, Signednumber concepts and Arithmetic Operations, Logic and Compare Instructions, Rotate

Instruction and data Serialization, BCD, ASCII, and other Application Programs

**8051 Serial Port Programming in Assembly:** Basic of Serial communication, 8051connection to RS232, 8051 Serial port Programming in Assembly, Programming the second Serial port

**Interrupts Programming in Assembly:** 8051 Interrupts, Programming timer Interrupts,

Programming external hardware Interrupts, Programming the Serial Communication interrupt, Interrupt Priority in the 8051

**ADC, DAC, and Sensor Interfacing:** Parallel and Serial ADC, DAC InterfacingSensor Interfacing and Signal Conditioning

**Interfacing to External Memory:** Semiconductor Memory, Memory Address Decoding,

Interfacing with External ROM, 8051 Data Memory space, Accessing External data Memory

**8051 Interfacing with the 8255:** 8255 Interfacing, Pogramming for the 8255

**Motor Control: RELAY, PWM, DC, and Stepper Motors:** Relays and Opto-isolations,

Stepper Motor Interfacing, DC Motor Interfacing and PWM

**(**Book-3: Ch.1.1,1.2,ch.2.1 to 2.7,ch.3.1 to 3.3,ch.4.1,4.2,ch.5.1 to 5.3,ch.6.1 to6.5,ch.10.1 to 10.4,ch.11.1 to 11.5,ch.13.1 to 13.3,ch.14.1 to 14.4,ch.15.1,15.2,ch.17.1 to 17.3)

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**TEXT BOOKS**

1. Ghosh & Sridhar,0000 to 8085–Introduction to Microprocessor for Scientists & Engineers,

PHI

1. A.K. Roy & K.M. Bhurchandi, Advanced Microprocessor and Peripherals (Architecture, Programming & Interfacing)– TMH Publication
2. Mazidi & Mazidi, The 8051 Microcontroller & Embedded Systems– Pearson / PHI publication

. ***REFERENCE:***

1. M. Rafiqzzaman, Microprocessor – Theory & Applications. (Intel & Motorola ), PHI 2.The 8086 Microprocessor: Programming & Interfacing the PC by Keneeth J. Ayela

1. Douglas V.Hall, “Microprocessors and Interfacing: Programming and Hardware”, TMH
2. R.S. Gaonkar, Microprocessor architecture, programming & application with 8085, Penram International Publishing. (India) Pvt. Ltd.

5.W.A.Triebel and Avtar Singh, The 8088 and 8086 Microprocessors, Pearson Education

6. Barry B. B The Intel Microprocessor – (Architecture, Programming & Interfacing) by Pearson

PCEC4304 **DIGITAL SIGNAL PROCESSING** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
| CO1:   Represent discrete-time signals analytically and visualize them in the time domain.             |
| CO2:    Analyze and implications of the properties of systems and signals. |
| CO3: Understand the Transform domain and its significance. |
| CO4:   Compute Transform domain and its significance and problems related to computational complexity. |
| CO5:   Evaluates different types of complex problems related to signal processing.. |
| CO 6: Design various types of filters. |

**Module – I** (10 hours)

**The Z-Transform and Its Application to the Analysis of LTI Systems:**

The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the

Z-Transform; Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction Expansion;

Analysis of Linear Time-Invariant Systems in the z-Domain: Response of Systems with rational System Functions, Transient and Steady-State Responses, Causality and

Stability, Pole-Zero Cancellations.

Selected portions from Chapter 3 (3.1.1, 3.1.2, 3.2, 3.4.2, 3.4.3, 3.5.1, 3.5.2, 3.5.3, 3.5.4) of Textbook – I

**The Discrete Fourier Transform: Its Properties and Applications**

Frequency Domain Sampling: Frequency-Domain Sampling and Reconstruction of

Discrete-Time Signals, The Discrete Fourier Transform, The DFT as a Linear Transformation, Relationship of the DFT to other Transforms; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties; Linear Filtering Methods Based on the DFT:

Use of the DFT in Linear Filtering, Filtering of Long Data Sequences; Frequency

Analysis of Signals using the DFT; The Discrete Cosine Transform: Forward DCT, Inverse DCT, DCT as an Orthogonal Transform.

Chapter – 7 of Textbook – 1.

**Module – II** (10 hours)

**Implementation of Discrete-Time Systems:**

Structure for the Realization of Discrete-Time Systems, Structure for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures;

Structure for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures.

Selected portions from Chapter 9 (9.1, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 9.3.2, 9.3.3, 9.3.4) of Textbook – I

**Design of Digital Filters:**

General Considerations: Causality and Its Implications, Characteristics of Practical

Frequency-Selective Filters; Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase

FIR Filters by the Frequency-Sampling Method; Design of IIR Filters from Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

Selected portions from Chapter 10 (10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.2.3, 10.2.4, 10.3.2, 10.3.3) of Textbook – I

**Module- III** (15 hours)

**Efficient Computation of the DFT: Fast Fourier Transform Algorithms**

Efficient Computation of the DFT: FFT Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms: Decimation-In-Time (DIT), Decimation-In-Time (DIF); Applications of FFT Algorithms: Efficient Computation of the DFT of two Real Sequences, Efficient Computation of the DFT a 2N-Point Real Sequence, Use of the

FFT Algorithm in Linear Filtering and Correlation.

Selected portions from Chapter 8 (8.1.1, 8.1.3, 8.2.1, 8.2.2, 8.2.3) of Textbook – I

**Adaptive Filters:**

Application of Adaptive Filters: System Identification or System Modeling, Adaptive

Channel Equalization, Adaptive Line Enhancer, Adaptive Noise Cancelling; Adaptive Direct-Form FIR Filters-The LMS Algorithm: Minimum Mean Square Error Criterion, The LMS Algorithm.

Selected portions from chapter 13 (13.1.1, 13.1.2, 13.1.5, 13.1.6, 13.2.1, 13.2.2) of Text book –I

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 2 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**Text Books**

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G.

Proakis and D. G. Manolakis, 4th Edition, Pearson.

**Reference Book :**

1. Digital Signal Processing – S.K. Mitra, TMH

PCEE4304 **Communication Engineering**(3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
| CO1: Understand modulation schemes and provide an insight to analog communication |
| CO2: understand modulation schemes and provide an insight to digital communication |
| CO3: Identify and describe different theoretical terms related to TV transmission and reception |
| Co4: Analyze mechanism used in radar and satellite systems |
| Co5: Implement their knowledge in communication engineering using analog systems |
| CO6: implement their knowledge in communication engineering using digital systems |

**MODUE-I**

**INTRODUCTION:** Elements of an Electrical Communication System, CommunicationChannels and their Characteristics, Mathematical Models for Communication Channels

**FREQUENCY DOMAIN ANALYSIS OF SIGNALS AND SYSTEMS:** Fourier series, FourierTransforms, Power and Energy, Sampling and Band limited signals, Band pass signals

**MODULE-II**

**ANALOG SIGNAL TRANSMISSION AND RECEPTION:** Introduction to modulation,Amplitude Modulation (AM), Angle Modulation, Radio and Television broadcasting

**MODULE-III**

**PULSE MODULATION SYSTEMS:** Pulse amplitude modulation, Pulse Time Modulation **PULSE CODE MODULATION:** PCM system, Intersymbol interference, Eye patterns,Equalization, Companding, Time Division Multiplexing of PCM signals, Line codes, Bandwidth of PCM system, Noise in PCM systems, Delta Modulation (DM), Limitations of DM, Adaptive Delta Modulation, Noise in Delta Modulation, Comparison between PCM and DM, Delta or Differential PCM (DPCM), S-Ary System

Beyond Syllabus-

**PO Matrix:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**Text Book:**

1. John G.Proakis,M. Salehi, *COMMUNICATION SYSTEMS ENGINEERING*, 2nd ed. New Delhi,India: PHI Learning Private Limited, 2009.; Selected portion from Chapter 1,2 and 3 for module MODULE-I and MODULE-II of the course.
2. R.P Singh and S.D Sapre, *COMMUNICATION SYSTEMS Analog & Digital*, 2nd ed. New Delhi, India: Tata McGraw Hill Education Private Limited, 2009; Selected portions from Chapter 7 and 8 of the book for MODULE-III.

**Reference Book:**

Taub, Schilling, Saha, Taub’s Principles of Communication Systems, TMH.

1. Modern Digital and Analog Communication Systems, by B.P. Lathi, Oxford

PEEL5303: **Electric Drives** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
| CO1: Understand different characteristics of electrical machines used in industry |
| CO2: Analyze Model electric drives based on energy efficiency |
| CO3: Understand the speed control techniques implemented in electric drives using conventional methods. |
| CO4: Evaluates the problems in different types of drives used in industries. |
| CO5: Apply his knowledge on speed control techniques implemented in electric drives using solid state power electronics |
| CO6: Appreciate the different closed loop control schemes applied in electric drives |

**Module-I** **(12 Hours)**

**Study of Motor Drives**: Electrical Drives, Advantages of Electrical Drives, Electrical Motors, Power Modulators, Choice of electrical Drives, Fundamentals of Torque Equations, Speed Torque Conventions and Multi-quadrant Operation, Equivalent Values of Drive Parameters, Components of Load Torques, Nature and Classification of Load Torques, Calculation of Time and Energy Loss in Transient Operations, Steady State Stability, Load Equalization, Control of Electrical Drives, Thermal Model of Motor for Heating and Cooling, Classes of Motor Duty, Determination of Motor Rating.**Book-1:Ch. 1.1, Ch. 1.2, Ch. 1.3, Ch. 1.4; Ch. 2.1, Ch. 2.2, Ch.** **2.3, Ch. 2.4, Ch. 2.5, Ch. 2.6, Ch. 2.7, Ch. 2.8; Ch. 3.3, Ch. 4.1; Ch. 4.2, Ch. 4.3.**

**Module-II** **(14 Hours)**

Steady State Performance of DC/AC Drives: Closed Loop Control of Drives, DC Motors and their Performances, Starting, Braking, Transient Analysis, Speed Control, Methods of Armature Voltage Control, Transformer and Uncontrolled Rectifier Control, Controlled Rectifier Fed DC Drives, Chopper Controlled DC Drives.

Induction Motor Drives: Speed Control, Pole Changing, Pole Amplitude Modulation, Stator Voltage Control, Variable Frequency Control from Voltage Source, Voltage Source Inverter Control, Variable Frequency Control from Current Source, Current Source Inverter Control, Current Regulated Voltage Source Inverter Control, Rotor Resistance Control, Slip Power Recovery. **. 5.19, Ch. 5.20, Ch. 5.21; Ch. 6.8, Ch. 6.9, Ch. 6.10, Ch. 6.11, Ch. 6.12, Ch. 6.13, Ch. 6.16, Ch. 6.17, Ch. 6.18, Ch. 6.20, Ch. 6.21; Ch. 7.3.1, Ch. 7.3.2, Ch. 7.4.**

|  |  |  |
| --- | --- | --- |
| **Module-III** | **(12** | **Hours)** |
| Traction Drives: Nature of Traction Load, Calculation of Traction Drive Ratings and Energy |
| Consumption, Tractive Effort and | Drive Ratings, Specific Energy Consumption, | Maximum |

Allowable Tractive Effort, Conventional DC and AC Traction Drives, 25 kV AC Traction using Semiconductor Converter Controlled DC Motors, DC Traction employing Polyphase AC Motors, AC Traction employing Polyphase AC Motors.

**Book-1:Ch. 10.2, Ch. 10.6, Ch. 10.10, Ch. 10.12, Ch. 10.15, Ch. 10.16.**

Drives for Specific Applications: Drive Considerations for Textile Mills, Steel Rolling Mills, Cranes and Hoist Drives, Cement Mills, Sugar Mills, Machine Tools, Paper Mills, Coal Mines, Centrifugal Pumps.**Book-2:Ch. 7.1, Ch. 7.2, Ch. 7.3, Ch. 7.4, Ch. 7.5, Ch. 7.6, Ch. 7.7, Ch.**

**7.8, Ch. 7.9.**

Microprocessors and Control of Electrical Drives: Dedicated Hardware Systems versus Microprocessor Control, Application Areas and Functions of Microprocessors in Drive Technology, Control of DC Drives using Microprocessors.

**Book-2:Ch. 8.2, Ch. 8.3, Ch. 8.4.1.**

**Beyond Syllabus-**

**Electric Braking in Electric Locomotive(Plugging, Rheostatic braking and Regenerative Braking),Locomotive used in Urban Service.**

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 1 |

**Text Books:**

1. Book-1: Fundamentals of Electrical Drives-By G.K.Dubey, Alpha Science International Limited, Pangbourne, UK, **Second Edition**, 2001.
2. Book-2: Electric Drives-Concepts and Applications- By Vedam Subramanyam, **Second**

**Edition**, Tata McGraw Hill Publication, 2010-11.

**Reference Book**:

(1) Modern Power Electronics and AC drives- by B.K.Bose, Pearson Education.

PCCS4304 **OPERATING SYSTEM** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
|  CO 1: Understand the architecture and various functional modules of operating system such as: Process Management,  |
| CO 2: Implement their knowledge for Memory Management, I/O Management. |
| CO 3: Analyze and compare their knowledge for File Management. |
| CO 4: Interpret the concept of Operating system in  development of any software system, so as to build robust and scalable systems. |
| CO 5: Understand the architecture and various functional modules of operating system such as: Process Management,  |
| CO 6: Apply knowledge of the functional modules of operating system in future scope management system. |

**MODULE-I** **12 Hours**

**INTRODUCTION TO OPERATING SYSTEM:**

What is an Operating System? Simple Batch Systems, Multiprogramming and Time Sharing systems. Personal Computer Systems, Parallel Systems, Distributed Systems and Real time Systems.

Operating System Structures: Operating System Services, System components, Protection system, Operating System Services, system calls

**PROCESS MANAGEMENT:**

Process Concept, Process Scheduling, Operation on Processes, Interprocess communication, Examples of IPC Systems, Multithreading Models, Threading Issues, Process Scheduling Basic concepts, scheduling criteria, scheduling algorithms, Thread Scheduling.

**MODULE-II** **12 Hours**

PROCESS COORDINATION: Synchronization: The Critical section problem, Peterson’s solution, Synchronization hardware, Semaphores, Classical problems of synchronization,

Monitors.

Deadlocks: System model, Deadlock Characterization Methods for Handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock Detection, recovery from Deadlock. MEMORY MANAGEMENT: Memory Management strategies, Logical versus Physical

Address space, swapping, contiguous Allocation, Paging, Segmentation.

Virtual Memory: Background, Demand paging, performance of Demand paging, Page Replacement, Page Replacement Algorithms. Allocation of frames, Thrashing, Demand Segmentation.

**MODULE-III** **11 Hours**

STORAGE MANAGEMENT:

File System Concept, Access Methods, File System Structure, File System Structure, File System Implementation, Directory implementation, Efficiency and Performance, Recovery, Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management,

Swap-Space Management, I/O System Overview, I/O Hardware, Application I/O Interface,

Kernel I/O Subsystem, Transforming I/O Request to Hardware Operation.

CASE STUDIES: The LINUX System, Windows XP, Windows Vista

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 3 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**TEXT BOOK:**

1. **Operating System Concepts –** Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 8thedition, Wiley-India, 2009.
2. **Mordern Operating Systems –** Andrew S. Tanenbaum, 3rdEdition, PHI
3. **Operating Systems:** A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition

**REFERENCE BOOK:**

1. **Operating Systems –** Flynn, McHoes, Cengage Learning
2. **Operating Systems –** Pabitra Pal Choudhury, PHI
3. **Operating Systems –** William Stallings, Prentice Hall
4. **Operating Systems –** H.M. Deitel, P. J. Deitel, D. R. Choffnes, 3rdEdition, Pearson

**Microprocessor & Microcontroller Laboratory**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 2

|  |
| --- |
| CO1: Perform various aruthimatic operation with the 8085 microprocessor. |
| CO2: Understand how different peripherals are interfaced with microprocessor. |
| CO3: Create squre wave with 8255chip. |
| CO4: Create a programme for arithimatic function with 8086 microprocessor. |
| CO5: Understand small embeded aplication with 8051 microcontroller. |

**List of Experiment : 8085**

1. Addition, subtraction, multiplication and division of two 8 bit numbers
2. Smallest/largest number among n numbers in a given data array, Binary to Gray

code, Hexadecimal to decimal conversion

**Interfacing**

1. Generate square wave on all lines of 8255 with different frequencies
2. Study of stepper motor and its operations

**Optional (any two)**

1. Study of traffic light controller
2. Study of elevator simulator
3. Generation of square, triangular and saw tooth wave using D to A Converter
4. Study of 8253 and its operation(Mode0, Mode2, Mode3)
5. Study of Mode0,Mode1 and BSR Mode operation of 8255
6. Study of 8279 (keyboard and display interface)
7. Study of 8259 Programmable Interrupt Controller

**8051 Microcontroller**

1. Initialize data to registers and memory using immediate, register, direct and indirect

Addressing mode

**Optional (any one)**

1. Addition and subtraction of 16 bit numbers
2. Multiplication and division of two 16 bit numbers
3. Transfer a block of data to another memory location using indexing
4. Operation of 8255 using 8051 microcontroller

**8086**

1.Addition , subtraction ,multiplication and division of 16 bit numbers, 2’s complement of a 16 bit number

**Optional (any one)**

1. Finding a particular data element in a given data array
2. Marking a specific bit of a number using look-up table
3. Largest/smallest number of a given data array
4. To separate the odd and even numbers from a given data array
5. Sorting an array of numbers in ascending/descending order

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**Digital Signal Processing Laboratory (0-0-3)**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 2

|  |
| --- |
| CO1: Create a program on how design algorithms for implementation. |
| CO2: Understand how digital to analog (D/A) converters work. |
| CO 3: Operate on a signal and be able to model these operations mathematically. |
| CO4: Analyze how Analog to digital (A/D) converters work. |
| CO5: Use Z transforms and discrete time Fourier transforms to synthesize a digital system |

**List of Experiment:**

1. Different types of signal generation using MATLAB
2. Linear convolution of sequences (without using the inbuilt function ‘conv’ available in MATLAB)
3. Circular convolution of two sequences, Comparison of result with that of Linear convolution
4. (a) Finding auto correlation of a sequence

(b) Finding cross correlation of two sequences

( c ) Finding power spectral density of a sequence

1. Finding the convolution of periodic sequence using DFT and IDFT
2. Implementation of FFT (Fast Fourier Transform) algorithm
	1. Decimation in Time (DIT)
	2. Decimation in Frequency (DIF)
3. Design of FIR filter(low pass, high pass and band pass) using windowing technique(harming window, haming window, rectangular window and Kaiser

window)

8. Design of IIR filter (Design of Butterworth and Chebyshev filter)

1. Convolution of long duration sequences using overlap add, overlap save meter
2. Working with DSP processor (fixed point-TMS320C-5X/Floating point) series
3. Implement convolution (Linear and circular convolution)

FIR and IIR implementation

**PO Matrix:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 2 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Communication System Engineering Lab** (0 0 2 )

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3hr/ Week **Credits:** 2

|  |
| --- |
| CO1 Analyze the process of frequency division multiplexing and design of Am modulation and demodulation.           |
| CO2 Analyze and evaluate the performance of Fm modulation and process of PAM for determination of Quantization of noise. |
| CO3 Design and implement basic modulator and demodulation in PCM and delta modulator and by using this modulation software can simulate AM and FM modulation. |
| CO4 Design and implement their knowledge for multiplexing 2-4 PAM/PPM and PWM signals and able to analyze frequency for AM and FM signal by using MATLAB. |
| CO5: Design and implement their knowledge for multiplexing 2-4 PAM/PPM and PWM signals and able to analyze frequency for AM and FM signal by using MATLAB. |

Analyze and plot the spectrum of following signals with aid of spectrum analyzer: Sine wave, square wave, triangle wave, saw-tooth wave of frequencies 1KHz, 10Khz, 50Khz, 100KHz and 1 MHz

**Experiment objective:** Analysis of spectrum of different signals. Measurement ofpower associated with different harmonics in signals.

**Equipment Required:**

* + Signal/ function generator- frequency range upto 1MHz, signal types: square, triangle, sinusoidal, saw-tooth, DC offset signal.
	+ Spectrum analyzer Upto 100MHz atleast
1. Analyze the process of frequency division multiplexing and frequency division de-multiplexing.

**Experiment objective:** Demonstrate the process of multiplexing of signals in timeand frequency domain.

**Equipment Required:**

* + Frequency division multiplexing/ de-multiplexing experiment board.
	+ CRO
1. Study and design of AM modulator and demodulator. (Full AM, SSB, DSBSC, SSBSC) **Experiment objective:** Demonstrate the process of modulation and demodulation

using AM. Measure different parameters associated with modulated signals.

Analyze the spectrum of modulated signals.

**Equipment Required:**

* + AM modulator/ demodulator experimental board.
	+ Function generator (sine, square, modulating signal), 1MHz maximum frequency
	+ CRO - 20MHz, dual trace
	+ Spectrum analyzer.
1. Study of FM modulation and Demodulation Techniques.

**Experiment objective:** Demonstrate the process of modulation and demodulationusing FM. Measure different parameters associated with modulated signals. Analyze the spectrum of FM modulated signals and compare with theoretical bandwidth.

**Equipment Required:**

* + FM modulator/ demodulator experimental board.
	+ Function generator (sine, square, modulating signal), 1MHz maximum frequency
	+ CRO - 20MHz, dual trace
	+ Spectrum analyzer.
1. Observer the process of PAM, quantization and determination of quantization noise. **Experiment objective:** Demonstrate the process of PAM, PWM and PPM. Measure

the spectrum of the PAM, PPM and PWM signals.

**Equipment Required:**

* + Experiment board for PAM/ PPM/ PWM signal generation and detection
	+ Multiplexing board
	+ CRO
1. Multiplex 2-4 PAM/ PPM and PWM signals.

**Experiment objective:** Demonstrate the process of multiplexing in time domain.

**Equipment Required:**

* + Experiment board for PAM/ PPM/ PWM signal generation and detection
	+ Multiplexing board
	+ CRO
1. Study the functioning of PCM and Delta modulator

**Experiment objective:** Demonstrate the process of PCM modulation and Deltamodulation.

**Equipment Required:**

* + Experiment board for PCM/ Delta Modulation/ Adaptive Delta Modulation generation and detection
	+ Signal generator
	+ CRO
1. Using MATLAB/ SCILAB generate a carrier and a modulating signal. Modulate the carrier using AM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
2. Using MATLAB/ SCILAB generate a carrier and a modulating signal. Modulate the carrier using FM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
	* For experiment 7/8 MATLAB of current version/ scilab is required.
	* Computer of good configuration
3. Using Lab-View software simulate AM modulation and demodulation system.
4. Using Lab-View software simulate FM modulation and demodulation system.
	* For experiment 9/10 Lab-View of current version is required.
	* Computer of good configuration
5. Design a receiver to demodulate and receive the signal from am AM radio station.
6. Design a receiver to demodulate and receive the signal from the local FM radio station.
	* For experiment 11/12 following equipment is required
	* CRO
	* Components of assorted values.
	* AM and FM receiver ICs.

**Experiment objective (for simulation exercises):** Verify the process of modulation anddemodulation in simulation environment. Analyze frequency spectrum of the signal after modulation and demodulation. Observe the modulated and demodulated signals for different forms of modulation signal.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 |

**PSO MATRIX:**

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| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**BIJU PATNAIK UNIVERSITY OF TECHNOLOGY ,**

**ORISSA**

**ELECTRICAL & ELECTRONICS ENGINEERING (EEE)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **7th Semester** |  |  |  | **8th Semester** |  |  |
| **Code** | **Subjects** | **L-T-P** | **Credit** | **Code** | **Subjects** | **L-T-P** | **Credit** |
|  | **Theory** |  |  |  | **Theory** |  |  |
| HSSM3401 | Entrepreneurship Development | 3-0-0 | 3 | PCEE4402 | Power System Protection | 3-0-0 | 3 |
| PCEE4401 | Electrical Power Transmission and | 3-0-0 | 3 |  |  |  |  |
|  | Distribution |  |  |  |  |  |  |
| PE |  |  |  | PEEE5410 | ***Professional Elective-V (Any one)*** | 3-0-0 | 3 |
| ***Professional Elective-III (Any one)*** | 3-0-0 | 3 | Advanced Power Electronics |  |  |
| PEEE5406 | Soft Computing |  |  | PEEL5403 | Electrical Power Quality |  |  |
| PEEE5407 Industrial Automation & Control |  |  | PEEI5402 | Optimal Control |  |  |
| PCEC4401 | VLSI Design |  |  |  |  |  |  |
| PEEE5408 High Voltage DC Transmission |  |  |  |  |  |  |
| PEEE5409 Flexible AC Transmission System | 3-0-0 | 3 |  | ***Free Elective-IV (Any one)*** | 3-0-0 | 3 |
| PEEC5414 | ***Professional Elective-IV (Any one)*** | PEEC5418 |
| Advanced Control Systems |  |  | Satelite Communication Systems |  |  |
|  |  |  |  | PECS5406 | Digital Image Processing |  |  |
| PEEC5402 | Advanced Communication Systems |  |  | PEEI5403 | Industrial Instrumentation |  |  |
| PCEL4401 Power System Operation and Control | 3-0-0 | 3 | PEEC5405 | Embedded Systems | 3-0-0 | 3 |
| PEEC5416 | ***Free Elective-III (Any one)*** |  | ***Free Elective-V (Any one)*** |
| Biomedical Instrumentation |  |  | FEEE6401 Power Station Engg and Economy |  |  |
| PEEL5401 | Adaptive Signal Processing |  |  | HSSM3403 | Marketing Management |  |  |
| PEME5407 | Mechatronics |  |  | PCME4404 | Production & Operations |  |  |
|  |  |  |  |  | Management |  |  |
|  | **Theory Credits** | **15** |  | **Theory Credits** | **12** |
|  | **Practical/Sessional** |  |  |  | **Practical/Sessional** |  |  |
| PCEE7401 | Power System Lab. | 0-0-3 | 2 | PCEE7404 | Major Project | 0-0-6 | 7 |
| PCEE7402 | Minor Project | 0-0-3 | 3 | PCEE7405 | Comprehensive Viva-Voce | 0-0-3 | 2 |
| PCEE7403 | Seminar / Training Seminar | 0-0-3 | 3 |  |  |  |  |
|  | **Practical/Sessional Credits** | **08** |  | **Practical/Sessional Credits** | **09** |
|  |  |  |  |  |  |
|  | **TOTAL SEMESTER CREDITS** | **23** |  | **TOTAL SEMESTER CREDITS** | **21** |
|  | **TOTAL CUMULATIVE CREDITS** | **183** |  | **TOTAL CUMULATIVE CREDITS** | **204** |

**ENTREPRENEURSHIP DEVELOPMENT**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

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| --- |
| CO1:Define Building up entrepreneurial abilities |
| CO2: Analyze sustain accelerated economic growth by developing entrepreneurial spirit. |
| CO3: Aware of various industries and financial institutions working towards encouraging innovation. |
| CO4: Create awareness and inspirations for new scheme, Informing about various schemes. |
| CO5: awareness and inspirations for new Guidance for patents. |
| CO6: Create awareness and inspirations for new scheme, Informing about various schemes & Guidance for patents. |

**Module I:** **Understanding Entrepreneurship**

Concept of Entrepreneurship, Motivation for Economic Development and Entrepreneurial Achievement, Enterprise and Society

Why and how to start Business – Entrepreneurial traits and skills, Mind Vrs

Money in Commencing New Ventures, Entrepreneurial success and failures, Environmental dynamics and change.

**Entrepreneurial Process**

Step by step approach to entrepreneurial start up

Decision for Entrepreneurial start up.

**Module II:** **Setting up of a small Business Enterprise.**

Identifying the Business opportunity - Business opportunities in various sectors, formalities for setting up small enterprises in manufacturing and services, Environmental pollution and allied regulatory and non-regulatory clearances for new venture promotion in SME sector.

Writing a Business plan, components of a B-Plan, determining Bankability of the project.

**Module III:** **Institutional Support for SME.**

Central / State level Institution promoting SME. Financial Management in small business. Marketing Management, problems & strategies

Problems of HRM – Relevant Labour – laws.

**Sickness in Small Enterprises.**

Causes and symptoms of sickness – cures of sickness. Govt. policies on revival of sickness and remedial measures.

**PO Matrix:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 2 | 1 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**Reference Books:**

1. Entrepreneurship Development, Small Business Enterprises, Chavantimath, Pearson.
2. Entrepreneurial Development, S.S. Khanka, S Chand
3. Entrepreneurship, Barringer BR, Ireland R.D., Pearson
4. Entrepreneurship, David H Holt, PHI
5. Entrepreneurship, Kurilko, D.F. and Attodgets RM, Cengage
6. The Dynamics of Entrepreneurial Development & Management, Vasant Desai, HPH.
7. Entrepreneurship, Roy, Oxford
8. Entrepreneurship, Hisrich, Peters, Shepherd, TMH

**ELECTRICAL POWER TRANSMISSION & DISTRIBUTION**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
| CO1: Identify Transmission Line Parameter & their performance. |
| CO2: Calculate the SAG,tension,string efficiency during stringing of conductors of EHT line. |
| CO3: Analyze about HVDC transmission line. |
| CO4: Analyze the perfermance of different types of insulators and cables used in transmission and distribution system. |
| CO5: Exaplain different types of distribution systems and load estimation |
| CO6: Evalutes problems of different types of grounding methods |
| **Module – I** | **(13** | **Hours)** |
| Transmission Line Parameters: | (Book – 1, Ch.4) |
| Types of Conductors, Resistance, | Tabulated Resistance Values, | Inductance of a |

Conductor due to Internal Flux, Flux Linkages between Two Points External to an Isolated Conductor, Inductance of a Single Phase Two Wire Line, Flux Linkages of One Conductor in a Group, Inductance of Composite-Conductor Lines, The Use of Tables, Inductance of a Three Phase Line with Equilateral Spacing, Inductance of a Three Phase Line with Unsymmetrical Spacing, Inductance Calculations for Bundled Conductors. **Book-1:Ch.** **4.1, Ch. 4.2, Ch. 4.3, Ch. 4.4, Ch. 4.5, Ch. 4.6, Ch. 4.7, Ch. 4.8, Ch. 4.9, Ch. 4.10, Ch.**

**4.11, Ch. 4.12.**

Resistance, Inductance, Capacitance (Book – 1, Ch.5)

Electric Field of a Long, Straight Conductor, The Potential Difference between Two Points due to a Charge, Capacitance of a Two Wire Line, Capacitance of a Three Phase Line with Equilateral Spacing, Capacitance of a Three Phase Line with Unsymmetrical Spacing,

Effect of Earth on the Capacitance of a Three Phase Line, Capacitance Calculations for Bundled Conductors, Parallel-Circuit Three Phase Lines. **Book-1:Ch. 5.1, Ch. 5.2, Ch.** **5.3, Ch. 5.4, Ch. 5.5, Ch. 5.6, Ch. 5.7, Ch. 5.8.**

**Module – II** **(12 Hours)**

Transmission Line Performances (Book – 1, Ch.6)

Short, Medium & Long Transmission Lines

Representation of Lines, Short Transmission Lines, The Medium Transmission Lines, The Long Transmission Line: Interpretation of Equations, The Long Transmission Line: Interpretation of Equations, The Long Transmission Line: Hyperbolic Form of The

Equations, The Equivalent Circuit of a Long Line, Power Flow Through Transmission Line,

Reactive Compensation of Transmission Line. **Book-1:Ch. 6.1, Ch. 6.2, Ch. 6.3, Ch. 6.4,**

**Ch. 6.5, Ch. 6.6, Ch. 6.7, Ch. 6.8, Ch. 6.9.**

HVDC Transmission (Book – 2, Ch.15)

Introduction, Types of DC Links, Advantages of DC Transmission, Incorporating HVDC

into AC system, Converter station Equipment, Ground Return, Earth Electrode, Station

Earth, Reliability of HVDC Systems, Recent Advances, HVDC Systems in India. **Book-2:Ch. 15.1, Ch. 15.2, Ch.15.3, Ch. 15.4, Ch. 15.5, Ch. 15.6, Ch. 15.7, Ch. 15.8, Ch. 15.9,**

**Ch.15.10.**

Overhead Line Insulators (Book – 2, Ch.4)

Insulator Materials, Types of Insulators, Voltage Distribution over Insulator String, Improvement of String Efficiency, Insulator Failure, Testing of Insulators. **Book-2:Ch. 4.1,**

**Ch. 4.2, Ch.4.3, Ch. 4.4, Ch. 4.5, Ch. 4.6.**

**Module – III** **(15 Hours)**

Mechanical Design of Overhead Transmission Lines (Book – 2, Ch.5)

General Considerations, Line Supports, Types of Steel Towers, Cross Arms, Span,

Conductor Configuration, Spacings and Clearances, Sag and Tension Calculations,

Erection Conditions, Factors affecting Sag, Sag Template, Catenary, Conductor Vibration.

**Book-2:Ch. 5.1, Ch. 5.2, Ch. 5.3, Ch. 5.4, Ch. 5.5, Ch. 5.6, Ch. 5.7, Ch. 5.8, Ch. 5.9, Ch.5.10, Ch.5.11.**

Distribution (Book – 2, Ch.16)

Comparison of various Distribution Systems, AC three-phase four-wire Distribution

System, Types of Primary Distribution Systems, Types of Secondary Distribution Systems,

Voltage Drop in DC Distributors, Voltage Drop in AC Distributors, Kelvin’s Law, Limitations of Kelvin’s Law, General Design Considerations, Load Estimation, Design of Primary

Distribution, Sub-Stations, Secondary Distribution Design, Economical Design of Distributors, Design of Secondary Network, Lamp Flicker, Application of Capacitors to

Distribution Systems.

**Book-2:Ch. 16.1, Ch. 16.2, Ch.16.3, Ch. 16.4, Ch. 16.5, Ch. 16.6, Ch. 16.7, Ch. 16.8, Ch. 16.9, Ch.16.10, Ch. 16.11, Ch. 16.12, Ch.16.13, Ch. 16.14, Ch. 16.15, Ch. 16.16, Ch. 16.17.**

Underground Cables (Book – 2, Ch. 8)

Introduction, Insulation, Sheath, Armour and Covering, Classification of Cables, Pressurized Cables, Effective Conductor Resistance, Conductor Inductive Reactance, Parameters of Single Core Cables, Grading of Cables, Capacitance of Three Core Belted

Cable, Breakdown of Cables, Cable Installation, Current Rating of Cables, System Operating Problems with Underground Cables, HVDC Cables.

**Book-2:Ch. 8.1, Ch. 8.2, Ch.8.3, Ch. 8.4, Ch. 8.5, Ch. 8.6, Ch. 8.7, Ch. 8.8, Ch. 8.9, Ch.8.10, Ch. 8.11, Ch. 8.12, Ch.8.13, Ch. 8.14, Ch. 8.15.**

Power System Earthing: (Book – 2, Ch.18)

Soil Resistivity, Earth Resistance, Tolerable Step and Touch Voltage, Actual Touch and Step Voltages, Design of Earthing Grid.

**Book-2: Ch. 18.4, Ch. 18.5, Ch. 18.6, Ch. 18.7, Ch. 18.8.**

**Beyond Syllabus-**

**1.Corona: Critical Disruptive Voltage, Corona Loss, Disadvantage of Corona, Radio**

**Interference, Inductive Interference between Power and Communication Lines. Or**

**Related advanced topics as decided by the concerned faculty teaching the subject.**

**2.** **Load Estimation, Design of Primary Distribution, Sub-Stations, Secondary Distribution**

**Design, Economical Design of Distributors, Design of Secondary Network, Lamp Flicker.**

**PO Matrix:**

|  |  |  |  |  |  |  |  |  |  |  |  |
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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |

**PSO MATRIX:**

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| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Books:**

1. **Power System Analysis- By John J. Grainger & W. D. Stevenson, Jr, Tata Mcgraw-Hill, 2003 Edition, 15th Reprint, 2010.**
2. **Power System Analysis & Design- By B. R. Gupta, S. Chand Publications, 3rd Edition, Reprint, 2003.**

**FLEXIBLE AC TRANSMISSION SYSTEM** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
| CO1Understand transmission , interconnctions, power flowand stability of AC power system. |
| CO2: Know static shunt compensator and static series compensator. |
| CO3: Analyze the operation and perfermance of voltage and Phase angle regulator(TCVRS and TCPARS) |
| CO4: Analyze voltage stability using STATCOM. |
| CO5 Undrstand the operation,construction and perfermance of UPFC in combined compensator. |
| CO6Undrstand the operation,construction and perfermance of IPFC in combined compensator. |

**MODULE-I** **(12 Lectures)**

***FACTS concept and General System Considerations***: Transmission Interconnections,

Flow of Power in an AC System, What limits the Loading Capability, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters, Basic Types of FACTS Controllers, Basic Description and Definitions of FACTS Controllers.

***Static*** ***Shunt*** ***Compensation***: Objectives of Shunt Compensation, Methods of

Controllable VAR Generation, Static VAR Compensators, SVC and STATCOM. (Chapter-1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 and 1.7)

(Chapter-5: 5.1, 5.2 and 5.3)

**MODULE-II** **(12 Lectures)**

***Static Series Compensators***: Objective of Series Compensation (GCSC, TSSC, TCSC),Variable Impedance Type Series Compensators, Switching Converter Type Series

Compensators (SSSC)

***Static Voltage and Phase Angle Regulators***: Objectives of Voltage and Phase Angle

Regulators, Approaches to Thyristor-Controlled Voltage and Phase Angle Regulators (TCVRs and TCPARs).

(Chapter-6: 6.1, 6.2 and 6.3) (Chapter-7: 7.1 and 7.2)

**MODULE-III** **(10 Lectures)**

***Combined Compensators***: Introduction, Unified Power Flow Controller (UPFC), TheInterline Power Flow Controller (IPFC), Generalized and Multifunctional FACTS Controllers.

(Chapter-8: 8.1, 8.2, 8.3 and 8.4)

Beyond Syllabus-

Optimal Placement of STATCOM, Load compensation using DSTATCOM, Brief idea on UPFC and IPFC.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |

**PSO MATRIX:**

|  |  |  |
| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**TEXT BOOK**:

“***Understanding FACTS: Concepts & Technology of Flexible AC Transmission*** ***Systems***” By N.G.Hingorani & L.Gyugyi, IEEE Press, Standard Publishers Distributors,

Delhi.

**Reference Book:**

1. Facts Controllers in Power Transmission & Distribution by K.R.Padiyan, New Age Intermational.
2. Modelling & Simulation in Power Networks, Enrique Acha, Clandio Esquival &

H.A.Perez,CA Camcho, John Wiley & Sons.

**POWER SYSTEM OPERATION & CONTROL** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
| CO1: Conversant with the engineering and economic involvement in the planning, operation and control of power generation and transmission systems in electric utilities |
| CO2: Understand the subtle concepts of energy exchanges between different power systems |
| CO3: Analyze implement security functions |
| CO4:- Evaluate the load frequency control in complex power system network. |
| CO5: Defend Power system stability problem and its solution. |
| CO6: Analyze control area system and modeling of Tie line. |

**Module – I** **(14 Hours)**

Fundamentals of Power System (Book No.1, Ch. 1)

Introduction, Single Subscript Notation, Double Subscript Notation, Power in Single Phase AC Circuit, Complex Power, The Power Triangle, Direction of Power Flow, Voltage and Current in Balanced Three Phase Circuits, Power in Balanced Three Phase Circuits, Per- Unit Quantities, Changing the Base in Per- Unit Quantities, Node Equations, The Single Line or One Line Diagram, Impedance and Reactance Diagrams. (Book -1:Ch. 1.1, Ch. 1.2, Ch. 1.3, Ch. 1.4, Ch. 1.5, Ch. 1.6, Ch. 1.7, Ch. 1.8, Ch. 1.9, Ch. 1.10, Ch. 1.11, Ch. 1.12, Ch. 1.13, Ch. 1.14.)

|  |  |
| --- | --- |
| The Admittance Models & Network Calculations | (Book – 1) Ch. 7 (7.1 To 7.5) |
| Branch and Node Admittances, Mutually Coupled Branches in Ybus, An Equivalent Admittance |
| Network, Modification of Ybus, The Network Incidence Matrix and Ybus. | (Book-1:Ch. 7.1, Ch. 7.2, |
| Ch. 7.3, Ch. 7.4, Ch. 7.5.) |  |  |
| Power Flow Solutions | (Book – 1, Ch. 9) |

The Power-Flow Problem, The Gauss-Seidal Method, The Newton-Raphson Method, The Newton-Raphson Method, Power-Flow Studies in System Design and Operation, Regulating Transformers, The Decoupled Method. (Book-1:Ch. 9.1, Ch. 9.2, Ch. 9.3, Ch. 9.4, Ch. 9.5, Ch. 9.6, Ch. 9.7.)

**Module – II** **(14 Hours)**

Economic Operation of Power System (Book – 1, Ch.13)

Distribution of Load between Units within a Plant, Distribution of Load between Plants, The Transmission -Loss Equation, An interpretation of Transformation **C**, Classical Economic Dispatch with Losses, Automatic Generation Control, Unit Commitment, Solving the Unit Commitment Problems.

(Book-1: Ch. 13.1, Ch. 13.2, Ch. 13.3, Ch. 13.4, Ch. 13.5, Ch. 13.6, Ch. 13.7, Ch. 13.8.) Load Frequency Control, Control Area Concept (Book – 2, Ch.9)

Automatic Load -Frequency Control of Single Area Systems: Speed- Governing System, Hydraulic Valve Actuator, Turbine -Generator Response, Static Performance of Speed Governor, Closing the ALFC Loop, Concept of Control Area, Static Response of Primary ALFC Loop, Dynamic Response of ALFC Loop, Physical Interpretation of Results, The Secondary (“Reset”) ALFC Loop, Economic Dispatch Control.

(Book – 2: Ch. 9.3.1, Ch. 9.3.2, Ch. 9.3.3,Ch. 9.3.1, Ch. 9.3.4, Ch. 9.3.5, Ch. 9.3.6, Ch. 9.3.7, Ch. 9.3.8, Ch. 9.3.9, Ch. 9.3.10, Ch. 9.3.11.)

|  |  |
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| **Module – III** | **(12 Hours)** |
| Two Area System | (Book – 2, Ch.9) |

ALFC of Multi-Control -Area Systems (Pool Operation): The Two Area Systems, Modeling the Tie-Line, Block Diagram Representation of Two Area System, Mechanical Analog of Two Area System, Dynamic Response of Two Area System, Static System Response, Tie-Line Bias Control of Multi-area Systems. (Book – 2: Ch. 9.4.1, Ch. 9.4.2, Ch. 9.4.3 Ch. 9.4.1, Ch. 9.4.4, Ch. 9.4.5, Ch. 9.4.6, Ch. 9.4.7, Ch. 9.4.8, Ch. 9.4.9, Ch. 9.4.10.)

Power System Stability (Book-1, Ch.16)

The Stability Problem, Rotor Dynamics and the Swing Equation, Further Considerations of the Swing Equations, The Power -Angle Equation, Synchronizing Power Coefficients, Equal- Area Criterion for Stability, Further Applications of the Equal-Area Criterion, Multi-machine Stability Studies: Classical Representation, Step -By-Step Solution of the Swing Curve, Computer Programs for Transient Stability Studies, Factors Affecting Transient Stability. (Book-1:Ch. 16.1, Ch. 16.2, Ch. 16.3, Ch. 16.4, Ch. 16.5, Ch. 16.6, Ch. 16.7, Ch. 16.8, Ch. 16.9, Ch. 16.10, Ch. 16.11.)

Beyond Syllabus-

Computer Application to Power System. State estimation, Data Acquisition and Compensation.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 2 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 1 |

**Text Books:**

1. Power System Analysis- John. J. Grainger & W. D. Stevenson, Jr.,TMH Pub,15th Reprint.
2. An Introduction to Electric Energy System Theory- By O. I. Elgerd, TMH Pub, 2nd Edition.

**Reference:**

1. Power System Analysis- By Hadi Saadat, TMH Publications, 2002 Edition, Eighth Reprint.
2. Power System Analysis Operation and Control- By A. Chakrabarti and S. Haldar, Third Edition, PHI Publications, 6th Reprint, 2010.

**MECHATRONICS**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

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| CO1: know the basic building block of mechatronics system and its element. |
| CO2: Understand different types of sensor. |
| CO3: Demonstrate pneumatic and hydrolic Actuation system |
| CO4: Understand the concept of all the progarammable logic controller. |
| CO-5-Implemention of Various controllers in mechatronics system. |
| CO6- Analyze the difference between PID controller and PLC. |

***Module – I:-***

**Sensors and Transducers:-** Sensors and transducers, Performance terminology,

Displacement, position and proximity, Velocity and motion, Force, Fluid pressure, Liquid flow, Liquid level, Temperature, Light sensors, Selection of sensors, Inputting data by switches.

Book – 1: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12.

**Signal conditioning:-** Signal conditioning, The operational amplifier, Protection, Filtering,

Pulse modulation.

Book – 1: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6.

**Digital Signals:-** Digital signals, Analogue and digital signals, digital-to-analogue andanalogue-to-digital converters, Multiplexers, Data acquisition, Digital signal processing. Book – 1: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6.

**Pneumatic and Hydraulic Actuation Systems:-** Actuation systems, Pneumatic andhydraulic systems, Directional control valves, Pressure control valves, Cylinders, Servo and proportional control valves, process control valves, Rotary actuators.

Book – 1: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8.

***Module – II:-***

**Mechanical Actuation Systems:-** Mechanical systems, Types of motion, Kinematicchains, Cams, GTears, Belt and chain drives, bearings, Mechanical aspects of motor selection.

Book – 1: 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9.

**Electrical Actuation Systems:-** Electrical systems, Mechanical switches, Solid-stateswitches, Solenoids, D.C. motors, A.C. motors, Stepper motors.

Book – 1: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7.

**Basic System Models:-** Mathematical models, Mechanical system building blocks,Electrical system building blocks, Electrical system building blocks, Fluid system building blocks, Thermal system building blocks.

Book – 1: 10.1, 10.2, 10.3, 10.4, 10.5.

***Module – III:-***

**System Models:-** Engineering systems, Rotational-translational systems,Electromechanical systems, Electromechanical systems, Linearity, Hydraulic-mechanical systems, Summary, Problems.

Book – 1: 11.1, 11.2, 11.3, 11.4, 11.5.

**Closed-loop Controllers:-** Continuous and discrete control processes, Terminology,

Two-step mode, Proportional mode, Derivative control, Integral control, PID controller, Digital controllers, Control system performance, Controller tuning, Velocity control, Adaptive control, Summary, Problems.

Book – 1: 15.1, 15.2, 15.3, 15.4, 15.5, 15.6, 15.7, 15.8, 15.9, 15.10, 15.11, 15.12. **Programmable Logic Controllers:-** Introduction to PLCs, Basic Structure of a PLC,Principles of Operation, PLCs versus Computers, Introduction to Internal Architecture and

Hardware Components, PLC Programming, Analog I/O, Selecting a PLC for the

Application, Application of PLCs for Control.

Book – 2: 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.8, 13.9.

Beyond Syllabus-

Fundamental of SLDC and Scada, fuzzy Controller,Sliding Mode Control using MATLAB.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 2 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 3 |

**Text Books:**

1. Mechatronics Electronic Control Systems in Mechanical and Electrical Engg. Pearson Publication, 4th Edition by William Bolton, 2010.
2. Mechatronics Integrated Mechanical Electronic Systems by K. P. Ramachandran, G. K. Vijayaraghavan, M. S. Balasundaram, Wiley India Edition, Printed on 2008.

**Reference Books:**

1. Mechatronics integrated Technologies for Intelligent Machines by A. Smaili, F.Mrad, Oxford University Press, Printed on 2009.
2. Mechatronic Sources Book, Cengage Learning India Edition by Newton C Braga, 2nd Edition, 2010.

**Practical / Sessional**

**POWER SYSTEM LAB**

**Lecture:** 0 hr/ Week **Internal Assessment:** 100

**Tutorial:** 0 hr/ Week **Final Examination:** 0

**Practical:** 3 hr/ Week **Credits:** 2

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| CO1: Evaluate the key aspects of a power system and address its performance, cost effectiveness, reliability and stability |
| CO2:Analyze performance and parameters of Transmission line. |
| CO3: Evaluate Y-Bus matrix and load flow diagram using MATLAB. |
| CO4: Compute ferranti effect in long transmission line when lightly loaded. |
| CO5: Create new transmission line by calculating voltage distribution in long , short and medium line. |

 (Any 10 experiments out of which atleast 7 experiments from Group-A and 3 experiments from Group-B.)

**Group A:** HARDWARE BASED

1. To determine negative and zero sequence synchronous reactance of an alternator.
2. To determine sub-transient direct axis and sub-transient quadrature axis synchronous reactance of a 3-ph salient pole alternator.
3. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.
4. To study the IDMT over-current relay and with different plug setting and time setting multipliers and plot its time – current characteristics.
5. To determine the operating characteristics of biased different relay with different % of biasing.
6. To study the MHO and reactance type distance relays.
7. To determine A, B, C, D parameters of an artificial transmission line.
8. To compute series inductance and shunt capacitance per phase per km of a three phase line with flat horizontal spacing for single stranded and bundle conductor configuration.
9. To determine location of fault in a cable using cable fault locator.
10. To study the Ferranti Effect and voltage distribution in HV long transmission line using transmission line model.
11. Insulation test for Transformer oil.
12. a) Study of various types of Lightning arrestors.

b) Study of layout of outdoor pole mounted & plinth mounted sub-stations.

**Group B :** SIMULATION BASED (USING MATLAB OR ANY OTHER SOFTWARE)

1. To obtain steady-state, transient and sub-transient short-circuit currents in an alternator.
2. To formulate the Y-Bus matrix and perform load flow analysis.
3. To compute voltage, current, power factor, regulation and efficiency at the receiving end of a three phase Transmission line when the voltage and power at the sending end are given. Use П model.
4. To perform symmetrical fault analysis in a power system.
5. To perform unsymmetrical fault analysis in a power system.
6. Write a program in ‘C’ language to solve economic dispatch problem of a power system with only thermal units. Take production cost function as quadratic and neglect transmission loss.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 2 |

**PSO MATRIX:**

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| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**TEXT BOOKS:**

1. Hadi Sadat- Power System Analysis – TMH
2. T. K. Nagsarkar and M. S. Sukhija - Power System Analysis – Oxford University Press

**8th Semester**

**POWER SYSTEM PROTECTION** (3-0-0)

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

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| CO1: Understand the working principle and functioning of all power system devices. |
| CO2: Analyze the construction and characteristics of protective devices in a complex power system network. |
| CO3: Imbibe the functioning of protective relays of generators, transformers and feeders |
| CO4:- Evaluate different types of faults occurring in a complex power system. |
| CO5: Apply their knowledge to protect instruments during over-current and over-voltage condition. |
| CO6:-Create idea on numerical relay and switchgears. |

**MODULE-I** **(10 Hours)**

Introduction and Basic Principles: Basic Idea of relay protection, Nature and causes of faults, Zones of protection, Primary and back-up protection, Basic principle of operation of protective system, Methods of discrimination, Derivation of single phase quantity from three phase quantity, Components of Protection.

Relay (Principle, Construction and Characteristics) : Relay classification, Principal Types of Electromagnetic relays, Theory of Induction relay torque, Relay design and construction,

General Equations of Comparators and Electromagnetic Relays, Over Current relays, Directional relays, Distance relays, Differential relays. Book-1: CH 1.1, 1.2, 1.5, 1.7, 1.8,

2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 4.2, 4.3, 4.4, 4.7, 4.8, 4.9.

**MODULE-II** **(12 Hours)**

Fault analysis using symmetrical components: Symmetrical & unsymmetrical faults.

3-Phase systems, Significance of positive, negative and zero sequence components,

Average 3-phase power in terms of symmetrical components, sequence impedance, fault calculations, Single line to ground fault, Line to ground fault with Zf, Faults in Power systems, Concept of short circuit capacity of a Bus. Book-3: CH 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7, 13.8, 13.10, 13.13.

Feeder Protection: Over-current, Distance and Pilot Protection Schemes. Book-1: CH 5.2,

5.3, 5.4.

Apparatus Protection: Transformer Protection, Generator Protection, Motor Protection, Bus zone protection schemes. Book-1: CH 6.2, 6.3, 6.4, 6.5.

**MODULE-III** **(12 Hours)**

Static Relays: Comparators and different relays.

Amplitude comparator, Phase Comparator, Coincidence type phase comparator, Basic elements of a static relay, Over-Current Relays, Differential Protection, Static distance

Protection. Book-1: CH 11.1, 11.2, 11.3 & CH 12.1, 12.2, 12.3, 12.4.

Numerical relays:

Block Diagram of Numerical Relay, Signal Sampling & Processing , Numerical Over-current protection, Numerical Transformer differential Protection, Numerical distance Protection of Transmission Line. Book-2: CH 11.2, 11.3, 11.7, 11.8, 11.9.

Switchgears: Auto-reclosing fundamentals, Circuit breaker rating, Circuit constants and circuit conditions, Theory of Circuit interruption, Re-striking voltage transients, characteristics of Re-striking Voltage, Interaction between breaker and circuit, Current chopping, Automatic switch, Air-break circuit breakers, Oil circuit breakers, Air-blast circuit breakers, Vacuum circuit breakers, SF6 circuit breakers, DC circuit breakings.

Book-1: CH 7.1, 7.2, 7.3, 7.4, CH 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 14.2,14.3, 14.4, 14.5,

14.6, 14.7, 15.1, 15.2, 15.3, 15.5, 16.2, 16.3, 16.4.

Beyond Syllabus-

MOCB,SF6 CB,ELCB, Surge Arrester.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 |

**PSO MATRIX:**

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| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 1 |

**Text Book(s):**

1. Power System Protection and Switchgear–B Ravindranath & M Chander–New Age International Publishers. (Book-1)
2. Fundamentals of Power system Protection–Y G Paithankar & S R Bhide, PHI Pub.(Book-2)
3. Electrical Power System by C L Wadhwa New Age International Publishers. (4th Ed),(Book3)

**Reference books:**

1. Power System relaying by Horwitz, Phadke, Research Press.

2) Power System Protection and Switchgear by B.Oza, N.K Nair, R.Mehta,V.H.Makwana, TMH

**Advanced Power Electronics (3-0-0)**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

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| CO1 Understand the concept of SMPS and different types of isolated type converter and its application. |
| CO2: Analyze opeartion and perfamance of resonant converter,ZVS and ZCS. |
| CO3: Analyze different types of nonisolated type converter and its application. |
| CO4: Analyze the concept of voltage fed converter and current fed converter. |
| CO 5: Understand the operation of different Ac voltage controllers. |
| CO 6: Analyze and perfermance of HVDC,inverter connection of renewable energy and utility grid. |

**Module I (12 Lectures)**

Switched Mode Power Supply:

Isolated switched mode power supplies, Forward converter, Fly back converter,Half bridge converter, Bridge converter, Push pull converter, Cuk converter, resonant converter, Switched mode power supply with multiple outputs

(1.5, 1.7 SMPS Design and Construction by H W Whittington, Universities Press)

Multi output Boost Converter, Diode rectifier fed boost converter, State space analysis of regulators.

(5.10,5.11 and 5.13 Power Electronics, Circuits, Devices and Applications by M H Rashid,Pearson)

SMPS Control: Control requirements and technique, PWM controller, Isolation in the feed back loop, Power supplies with multiple outputs

(3.3 SMPS Design and Construction by H W Whittington, Universities Press)

**Module II (12 Lectures)**

Inverters:

Voltage Fed Converters:

Pulse width modulation techniques, Sinusoidal PWM, Selected harmonic elimination PWM, Space vector PWM, Hysteresis band current control PWM, Sigma delta modulation

Three level inverters, Resonant inverters, Soft switched inverters

Current Fed Converters:

Load commuted inverters, Forced commutated inverters, Inverters with self commutated devices

(5.5,5.6,5.7,5.8,5.9,6.3,6.4,6.7,6.7.2.2,6.8 Modern Power Electronics and AC Drives by

Bimal K Bose, Eastern Economy Edition, PHI)

**Module III (12 Lectures)**

AC voltage controllers with PWM Control, Matrix Converter

(11.10,11.11 Power Electronics, Circuits, Devices and Applications by M H Rashid,

Pearson)

Application: High Voltage DC Transmission, Interconnection of renewable energy sources and energy storage system to the utility grid, Active harmonic filter

(11.4, 17.2, 17.4 Power Electronics: Converters , Applications and Design by Mohan, Undeland and Robbin, Wiley India Edition)

Beyond Syllabus-

Harmonic Analysis of cascaded Multilevel Inverter. Space Vector Modulation.

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 2 |

**PSO MATRIX:**

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| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**Text Books:**

1. Power Electronics: Circuits, Devices and Applications by M H Rashid, 3rd Edition, Pearson
2. Power Electronics: Converters , Applications and Design by Mohan, Undeland and Robbin, Wiley India Edition
3. Modern Power Electronics and AC Drives by Bimal K Bose, Eastern Economy Edition, PHI.
4. Switched Mode Power Supplies: Design and Construction by H W Whittington, B.W Flynn and D E Macpherson, 2nd Edition, Universities Press)

**SATELLITE COMMUNICATION SYSTEMS**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

**Module – I** **(12 Hours)**

**Introduction to state of satellite communication:** Orbital mechanics and parameters,look angle determination, Launches and Lunch vehicle, Orbital effects in communication system performance. Attitude and orbit control system(AOCS), TT&C , Description of spacecraft System – Transponders,

**Equipment reliability and space qualification.**

**Satellite Link Design:** Basics of transmission theory, system noise temperature and G/Tratio, Uplink and Downlink design, design of satellite links for specified (C/N) performance.

**Module – II (10 Hours) Analog telephone and television transmission:** Energy dispersal, digital transmission

**Multiple Access:** Multiplexing techniques for satellite links, Comprehensive study onFDMA, TDMA and CDMA. Spread Spectrum Transmission and Reception. Estimating Channel requirements, SPADE, Random access

**Application of Satellite communication:** Network distribution and direct broad castingTV, fundamentals of mobile communication satellite

**Module – III** **(12 Hours)**

**Propagation on satellite:** Earth paths and influence on link design: Quantifyingattenuation and depolarization, hydrometric & non hydrometric effects, ionosphere effects, rain and ice effects

**Satellite Antennas:** Types of antenna and relationships , Basic Antennas Theory – linear,rectangular & circular aperture. Gain, pointing loss,

**Earth station Technology:** Earth station design, Design of large antennas – Cassegrainantennas, optimizing gain of large antenna, antenna temperature, feed system for large cassegrain antennas,

**Design of small earth station antennas:** Front fed paraboloid reflector antennas, offsetfed antennas, beam steering, Global Beam Antenna, equipment for earth station

***Text Books:***

1. Satellite Communication by T. Pratt, C. Bostian. 2nd Edition, John Wiley Co.

**Reference Books:**

1. Digital Communication with Satellite and Fiber Optic Application, Harlod Kolimbins,

PHI

1. Satellite Communication by Robert M. Gagliardi, CBS Publishers

**POWER STATION ENGINEERING AND ECONOMY**

**Lecture:** 3 hr/ Week **Internal Assessment:** 30

**Tutorial:** 0 hr/ Week **Final Examination:** 70

**Practical:** 0hr/ Week **Credits:** 3

|  |
| --- |
| CO1: Know various sources of electrical energy. |
| CO2: create computational models for analysis of both symmetrical and unsymmetrical conditions in power systems |
| CO3: Design and modify Power System requirements. |
| CO4: Understand different types of loads and its effect. |
| CO5: know about the depreciation cost and the revenue generation.. |
| CO6: Analyze different types of load and control method using economic power generation. |

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**MODULE-1:** **14 classes**

Introduction to different sources of energy and general discussion on their application to generation, Indian Energy Scenario. (Nag-1.5)

Load duration curves, Load Factor, Capacity Factor, Reserve Factor, Demand Factor, Diversity Factor, Plant Use Factor, Base Load, Intermediate Load and Peak Load Plants. (Nag-1.2)

ECONOMICS OF POWER GENERATION:

Construction costs, Fixed cost and Depreciation, Fuel cost, Economic scheduling principle, Annual Operating Costs, Effect of Load Factor on cost per kWh. (Vopat- 29.2- 29.5, 29.13-29.22, Nag-1.4)

NUCLEAR POWER STATION:

Introduction to fission & fusion, reactor construction, controlled chain reaction, operational control of reactors, Brief study of various types of reactors (Boiling water, pressurized water, heavy water, breeder) , Location and layout of nuclear power plant (Nag- 9.5, 9.6, 9.13, 9.15 - 9.21

**MODULE-2:** **10 classes**

HYDEL POWER STATION:

Selection of site for hydro-electric power plant. (Nag-10.4)

Hydrology: Hydrological cycle, precipitation, run-off and its measurement, hydrograph, flow duration and mass curves, Estimation of amount stored by a dam across the river, Storage and Pondage. (Vopat- 25.2, 25.3, 25.5, Nag – 10.5 - 10.7)

Turbines: Operational principle of Kaplan and Francis Turbine and Pelton wheel, Speed and Pressure Regulation, Work done, efficiency ( Vopat – Chapter-26, Nag- 10.10 – 10.15, 10.24 - 10.25)

Essential Elements of a Hydro-electric Power Plant: Catchment area, Reservoir, Dam, Head Gate, Spillways, Pen stock, Surge Tanks, Scroll case, Draft tubes and Tail Race, Power House, Classification of Hydroelectric Power Plants. (Vopat- 25.6 – 25.9, Nag- 10.8, 10.9)

Governors, Plant auxiliaries (Nag – 10.21)

**MODULE-3:** **11 classes**

THERMAL POWER STATION:

Selection of site for thermal power plant. (Vopat-31.3, Nag-1.3)

Overall Block Diagram indicating the air circuit, coal and ash circuit, water and steam circuit, various types of steam turbines, ash and coal handling system, High Pressure and High capacity water tube boilers, Economizer, Superheaters, De-Superheater, Re-heater, Air Pre-heater. (Vopat – 7.4, Chap-8, Chap-10, Nag-2.15, 6.3.1, 6.3.2, 6.4-6.6, 6.8, 6.12 - 6.15 )

Draft System: Natural, Induced Forced and Balance Draft, PA fan, FD fan, ID fan, Chimney. (Vopat – 9.1, 9.4, Nag- 4.14.1, 4.14.3, 4.15)

Condensers, Feed water heaters, Evaporators, Make-up water, Bleeding of steam, Cooling water system. (Vopat- 14.1, 14.6, 18.2, 18.13, Nag – 8.1- 8.6),

Electrostatic Precipitator: Basic working Principle and constructional details (Nag-6.10) Governors, Plant auxiliaries (Vopat- 12.14)

**Beyond Syllabus-**

**PO Matrix:**

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| **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO11** | **PO12** |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 |

**PSO MATRIX:**

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| --- | --- | --- |
| **PSO1** | **PSO2** | **PSO3** |
| 3 | 3 | 2 |

**TEXT BOOKS AND REFERENCES:**

1. P. K. Nag, “Power Plant Engineering”, 3rd Edition, Tata McGraw Hill Publication
2. Bernhardt G. A. Skrotzki, William A. Vopat, ‘Power Station Engineering and Economy’, 2nd Ed, Tata McGraw Hill Publication
3. M. V. Deshpande, Elements of Electrical Power Station Design, PHI
4. Arora & Domkundwar, ‘A Course in Power Plant Engineering’, Dhanpat Rai and sons.
5. R. K. Rajput, ‘A Text Book of Power Plant Engineering’, 3rd Edition, Laxmi Publishing.