BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

Electrical & Electronics Engineering (EEE)

3rd Semester				4th Semester			
Code	**Subjects**	**L-T-P**	**Credi**	**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 Programming	3-0-0	3	PCEE4204	Electrical & Electronics Measurement	3-0-0	3
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 Programming Laboratory	0-0-3	2	PCEE7204	Electrical & Electronics Measurement Laboratory	0-0-3	2
PCEC7201	Analog Electronics Circuit Lab.	0-0-3	2	PCEC7202	Digital Electronics Circuit Lab.	0-0-3	2
				HSSM7203	Communication & Interpersonal skills for Corporate Readiness Laboratory	0-0-3	2
	Practical/Sessional Credits		**06**		**Practical/Sessional Credits**		**08**
	TOTAL SEMESTER CREDITS		**27**		**TOTAL SEMESTER CREDITS**		**28**
	TOTAL CUMULATIVE CREDITS		**83**		**TOTAL CUMULATIVE CREDITS**		**111**

BSCM1205 **Mathematics - III**

Module-I **(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.

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**

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

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**

Module-I **(10 Hours)**

1. **Introduction to the quantum theory of solids**: Formation of energy bands, The k-space diagram (two and three dimensional representation), conductors, semiconductors and insulators.
2. **Electrons and Holes in semiconductors:** Silicon crystal structure, Donors and acceptors in the band model, 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 E_F 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)**

4. **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.
5. **PN Junction:** Building blocks of the pn junction theory: Energy band diagram and depletion layer of a pn junction, 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.
6. **The Bipolar Transistor:** Introduction, Modes of operation, Minority Carrier distribution, Collector current, Base current, current gain, Base width Modulation by collector current, Breakdown mechanism, Equivalent Circuit Models - Ebers -Moll Model.

Module III **(12 Hours)**

7. **Metal-Semiconductor Junction:** Schottky Diodes: Built-in potential, Energy-band diagram, I-V characteristics, Comparison of the Schottky barrier diode and the pn-junction diode. Ohmic contacts: tunneling barrier, specific contact resistance**.**
8. **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, Q_{inv} in MOSFET.
9. **MOS Transistor:** Introduction to the MOSFET, Complementary MOS (CMOS) technology, V-I Characteristics, Surface mobilities and high-mobility FETs, JFET, MOSFET V_t, Body effect and steep retrograde doping, pinch-off voltage,

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**

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.

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**

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.

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**

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)**

3. 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).

4. 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)**

5. 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.

6. 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.

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):

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

BECS2212 C++ & Object Oriented Programming

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.

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**

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)
2. **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)
3. **Biasing of FETs and MOSFETs:** Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design (4 Hrs)

MODULE – II **(17 Hours)**

4. **Small Signal Analysis of BJTs:** Small-Signal Equivalent-Circuit Model, Graphical Determination of h-parameters Small Signal Analysis of CE, CC, CB Amplifier with and without R_E. Effect of R_S and R_L on CE Amplifier, Emitter Follower, Analysis of Cascade, Darlington Connection and Current Mirror Circuits using BJTs. (6 Hrs)
5. **Small Signal Analysis of FETs:** Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifier with and without R_S. Effect of R_{SIG} and R_L on CS Amplifier, Analysis of Source Follower and Cascaded System using FETs. (6 Hrs)
6. **High Frequency Response of FETs and BJTs:** Low and High Frequency Response of BJTs and FETs, The Unit gain – frequency (f_t), 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)**

7. **Feedback and Oscillators:** Feedback Concepts, Four Basic Feedback Topologies, Practical Feedback Circuits, Feedback Amplifier Stability using Nyquist Plot, Basic Principle of Sinusoidal Oscillator, Wein-Bridge, Phase Shift and Crystal Oscillator Circuits. (4 Hrs)
8. **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)
9. **Power Amplifier:** Classifications, Class-A and Class-B Amplifier Circuits, Transfer Characteristics, Power Dissipation and Conversion Efficiency of Power Amplifiers. (3 Hrs)

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

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

BECS7212 C++ & Object Oriented Programming Lab

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

PCEC7201 **Analog Electronics Circuit Lab**

List of Experiments

(At least 10 out of 13 experiments should be done)

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.

11. Square wave testing of an amplifier.

12. R.C phase shift oscillator/Wien-Bridge Oscillator using OP-Amp/Crystal Oscillator.

13. Class A and Class B Power Amplifier.

4th Semester

PCEC4205 Electromagnetic Fields and Waves

MODULE – I **(11 Hours)**

7. **Vectors and Fields:** Vector Algebra, Cartesian Coordinate System, Scalar and Vector Fields, Sinusoidally Time-Varying Fields, Electric Field, Magnetic Field.
8. **Maxwell's Equations in Integral Form:** Line Integral, Surface Integral, Faradays Law, Ampere's Circuital Law, Gauss's Law for Electric Field, Gauss's Law for Magnetic Field.
9. **Maxwell's Equations in Differential Form:** Faradays Law, Ampere's Circuital Law, Curl and Stoke's Theorem, Gauss's Law for Electric Field, Gauss's Law for Magnetic Field, Divergence and Divergence Theorem.

MODULE – II **(11 Hours)**

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

MODULE – III **(10 Hours)**

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

Text Book(s):

9. Fundamentals of Electromagnetics for Engineering, First Impression – 2009, N. N. Rao, Pearson Education, New Delhi.
10. Introduction to Electromagnetic Fields, 3rd Edition, Clayton R. Paul, Keith W. Whites and Syed A. Nasar, Tata McGraw Hill Publishing Company Ltd., New Delhi.
11. 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**

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)**

3. 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.
4. 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)**

5. 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.
6. 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.

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**

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)

3. 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.
4. AMMETER and VOLTMETER: Derivation for Deflecting Torque of; PMMC, MI (attraction and repulsion types), Electro Dynamometer and Induction type Ammeters and Voltmeters.
5. POTENTIOMETER: Construction, Theory and Principle of operation of DC Potentiometers (Crompton, Vernier, Constant Resistance, & Deflectional Potentiometer), and AC Potentiometers (Drysdale-Tinsley & Gall-Tinsley Potentiometer).
6. 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)

7. CURRENT TRANSFPRMER and POTENTIAL TRANSFOMER: Construction, Theory, Characteristics and Testing of CTs and PTs.
8. 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.
9. 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.
10. COUNTERS and ANALYZERS: Introduction to Wave, Harmonic Distortion and Spectrum Analyzers, Frequency Counters, Computer Controlled Test Systems: Testing an Audio Amplifier.

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):

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

PCEC4202 **Digital Electronics Circuit**

MODULE – I (11 Hours)

1. **Number System:** Introduction to Binary Numbers, Data Representation, Binary, Octal, Hexadecimal and Decimal Number System and their Conversion. (2 Hours)
2. **Boolean Algebra and Logic Gates:** Basic Logic Operation and Identities, Algebraic Laws, NOR and NAND 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 Canonical Forms, 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)

4. **Concepts in VHDL:** Basic Concepts, Using a Hardware Description Language, Defining Module in VHDL, Structural and Combinational Modelling, Binary Words, Libraries, Learning VHDL. (4 Hours)
5. **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)
6. **Introduction to VLSI:** Introduction, Lithography and Patterning, MOSFET Design Rules, Basic Circuit Layout, MOSFET Arrays and AOI Gates, Cells, Libraries, and Hierarchical Design, Floor Plans and Interconnect Wiring. (5 Hours)

MODULE – III (16 hours)

7. **Logic Components:** Concept of Digital Components, An Equality Detector, Line Decoder, Multiplexers and De-multiplexers, Binary Adders, Subtraction and Multiplication. (5 Hours)
8. **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)
9. **Sequential Network:** Concepts of Sequential Networks, Analysis of Sequential Networks: Single State and Multivariable Networks, Sequential Network Design, Binary Counters, Importance of state machine. (5 Hours)

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**

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

PCEE7204 **Electrical and Electronics Measurement Lab**

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

PCEC7202 **Digital Electronics Circuit Lab**

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

HSSM7203 Communication & Interpersonal skills for Corporate Readiness Lab.

Lab **30 hours**

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

i. Preparing job-applications and CVs

ii. Facing an interview

iii. Participating in group discussion (as part of the recruitment process)

2 In-house communication

a. Superior/ Senior ➔ subordinate / junior (individual ➔ individual / group)
   i. Welcoming new entrants to the organization, introducing the workplace culture etc.
   ii. Briefing subordinates / juniors : explaining duties and responsibilities etc.
   ii. Motivating subordinates / juniors ('pep talk')
   iii. Instructing/ directing subordinates/ juniors
   iv. Expressing / recording appreciation, praising / rewarding a subordinate or junior
   v Reprimanding / correcting / disciplining a subordinate/junior (for a lapse) ; asking for an explanation etc.

b. Subordinate / Junior ➔ Superior / Senior
   i. Responding to the above
   ii. Reporting problems / difficulties / deficiencies
   iii. Offering suggestions

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BIJU PATNAIK UNIVERSITY OF TECHNOLOGY , ORISSA

ELECTRICAL & ELECTRONICS ENGINEERING (EEE)

5th Semester				6th Semester			
Code	**Subjects**	**L-T-P**	**Credit**	**Code**	**Subjects**	**L-T-P**	**Credit**
	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)

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.

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)

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 Northwest Corner 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 integer Programming 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, Projected gradient method

Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming

Introduction to Genetic Algorithm.

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)

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 quanties, 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 Gensalised 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, Releative 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 Mcircles, 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.

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)

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).
2. (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).
   (b) 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)

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)

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]**

2. Cylindrical Rotor type Three Phase Synchronous Generators (4+2=6 hours)

(a) 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 (0^o, 180^o,$+30^o$ and -30^o), 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]**

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, 5^{th} Edition, Reprinted 1990.

REFERENCE BOOKS:

(1) P.C.Sen-'Principles of Electric Machines and Power Electronics'-2^{nd} Edition, John Wiley and Sons, Wiley India Reprint, 2007.

(2) B.S.Guru & H.R.Hiziroglu-'Electric Machinery & Transformers'-3^{rd} Ed-Oxford Press, 2010.

Professional Elective-I

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

Module I **(5 Hours)**

Introduction: Fossil fuel based systems Impact of fossil fuel based systems, Non conventional 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, Anaerobic digester. 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

Text Books:

1. D. P. Kothari, K. C. Singal, R. Ranjan, *Renewable Energy Sources and Emerging Technologies*, Prentice Hall of India, New Delhi, 2008.
2. B.H.Khan, Non-Conventional Energy Resources, Tata McGrawHill, 2009
3. 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.

PEEL5301 **SENSORS AND TRANSDUCERS** (3-0-0)

Module –1 **10 lectures**

Elements of a general measurement system;
Static Characteristics: systematic characteristics, statistical characteristics, calibration;
Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, dynamic error in measurement systems. (Bentley: Chapters 1-4)

Module-2 **14 lectures**

Sensing elements: Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gages.
Capacitive sensing elements: variable separation, area and dielectric;
Inductive sensing elements: variable reluctance and LVDT displacement sensors;
Electromagnetic sensing elements: velocity sensors,
Thermoelctric sensing elements: laws, thermocouple characteristics, installation problems, cold junction compensation.
IC temperature sensor
Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement.
(Bentley: Sections 8.1 to 8.6; Ghosh: Section 10.3 to 10.4).

Module-3 **10 lectures**

Signal Conditioning Elements:
Deflection bridges: design of resistive and reactive bridges, push-pull configuration for improvement of linearity and sensitivity
Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation.
(Bentley: Sections 9.1 to 9.3; Ghosh: Sections 15.1 and 15.2) .

Text Books:

1. Principles of Measurement Systems- J.P. Bentley (3/e), Pearson Education, New Delhi, 2007.
2. Introduction to Measurement and Instrumentation- A.K. Ghosh(3/e), PHI Learning, New Delhi, 2009.
3. Transducers and Instrumentation- D.V.S. Murthy (2/e), PHI Learning, New Delhi, 2009.

Reference Books:

1. Measurement Systems Application and Design- E.O. Doeblin (4/e), McGraw-Hill, International, NY.
2. Instrumentation for Engineering Measurements- J.W. Dally, W.F. Riley and K.G. McConnel (2/e), John Wiley, NY, 2003.
3. Industrial Instrumentation- T.R. Padmanabhan, Springer, London, 2000.

PEEC4301 **ADVANCED ELECTRONIC CIRCUIT**

(3-0-0)

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.

2: Oscillators: Oscillators: Oscillator Principles, Oscillator Types, Quadrature Oscillator, Sawtooth wave generator, Voltage-controlled oscillator.

3: Comparators: Comparators: basic comparator, zero-crossing detector, Schmitt trigger, comparator characteristics, limitations of Op-Amp as comparators, voltage limiters.

MODULE-II **(14 Hours)**

4: Bistable Multivibrator: Bistable Multivibrator, fixed-bias bistable multivibrator, 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).

5: 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.

6: 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)**

7: 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.

8: 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.

9: 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.

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)
2. OP-Amps and Linear Integrated Circuits- Ramakant A. Gayakwad (PHI Publication).
(Selected portion from Chapter 7, 8 and 9)
3. 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

FESM6301 **NUMERICAL METHODS** (3-0-0)

Unit –I (10 hors)
Approximation of numbers, Significant figures, Accuracy and precision, Error definition, Round off errors, Error propagation, Total numerical error
Roots of equation: Bisection ethos, False-position method, Fixed point iteration, Newton-Raphson method, Secant method, Convergence and error analysis, System of non-linear equations
Linear algebraic equation: LU decomposition, The matrix inversion, Error analysis and system conditions, Gauss-Siedel method

Unit-II (10 hours)
Interpolation: Newton's divided difference interpolating polynomial, Lagrange interpolating polynomial, Spline interpolation.
Numerical integration: The Trapezoidal rule, Simpson's rule, Newton-Cotes algorithm for equations, Romberg integration, Gauss quadrature

Unit-III(10 Hours)
Ordinary differential equation: Euler method, Improvement of Euler's method, Runge-Kutta methods, System of equations, Multi step methods,
General methods for boundary value problems, Eigen value problems

(Algorithm and error analysis of all methods are included)

Text Book:

1. S.C. Chapra, R.P.Canale," *Numerical methods for Engineers*", Fifth edition, THM Publication.

Reference Books

1. S. Kalavathy, " *Numerica methods*", Thomson/ Cengage India
2. K.E. Atkinson," *Numerical analysis,*" Second edition, John Wiley & Sons.

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

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

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

PCCS4301 **COMPUTER ORGANIZATION** (3-0-0)

Module –I **12 Hrs**

Basic structures of Computers: Functional units, operational concepts, Bus structures, Software, Performance, Computer Architecture vs Computer Organization.

Machine Instruction and Programs: Memory location and addresses, Big-endian and Little-endian representation. Memory Operations, Instructions and instruction Sequencing, Addressing modes, Assembly Language, Basic Input/output operations, subroutine, additional Instructions.

Module – II **12 Hrs**

Arithmetic : Addition and subtraction of signed Numbers, Design of Fast Adders, Multiplication of positive Numbers, Signed-operand multiplication , Fast multiplication, Integer Division, Floating- point Numbers, (IEEE754 s…) and operations.

Module – III **12 Hrs**

Basic Processing units: Fundamental concepts, execution of complete Instructions, Multi bus organization, Hardwired control, Micro programmed control, RISC vs CISC architecture.

Memory System: Basic Concepts, cache Memory, Cache memory mapping policies, Cache updating schemes, performance consideration, Virtual memories, Paging and Page replacement policies, Memory Management requirement, secondary storage.

Text Books:

1. Computer Organization: Carl Hamacher, Zvonkovranesic, Safwat Zaky, Mc Graw Hill, 5th Edition.

2. Computer Organization and Design Hardware/ Software Interface: David A. Patterson, John L.
Hennessy, Elsevier, 4th Edition.

Reference Book :

1. Computer Architecture and Organization: William Stallings, Pearson Education.

2. Computer Architecture and Organizations, Design principles and Application: B. Govinda Rajalu, Tata McGraw-Hill Publishing company Ltd.

3. Computer Architecture: Parhami, Oxford University Press

4. Computer system Architecture: Morris M. Mano PHI NewDelhi.

5. Computer Architecture and Organization: John P. Hayes Mc Graw Hill introduction.

6. Structured Computer Organization: A.S. Tanenbum, PHI

7. Computer Architecture And Organization: An Integrated Approach, Murdocca, Heuring Willey India, 1st Edition.

PCIT4303 **JAVA Programming** (3-0-0)

Module – I **12 Hrs**

Introduction to Java and Java programming Environment. Object Oriented Programming. Fundamental Programming Structure: Data Types, variable, Typecasting Arrays, Operators and their precedence.

Control Flow: Java's Selection statements (if, switch, iteration, statement, while, do-while, for, Nested loop).

Concept of Objects and Classes, Using Exiting Classes building your own classes, constructor overloading, static , final, this keyword .

Inheritance: Using Super to Call Super class constructor, Method overriding, Dynamic method Dispatch, Using Abstract Classes, Using final with inheritance. The Object Class.

Packages & Interfaces : Packages, Access Protection, Importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.

Exception Handling: Fundamentals, Types Checked , Unchecked exceptions, Using try & catch, Multiple catch, throw , throws, finally, Java's Built in exceptions, user defined exception.

Module - II **12 Hrs**

Multi Threading: Java Thread Model, Thread Priorities, Synchronization, Creating a thread, Creating Multiple threads, Using isAlive ( ) and join ( ), wait () & notify ( ).

String Handling: String constructors, String length, Character Extraction, String Comparison, Modifying a string.

Java I/O: Classes & Interfaces, Stream classes, Byte streams, Character streams, Serialization.

JDBC: Fundamentals, Type I, Type II, Type III, Type IV drivers.

Networking: Basics, Socket overview, Networking classes, & interfaces, TCP/IP client sockets, whois, URL format, URL connection, TCP/IP Server Sockets.

Module - III **12 Hrs**

Applets: Basics, Architecture, Skeleton, The HTML APPLET Tag, Passing Parameters to Applets, Applet context and show documents ().

Event Handing: Delegation Event model, Event Classes, Event Listener Interfaces, Adapter classes.

AWT: AWT Classes window fundamentals, component, container, panel, Window, Frame , Canvas, Creating a frame window in an Applet , working with Graphics , Control Fundamentals , Layout managers, Handling Events by Extending AWT components.

Core java API package, reflection, Remote method Invocation (RMI)

Swing: J applet, Icons & Labels, Text fields, Buttons, Combo boxes, Tabbed panes, Scroll panes, Trees, Tables.

Exploring Java-lang: Simple type wrappers, Runtime memory management, object (using clone () and the cloneable Interface), Thread, Thread Group, Runnable.

Text Books:

1. Introduction to Java Programming: Liang, Pearson Education, 7th Edition.
2. Java The complete reference: Herbert Schildt, TMH, 5th Edition.

Reference Books:

1. Balguruswamy, Programming with JAVA, TMH.
2. Programming with Java*:* Bhave &. Patekar, Pearson Education.
3. Big Java: Horstman, Willey India, 2nd Edition.
4. Java Programming Advanced Topics: Wigglesworth, Cengage Learning.
5. Java How to Program: H.M. Deitel & Paul J. Deitel, PHI, 8th Edition.

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

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.

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

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

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

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

(a) Positive sequence reactance
(b) Negative sequence reactance
(c) Zero sequence reactance

5. Determination of power angle characteristics of an alternator
6. Determination of parameter of a single phase induction motor and study of

(a) Capacitor start induction motor
(b) Capacitor start and capacitor run induction motor
(c) Universal motor
(d) Shaded pole motor

7. Study of parallel operation of two alternators
8. Measurement of direct and quadrature axis reactance of a salient pole synchronous machine
9. Measurement of transient and sub transient reactance of a salient pole alternator
10. Performance of grid connected induction generator.
11. Three phase transformer connections (Star, Delta and Scott).
12. Determination of voltage regulation of alternator by synchronous impendence method.

6th Semester

PCEL4303 MICROPROCESSOR & MICRO CONTROLLERS

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/O Addressing, 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: Machine Level Programs, Machine Coding 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 Memory Interfacing, 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, Programming Assembling 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, Accessing memory using various Addressing Modes, Bit Addresses for I/O and RAM
Arithmetic & Logic Instructions and Programs: Arithmetic Instructions, Signed number 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, 8051 connection 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 Interfacing
Sensor 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 to 6.5,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)

TEXT BOOKS

1. Ghosh & Sridhar,0000 to 8085–Introduction to Microprocessor for Scientists & Engineers, PHI
2. A.K. Roy & K.M. Bhurchandi, Advanced Microprocessor and Peripherals (Architecture, Programming & Interfacing)– TMH Publication
3. 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
3. Douglas V.Hall, “Microprocessors and Interfacing: Programming and Hardware”, TMH
4. 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)

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

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)

MODUE-I

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

FREQUENCY DOMAIN ANALYSIS OF SIGNALS AND SYSTEMS: Fourier series, Fourier Transforms, 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

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:

1. Taub, Schilling, Saha, Taub's Principles of Communication Systems, TMH.
2. Modern Digital and Analog Communication Systems, by B.P. Lathi, Oxford

PEME5305 **ROBOTICS & ROBOT APPLICATIONS (3-0-0)**

Module – I

1. Fundamentals of Robotics: Evolution of robots and robotics, Definition of industrial robot, Laws of Robotics, Classification, Robot Anatomy, Work volume and work envelope, Human arm characteristics, Design and control issues, Manipulation and control, Resolution; accuracy and repeatability, Robot configuration, Economic and social issues, Present and future application.

2. Mathematical modeling of a robot: Mapping between frames, Description of objects in space, Transformation of vectors.
   Direct Kinematic model: Mechanical Structure and notations, Description of links and joints, Kinematic modeling of the manipulator, Denavit-Hartenberg Notation, Kinematic relationship between adjacent links, Manipulator Transformation matrix.

Module – II

3. Inverse Kinematics: Manipulator workspace, Solvable of inverse kinematic model, Manipulator Jacobian, Jacobian inverse, Jacobian singularity, Static analysis.
4. Dynamic modeling: Lagrangian mechanics, 2D- Dynamic model, Lagrange-Euler formulation, Newton-Euler formulation.
5. Robot Sensors: Internal and external sensors, force sensors, Thermocouples, Performance characteristic of a robot.

Module – III

6. Robot Actuators: Hydraulic and pneumatic actuators, Electrical actuators, Brushless permanent magnet DC motor, Servomotor, Stepper motor, Micro actuator, Micro gripper, Micro motor, Drive selection.
7. Trajectory Planning: Definition and planning tasks, Joint space planning, Cartesian space planning.
8. Applications of Robotics: Capabilities of robots, Material handling, Machine loading and unloading, Robot assembly, Inspection, Welding, Obstacle avoidance.

Text Books:

1. Robotics and Control**,** R.K. Mittal and I.J. Nagrath, Tata McGraw Hill
2. Introduction to Robotics: Mechanics and control, John J Craig, PHI
3. Robotics Technology and Flexible Automation, S.R.Deb and S. Deb, TMH

Reference Books:

1. Introduction to Robotics, S. K. Saha, Tata McGraw Hill
2. Robotics: Control, Sensing, Vision and Intelligence, K.S.Fu, R.C.Gonzalez and C.S.G.Lee, McGraw Hill
3. Robotics, Appuu Kuttan K.K., I.K. international
4. Robot Dynamics and Control, M.W.Spong and M. Vidyasagar , Wiley India.
5. Industrial Robotics Technology, programming and application, M.P.Groover, TMH.
6. Introduction to Robotics: Analysis, Systems, Applications, S.B.Niku, PHI
7. Robotics: Fundamental Concepts and Analysis, A. Ghosal, Oxford University Press
8. Fundamentals of Robotics: Analysis and Control, R. J. Schilling, PHI
9. Robotic Engineering: An Integrated Approach, R.D. KLAFTER, T. A. Chmielewski, and M. Negin, PHI
10. Robot Technology: Fundamentals: J. G. Keramas, Cengage Learning

PEEE5301 **Optoelectronics Devices & Instrumentation** (3-0-0)

Module –1

Wave Optics: 12 Hrs

Wave properties of light: Propagation, polarization, interference, diffraction, transmission of light through slab and cylindrical waveguides.

Optical Fiber:

Construction of step and graded index fibers, single mode and multimode fibers, loss and dispersion characteristics;

Module –2 12 Hrs

Fiber optic components: couplers, splicer, polarizer.

Sources and Detectors :

Sources: LED, Lasers-fundamentals, conditions for oscillations, construction and principle of operation of gas and semiconductor, pulsed and continuous type lasers;

Detectors: photodiodes- PN, PIN and APD.

Module –3

Optoelectronic Instrumentation 12 lectures

Modulation techniques: intensity, polarization, interference, electro-optic, electromagnetic; Sensing techniques for displacement, pressure, acceleration, flow, current and voltage measurement, Fiber optic gyroscope, Distributed fiber optic sensors- OTDR and OFDR principles.

Text Books:

1. A. Ghatak and K. Tyagrajan: Introduction to Fiber Optics: Cambridge University Press, New Delhi, 2004. (Chapter 2, Sections 7.2-7.3, Chapter 3, Sections 4.3,8.2, 17.2, 17.8, Section 11.3, 11.6, Chapter 12, Chapter 18)
2. J. Wilson and J.F.B. Hawkes: Optoelectronics: An Introduction (2/e), PHI, New Delhi, 2001. (Chapter 1, Sections 3.1-3.2; 8.1-8.2, Sections 8.3-8.4, 8.5, Sections 4.6, 5.1-5.6, 5.10.2, 7.2, Sections 3.4, 3.7, 3.8, Chapter 10)

Reference Books:

1. J.P. Bentley- Principles of Measurement Systems (3/e), Pearson Education, New Delhi, 2007.
2. N. Bala Saraswathi and I. Ravi Kumar- Principles of Optical Communications and Optoelectronics (2/e), Laxmi Publications, New Delhi, 2007.
3. M.K. Ghosh, S.Sen and S. Mukhopadhyay (ed.)- Measurement and Instrumentation: Trends and Applications, Ane Books, New Delhi, 2008.
4. R.P.Khare: Fibre Optics & Optoelectronics, Oxford University Press, New Delhi, 2010.

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

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.Synchronous Motor Drives: Synchronous Motor Variable Speed Drives, Variable Frequency Control of Multiple Synchronous Motors.**Book-1:Ch. 5.1, Ch. 5.2, Ch. 5.3, Ch. 5.4, Ch. 5.5, Ch. 5.6, Ch. 5.8, Ch. 5.9, Ch. 5.10, Ch. 5.11, Ch. 5.12, Ch. 5.13, Ch. 5.14, Ch. 5.15, Ch. 5.18, Ch. 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.

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.

PEEC4304 **COMPUTER NETWORK & DATA COMMUNICATION** (3-0-0)

Module – I **12 Hrs**

Overview of Data Communications and Networking.

Physical Layer : Analog and Digital, Analog Signals, Digital Signals, Analog versus Digital, Data Rate Limits, Transmission Impairment, More about signals.

Digital Transmission: Line coding, Block coding, Sampling, Transmission mode.

Analog Transmission: Modulation of Digital Data; Telephone modems, modulation of Analog signals. Multiplexing : FDM , WDM , TDM ,

Transmission Media: Guided Media, Unguided media (wireless)

Circuit switching and Telephone Network: Circuit switching, Telephone network.

Module –II **12 Hrs**

Data Link Layer

Error Detection and correction: Types of Errors, Detection, Error Correction

Data Link Control and Protocols:

Flow and Error Control, Stop-and-wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC.

Point-to –Point Access: PPP

Point –to- Point Protocol, PPP Stack,

Multiple Access

Random Access, Controlled Access, Channelization.

Local area Network: Ethernet.

Traditional Ethernet, Fast Ethernet, Gigabit Ethernet. Token bus, token ring

Wireless LANs: IEEE 802.11, Bluetooth virtual circuits: Frame Relay and ATM.

Module – III **12 Hrs**

Network Layer:

Host to Host Delivery: Internetworking, addressing and Routing

Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6

Transport Layer: Process to Process Delivery: UDP; TCP congestion control and Quality of service.

Application Layer :

Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP) and file transfer (FTP) HTTP and WWW.

Text Books:

1. Data Communications and Networking: Behrouz A. Forouzan, Tata McGraw-Hill, 4th Ed

3. Computer Networks: A. S. Tannenbum, D. Wetherall, Prentice Hall, Imprint of Pearson 5th Ed

Reference Book : .

1. Computer Networks:A system Approach:Larry L, Peterson and Bruce S. Davie,Elsevier, 4th Ed
2. Computer Networks: Natalia Olifer, Victor Olifer, Willey India
3. Data and Computer Communications: William Stallings, Prentice Hall, Imprint of Pearson, 9th Ed.
4. Data communication & Computer Networks: Gupta, Prentice Hall of India
5. Network for Computer Scientists & Engineers: Zheng, Oxford University Press
6. Data Communications and Networking: White, Cengage Learning

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

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

TEXT BOOK:

1. **Operating System Concepts –** Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 8th edition, Wiley-India, 2009.
2. **Mordern Operating Systems –** Andrew S. Tanenbaum, 3rd Edition, 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, 3rd Edition, Pearson

FEEE6301 **INDUSTRIAL PROCESS CONTROL AND DYNAMICS** (3-0-0)

Module-I (10 Hrs))

Analog Signal Conditioning

Introduction, Principles of Analog Signal Conditioning, Signal-Level Changes, Linearization, Conversions, Zero adjustment, Span adjustment, Level changing, AC/DC Power supply, Filtering and Impedance Matching, Passive Circuits, Divider Circuit, Bridge Circuits, RC Filters, Operational Amplifiers, Op Amp Characteristics, Op Amp Specifications, Op Amp Circuits in Instrumentation, Voltage Follower, inverting Amplifier, Non- inverting Amplifier, Differential Amplifier, Active Filters, Protection Voltage-to –Current Converter, Current-to-Voltage Converter, Integrator, Linearization.

Book-1-Ch-2.2,2.3,2.4,2.5,2.6.

Digital Signal Conditioning

Introduction, Review of Digital Fundamentals, Digital Information, Fractional Binary Numbers, Boolean Algebra, Digital Electronics, Programmable Logic Controllers, Busses and Tri-State Buffers, Converters, Comparators, Digital-to-Analog Converters (DCA), Analog-to-Digital Converters (ADCs), Sample and Hold, Multiplexer and De-multiplexer, decoder and encoder, Pulse modulations, Digital recorder.

Book-1-Ch-3.1,3.2,3.3,3.4,3.5.

Module-2 (20 Hrs)

Thermal Sensors

Definition of Temperature, Metal Resistance versus Temperature Device, Thermistors, Thermocouples, Other Thermal Sensors, Design Consideration.

Book-1-Ch-4.1,4.2,4.3,4.4,4.5,4.6,4.7.

Mechanical Sensors

Displacement, Position Sensors, Strain Sensors, Motion Sensors, Pressure Sensors, Flow Sensors.

Book-1-Ch-5.2,5.3,5.4,5.5,5.6

Optical Sensors

Photodetectors, Pyrometry, Leser Principles,Applications.

Book-1-6.2,6.3,6.4,6.5,6.6.

Final Control

Final Control Operation, Signal Conversions, Switching and Control Devices, Actuators, control Elements.

Book-1-Ch-7.2,7.3,7.4,7.5,7.6.

Discrete-State Process Control

Characteristics of the System, Relay Controllers and Ladder diagrams, PLCs.

Book-1-Ch-8.2,8.3,8.4,8.4,8.5.

Module-3 (10 Hrs)

Controller Principles

Process Characteristics, Control System Parameters, Discontinuous and Continuous Controller Modes, Composite Control Modes.

Book-1-Ch-9.2,9.3,9.4,9.5,9.6.

Analog Controllers

Electronic controllers, pneumatic controllers, design consideration.

Book-1-10.2,10.3,10.4,10.5.

Casecade,Feedforward, and Ratio Control

Casecade Control,Feedfrrward Control,Feedforward-feedback cControl Configuration,Ratio Control.

Book-2, Ch-!0.1,!0.2,!0.3,!0.4,!0.5.

Selective and Adaptive Control Systems

Selective Control, Adaptive Control,Adaptive Control Configuration.

Book-2. Ch-11.1,11.2,11.3,11.4.

TEXT BOOK

1.-PROCESS CONTROL INSTRUMENTATION TECHNOLOGY BY-Curtis D.Johnson.PHI Publication.
2-PROCESS CONTROL PRINCIPLES AND APPLICATIONS BY-Surekha Bhanot.Oxford Publication

Reference:-

Process control Systems and Instrumentation By-Terry Bartelt , Cengage Learning Publication

Microprocessor & Microcontroller Laboratory

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

Digital Signal Processing Laboratory (0-0-3)

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
5. Finding the convolution of periodic sequence using DFT and IDFT
6. Implementation of FFT (Fast Fourier Transform) algorithm
   (i) Decimation in Time (DIT)
   (ii) Decimation in Frequency (DIF)
7. 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)
9. Convolution of long duration sequences using overlap add, overlap save meter
10. Working with DSP processor (fixed point-TMS320C-5X/Floating point) series
    (i) Implement convolution (Linear and circular convolution)
    FIR and IIR implementation

Communication System Engineering Lab (0 0 2)

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, 100KKz and 1 MHz.

Experiment objective: Analysis of spectrum of different signals. Measurement of power 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 time and frequency domain.

   Equipment Required:

   - Frequency division multiplexing/ de-multiplexing experiment board.
   - CRO

2. 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.

3. Study of FM modulation and Demodulation Techniques.

   Experiment objective: Demonstrate the process of modulation and demodulation using 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.

4. 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

5. 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

6. Study the functioning of PCM and Delta modulator

   Experiment objective: Demonstrate the process of PCM modulation and Delta modulation.

Equipment Required:

- Experiment board for PCM/ Delta Modulation/ Adaptive Delta Modulation generation and detection
- Signal generator
- CRO

7. 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.

8. 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

9. Using Lab-View software simulate AM modulation and demodulation system.

10. 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

11. Design a receiver to demodulate and receive the signal from am AM radio station.

12. 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 and demodulation 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.

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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 Distribution	3-0-0	3				
					Professional Elective-V (Any one)	3-0-0	3
PE	***Professional Elective-III (Any one)***	3-0-0	3	PEEE5405	Advanced Power Electronics		
PEEE5401	Soft Computing			PEEL5403	Electrical Power Quality		
PEEE5402	Industrial Automation & Control			PEEI5402	Optimal Control		
PCEC4401	VLSI Design						
PEEE5403	High Voltage DC Transmission						
PEEE5404	Flexible AC Transmission System						
	Professional Elective-IV (Any one)	3-0-0	3		***Free Elective-IV (Any one)***	3-0-0	3
PEEC5401	Advanced Control Systems			PEEC5406	Satelite Communication Systems		
PEEC5402	Advanced Communication Systems			PECS5406	Digital Image Processing		
PCEL4401	Power System Operation and Control			PEEI5403	Industrial Instrumentation		
	Free Elective-III (Any one)	3-0-0	3	PEEC5405	Embedded Systems		
PEEC5403	Biomedical Instrumentation				***Free Elective-V (Any one)***	3-0-0	3
PEEL5401	Adaptive Signal Processing			FEEE6401	Power Station Engg and Economy		
PEME5407	Mechatronics			HSSM3403	Marketing Management		
				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

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.

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

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.

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.**

SOFT COMPUTING (3-0-0)

MODULE-I **(12 Lectures)**

Introduction: Soft Computing Constituents and Conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing Characteristics.

Fuzzy Sets: Introduction, Basic Definitions and Terminology, Set Theoretic Operations, MF Formulation and Parameterization.

Fuzzy Rules & Fuzzy Reasoning: Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning.

Fuzzy Inference Systems: Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Other Considerations.

(BOOK-1:- Chap-1: 1.1 to 1.3, Chap-2: 2.1 to 2.4, Chap-3: 3.2 to 3.4 & Chap-4: 4.2 to 4.5)

MODULE-II **(14 Lectures)**

Neural Networks: Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Neural Networks Defined, Architectures: Feed forward and Feedback, Salient Properties and Application Domains of Neural Networks, Multi-layered Network Architectures, Back-propagation Learning Algorithm, Practical Considerations in Implementing the BP Algorithm, Structure Growing Algorithms, Universal Function Approximation and Neural Networks, Applications of Feed Forward Neural Networks, Reinforcement Learning, Radial Basis Function Networks, Regularization Theory Route to RBFNs, Generalized Radial Basis Function Network, Learning in RBFNs, Associative Learning, Hopfield Network, Content Addressable Memory, Bidirectional Associative Memory, Self Organizing Feature Maps, Applications of the Self Organizing Map.

(BOOK-2:-Chap-3: 3.1 to 3.6, Chap-6: 6.1 to 6.2, 6.5 to 6.6 & 6.8 to 6.10, Chap-8: 8.4 to 8.7,

Chap-10: 10.2 & 10.5 to 10.6 & 10.16 and Chap-12: 12.8 to 12.9)

MODULE-III **(08 Lectures)**

Regression & Optimization: System Identification: an Introduction, Least Squares Estimator, Geometric Interpretation of LSE, Recursive Least Squares Estimator.

Derivative-Free Optimization: Genetic Algorithms, Simulated Annealing, random Search, Downhill Simplex Search.

Adaptive Neuro-Fuzzy Inference Systems (ANFIS): ANFIS Architecture, Hybrid Learning Algorithm.

(BOOK-1:- Chap-5: 5.1, 5.3 to 5.5, Chap-7: 7.2 to 7.5 and Chap-12: 12.2 to 12.3)

TEXT BOOK:

1. "***Neuro-Fuzzy and Soft Computing***" By J.-S.R.Jang, C.-T.Sun & E. Mizutani, PHI
2. "***Neural Networks: A Classroom Approach***" By Satish Kumar, TMH Education

Reference Book:

1. "***Neural Networks Fuzzy Logic & Genetic Algorithms; Synthesis & Applications,*** *S.Rajasekaran & G.A. VijayaLaxmi Pai, Prentice Hall, India, May'2006- LakshmiPai*
2. Principle of Soft Computing, S.N. Sivanandan & S.N. Deepa, Wiley India Edition,2010.

INDUSTRIAL AUTOMATION AND CONTROL

(**Prerequisite: Control System Engineering – I**)

Module I: (12 Hours)

Process Control: Introduction: Process Definition, Feedback Control, PID Control, Multivariable Control. (Chapter 1 of Text Book 1)

PID Controller Tuning: Introduction, Zeigler-Nichols Tuning Method (Based on Ultimate Gain and Period, and Process Reaction Curve), Digital PID Controllers. (Chapter 13 of Text Book 2)

Module II: (15 Hours)

Special Control Structures: Cascade Control, Feedfroward Control, Feedfroward-Feedback Control Configuration, Ratio Control, Selective Control, Adaptive Control, Adaptive Control Configuration. (Chapter 10 and 11 of Text book 3)

Actuators: Introduction, Pneumatic Actuation, Hydraulic Actuation, Electric Actuation, Motor Actuators and Control Valves. (Chapter 8 of Text Book 1)

Module III: (10 Hours)

Industrial Automation: Programmable Logic Controllers: Introduction, Principles of operation, Architecture, Programming (Programming Languages, Ladder Diagram, Boolean Mnemonics) (Chapter 5 of Text Book 1)

Distributed Control: Distributed vs. Centralized, Advantages, Functional Requirements, System Architecture, Distributed Control Systems (DCS), Communication options in DCS. (Chapter 6 of Text Book 1)

Real-time Programming: Multi-tasking, Task Management, Inter-task Communication, Real-time Operating System. (Chapter 9 of Text Book 1)

Text Books:

1. Krishna Kant, “Computer-Based Industrial Control”, PHI, 2009.
2. M. Gopal, “Digital Control and State Variable Methods” Tata McGraw Hill, 2003.
3. Surekha Bhanot, Process Control: Principles and Applications, Oxford university Press, 2010

Reference Books:

1. Smith Carlos and Corripio, “Principles and Practice of Automatic Process Control”, John Wiley & Sons, 2006.
2. Jon Stenerson, “Industrial Automation and Process Control”, Prentice Hall, 2003.
3. C. Johnson, “Process Control Instrumentation Technology”, PHI, New Delhi
4. D.R. Coughnowr, “Process System analysis and Control”, McGraw Hill.

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VLSI DESIGN

Module – I **08 Hours**

Introduction: Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology.

Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts, The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full-Customs Mask Layout Design.

MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance. (Chapter 1 to 3 of Text Book 1 and for Stick Diagram Text Book 2)

Module – II **14 Hours**

MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverters with n-Type MOSFET Load, CMOS Inverter.

MOS Inverters – Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.

Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates). (Chapter 5 to 7 of Text Book 1)

Module – III **18 Hours**

Sequential MOS Logic Circuits: Introduction, Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop.

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Non-volatile Memory, Flash Memory.

Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring I_{DDQ} Test.

Text Books:

1. Sung-Mo Kang and Yusuf Leblebici, *CMOS Digital Integrated Circuits: Analysis and Design*, 3rd Edn., Tata McGraw-Hill Publishing Company Limited, 2003.
2. K. Eshraghian and N.H.E. Weste, *Principles of CMOS VLSI Design – a Systems Perspective*, 2nd Edn., Addison Wesley, 1993.

Reference Books:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, *Digital Integrated Circuits – A Design Perspective*, 2nd Edn., Pearson Education, 2003.
2. Wayne Wolf, *Modern VLSI Design System – on – Chip Design*, 3rd Edn., Pearson Education, 2003.
3. Debaprasad Das, *VLSI Design*, Oxford University Press, New Delhi, 2010.
4. John P. Uyemura, *CMOS Logic Circuit Design*, Springer (Kluwer Academic Publishers), 2001.
5. Ken Martin, *Digital Integrated Circuit Design*, Oxford University Press, 2000.

HIGH VOLTAGE DC TRANSMISSION (3-0-0)

MODULE-I (12 Lectures)

HVDC Transmission: Introduction, Equipment required for HVDC Systems, Comparison of AC and DC Transmission, Limitations of HVDC Transmission Lines, Reliability of HVDC Systems, Comparison of HVDC Link with EHVAC Link, HVDC-VSC Transmission Systems.

HVDC Converters: Introduction, HVDC Converter Valves and Valve Assembly, HVDC-Voltage Source Converters: Principle and Operation, 3-phase 6-pulse Converters using SCRs or Thyristors, 12-pulse Bridge Converters.

6-Pulse Converter Operation and Analysis: Introduction, Conduction Sequence in 6-pulse Converter Configuration, The Ideal Commutation Process without Gate Control, DC Output Voltage, Gate Control (Phase Control) of Valves, Analysis of Voltage Waveforms with Overlap Angle (μ), Complete Characteristics of Converter as Rectifier/Inverter, Analysis of 12-pulse Converter, Power Flow in HVDC Links, Operation and Analysis of VSC Converters

(Chapter-1: 1.3 to 1.6 & 1.9 to 1.10, Chapter-2: 2.5 to 2.8 and Chapter-3: 3.2 to 3.6 & 3.8 to 3.11)

MODULE-II (14 Lectures)

Control of HVDC Converter and Systems: Mechanism of AC Power Transmission, Principle of Control, Necessity of Control in case of a DC link, Rectifier Control, Compounding of Rectifiers, Power Reversal in a DC Link, Voltage Dependent Current Order Limit (VDCOL)-Characteristics of the Converter, System Control Hierarchy and Basic Philosophy, Inverter Extinction Angle Control (EAG), Pulse Phase Control, Starting and Stopping of a DC Link, Constant Power Control, Control Systems for HVDC Converters, Inverter Operation Problems, Control of VSC Converters.

Harmonics in HVDC Systems: Importance of Harmonic Study, Generation of Harmonics by Converters, Characteristic Harmonics on the DC Side, Characteristic Current Harmonics, Characteristic variations of Harmonic Currents with Variation of α & μ, Effect of Control modes on Harmonics, Non-Characteristic Harmonics, Harmonics in VSC Converters.

(Chapter-4: 4.2 to 4.16 and Chapter-5: 5.2 to 5.9)

MODULE-III (10 Lectures)

Harmonic Suppression in HVDC System-Filters: Harmonic Model & Equivalent Circuit, Use of Filters, Filter Configurations, Design of a Band-Pass Filter, Design of High-Pass Filters, Protection of Filters, DC Filters.

Faults and Protection Schemes in HVDC Systems: Nature and Types of Faults, Faults on AC Side of Converter Stations, Converter Faults, Faults on DC Side of the System, Protection against Over Currents/ Over Voltages, Protection of Filter Units.

Multi-terminal HVDC Systems : Types of Multi-terminal (MTDC) Systems, Parallel Operation Aspects of MTDC, Paralleling (Disconnecting) of Units or Converter, Control of Power in MTDC, VSC-Multi-level DC Systems.

(Chapter-6: 6.2 to 6.5 & 6.7 to 6.8, 6.10, Chapter-8: 8.2 to 8.7 and Chapter-10: 10.2 to 10.6)

TEXT BOOK:

1. "***HVDC Transmission***" By S. Kamakshaiah & V. Kamaraju, TMH Education Private Ltd., 2011, New Delhi.

Reference Book:

1. "***HVDC Power Transmissions Systems: Technology & Systems Interaction***", K.R. Padiyar, New Age Publication, 2005

FLEXIBLE AC TRANSMISSION SYSTEM (3-0-0)

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), The Interline Power Flow Controller (IPFC), Generalized and Multifunctional FACTS Controllers.

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

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.

ADVANCED CONTROL SYSTEMS

Module-I ***: (15 Hours) Discrete - Time Control Systems*** :

Introduction: Discrete Time Control Systems and Continuous Time Control Systems, Sampling Process.

Digital Control Systems: Sample and Hold, Analog to digital conversion, Digital to analog conversion.

The Z-transform: Discrete-Time Signals, The Z-transform, Z-transform of Elementary functions, Important properties and Theorms of the Z-transform. The inverse Z-transform, Z-Transform method for solving Difference Equations.

Z-Plane Analysis of Discrete Time Control Systems: Impulse sampling & Data Hold, Reconstruction of Original signals from sampled signals: Sampling theorm, folding, aliasing. Pulse Transfer function: Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems. Mapping between the s-plane and the z-plane, Stability analysis of closed loop systems in the z-plane: Stability analysis by use of the Bilinear Transformation and Routh stability critgion, Jury stability Test. Book No. 1: 1.1; 1.2; 1.4; 2.1; 2.2; 2.3; 2.4; 2.5; 2.6; 3.2; 3.4; 3.5; 4.2; 4.3.

Module -II : ***(15 Hours) State Variable Analysis & Design:***

Introduction: Concepts of State, State Variables and State Model (of continuous time systems): State Model of Linear Systems, State Model for Single-Input-Single-Output Linear Systems, Linearization of the State Equation. State Models for Linear Continuous – Time Systems: State-Space Representation Using Physical Variables, State – space Representation Using Phase Variables, Phase variable formulations for transfer function with poles and zeros, State – space Representation using Canonical Variables, Derivation of Transfer Function for State Model. Diagonalization: Eigenvalues and Eigenvectors, Generalized Eigenvectors. Solution of State Equations: Properties of the State Transition Matrix, Computation of State Transition Matrix, Computation by Techniques Based on the Cayley-Hamilton Theorem, Sylvester's Expansion theorm. Concepts of Controllability and Observability: Controllability, Observability, Effect of Pole-zero Cancellation in Transfer Function. Pole Placement by State Feedback, Observer Systems. State Variables and Linear Discrete – Time Systems: State Models from Linear Difference Equations/z-transfer Functions, Solution of State Equations (Discrete Case), An Efficient Method of Discretization and Solution, Linear Transformation of State Vector (Discrete-Time Case), Derivation of z-Transfer Function from Discrete-Time State Model. Book No. 2: 12.1 to 12.9.

Module -III ***: (12 Hours) Nonlinear Systems :***

Introduction : Behaviour of Non linear Systems, Investigation of nonlinear systems.

Common Physical Non Linearities: Saturation, Friction, Backlash, Relay, Multivariable Nonlinearity.

The Phase Plane Method: Basic Concepts, Singular Points: Nodal Point, Saddle Point, Focus Point, Centre or Vortex Point, Stability of Non Linear Systems: Limit Cycles, Construction of Phase Trajectories: Construction by Analytical Method, Construction by Graphical Methods. The Describing Function Method: Basic Concepts: Derivation of Describing Functions: Dead-zone and Saturation, Relay with Dead-zone and Hysteresis, Backlash. Stability Analysis by Describing Function Method: Relay with Dead Zone, Relay with Hysteresis, Stability Analysis by Gain-phase Plots. Jump Resonance. Liapunov's Stability Analysis: Introduction, Liapunov's Stability Critrion: Basic Stability Theores, Liapunov Functions, Instability. Direct Method of Liapunov & the Linear System: Methods of constructing Liapunov functions for Non linear Systems.Book **2**: 13.1 to 13.4; 15.1 to 15.10.

Text :

1. Discrete-Time Control System, by K.Ogata, 2nd edition (2009), PHI.
2. Control Systems Engineering, by I.J. Nagrath and M.Gopal., 5th Edition (2007 / 2009), New Age International (P) Ltd. Publishers.

Reference :

1. Design of Feedback Control Systems-Stefani,Shahian, Savant,Hostetter, 4th Ed, OxfordPress.
2. Modern Control Systems by K.Ogata, 5th Edition (2010), PHI.
3. Modern Control Systems by Richard C. Dorf. And Robert, H.Bishop, 11th Edition (2008), Pearson Education Inc. Publication.
4. Control Systems (Principles & Design) by M.Gopal, 3rd Edition (2008), Tata Mc.Graw Hill Publishing Company Ltd.
5. Control Systems Engineering by Norman S.Nise, 4th Edition (2008), Wiley India (P) Ltd.

ADVANCED COMMUNICATION SYSTEMS

MODULE – I: (10 hrs)

Data-Link Protocol and Data Communications Networks: Data-link Protocol Function, Character and bit Oriented Data Link Protocols. Asynchronous Data Link Protocols, Synchronous Data-Link Protocols, Synchronous Data –Link Control, High-Level Data Link Control, Public Switched Data Networks, CCITTX. 25, User-to-Network Interface Protocol. Integrated Services Digital Network (ISDN) (Chapter 23)

MODULE – II: (15 hrs)

Digital T-Carriers and Multiplexing :Time-Division Multiplexing (TDM); T1 Digital Carrier. North American Digital Hierarchy. Digital Carrier Line Encoding. T Carrier Systems, Digital Carrier Frame Synchronization. Bit Vrs Word Interleaving. Statistical TDM. Codecs and Combo Chips. FDM. AT & T's FDM Hierarchy. Composite Base band Signal . Formation of Master group. Wavelength Division Multiplexing (WDM) (Chapter 11)

Cellular Telephone Concepts: Mobile telephone service, Cellular Telephone, Frequency Reuse, Interefernce, Cell Splitting, Sectoring, Segmentation, and dualization, Cellular System Topology, Roaming and Hand ofs, Cellular Telephone Network Components, Cellular Telephone call Processing (Chapter 19)

Data Communication and Networking: Data Communication Network Architecture, Protocols, and standards, Layered Network Architecture, Introduction to GSM, GPRS, CDMA (Chapter 20)

MODULE – III: (15 hrs)

Satellite Communication: Introduction, Keepler's Law, Satellite Orbir\ts, geosynchronous satellites, Antenna Look Angles, Satellite Classifications, spacing and frequency allocation, Satellite Antenna Radiation patterns, Satellite System Link Models, Satellite System Parameters, Satellite System Link Equations, Link Budget (Chapter 25)

Satellite Multiple Accessing Arrangements: Introduction, FDM/FM Satellite Systems, Multiple Access Techniques, Frequency Division Multiple Access (FDMA), TDMA, CDMA, Channel Capacity, Satellite Radio NavigationEstimating Channel Requirements, Practical Demand Access Systems, Random Access, Multiple Access With On Board Processing. VSAT (Chapter 26)

Text Book:

1. Electronic Communications Systems Fundamentals through Advanced by Wayne Tomasi; Pearson.

References:

1. Satellite Communication - by Timothy Pratt; Addison Wesley.

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

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 Y_{bus}, An Equivalent Admittance Network, Modification of Y_{bus}, The Network Incidence Matrix and $Y_{bus.}$ (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.)

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.)

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.

BIOMEDICAL INSTRUMENTATION

Module – I **(10 Hours)**

Fundamentals of Biomedical Instrumentation: Sources of Biomedical Signals, Basic Medical Instrumentation System, Intelligent Medical Instrumentation Systems, PC Based Medical Instrumentation Systems, General Constraints & Regulations of Medical Devices

Biomedical Signals & Electrodes: Origin of Bioelectric Signals-Repolarization, Depolarization, Resting Potential Recording Electrodes – Ag-AgCl Electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes, Skin Contact Impedance, Motion Artifacts

Module – II **(13 Hours)**

Physiological Transducers: Introduction to Physiological Transducers, Classification of Transducers, Pressure Transducers, Transducers for Body Temperature Measurement, Biosensors, Smart Sensors

Biomedical Recording Systems: Basic Recording Systems, General Considerations for Signal Conditioners, Biomedical Signal Analysis Techniques, Signal Processing Techniques, Writing Systems: Direct Writing Recorders, Inkjet Recorder, Potentiometric Recorders, Digital Recorders

Biomedical Recorders: Electrocardiograph (ECG), Phonocardiograph, Electroencephalograph (EEG), Electromayograph (EMG)

Module – III **(14 Hours)**

Patient Monitoring Systems: System Concepts, Measurement of Heart Rate, Blood Pressure Measurement, Measurement of Respiration Rate

Blood Flow meters: Electromagnetic Blood Flow meter, Ultrasonic Blood Flow meter, NMR Blood Flow meter, Laser-Doppler Blood Flow meter

Patient Safety: Electric Shock Hazards, Leakage Currents, Safety Codes for Biomedical Equipment

Text Books:

1. Hand Book of Biomedical Instrumentation-2nd Edition by R.S.Khandpur, Tata McGraw Hill 2003 (Chapters 1-6,11,18)
2. Biomedical Instrumentation and Measurements-2nd Edition by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, PHI learning Pvt Ltd 2nd Edition

Reference Books:

1. Introduction to Biomedical Equipment Technology-4th Edition by Joseph J. Carr, John M. Brown, Pearson Education 2007

ADAPTIVE SIGNAL PROCESSING

Module – I(10 Hours)

Introduction: Adaptive Systems – Definition and characteristics, General properties, Open and Closed Loop Adaptations, Applications

The Adaptive Linear Combiner: Performance function, Gradient and Mean Square Error, Examples.

Module – II(14 Hours)

Theory of Adaptation with Stationary Signals: Properties of the Quadratic Performance Surface, Significance of eigen values, eigen vectors, coorelation matrix.

Searching the Proformance Surface: A simple gradient search algorithm, Stability and Rate of convergence, the learning curve

Gradient Estimation and its effects on Adoption: The performance penalty, Variance of the gradient estimate, Misadjustment.

Module – III(16 Hours)

Adaptive Algorithms and Structures: The LMS Algorithm, Convergence, learning Curve, Performanece analysis, Filtered X LMS algorithm,

Applications: Adaptive Modeling and System Identification using adaptive filter, Inverse Adaptive Modeling, Deconvolution, and equalization using adaptive filter, Adaptive Control Systems using Filtered X LMS Algorithm, Adaptive Noise Cancellation using Adaptive filter

Text Books :

1. Bernard Widrow and Samuel D. Stearns, *Adaptive Signal Processing*, Pearson Education, 2nd impression 2009.

Reference Book:

1. Simon Haykin, *Adaptive Filter Theory*, 4th Edn., Pearson Education.

MECHATRONICS

Module – I:-

Sensors and Transduceers:- Sensors and transducers, Performance terminology, Displacement, position and proximitry, 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 and analogue-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 and hydraulic 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, Kinematic chains, 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-state switches, 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.

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

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 Π 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.

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)

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 Z_f, 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: Overcurrent, 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, OverCurrent 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: Autoreclosing fundamentals, Circuit breaker rating, Circuit constants and circuit conditions, Theory of Circuit interruption, Restriking voltage transients, characteristics of Restriking Voltage, Interaction between breaker and circuit, Current chopping, Automatic switch, Air-break circuit breakers, Oil circuit breakers, Air-blast circuit breakers, Vacuum circuit breakers, SF_6 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.

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)

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)

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)

ELECTRICAL POWER QUALITY (3-0-0)

MODULE-I **(12 Lectures)**

Terms & Definitions: General Classes of Power Quality Problems, Transients, Long Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuations, Power Frequency Variations, Power Quality Terms.

Voltage Sags & Interruptions: Sources of Sags and Interruptions, Estimating Voltage Sag Performance, Fundamental Principles of Protection, Solutions at the End-User Level, Evaluating the Economics of Different Ride-Through Alternatives, Motor Starting Sags, Utility System Fault-Clearing Issues.

(Chapter-2: 2.2 to 2.10 and Chapter-3: 3.1 to 3.7)

MODULE-II **(12 Lectures)**

Transient Over Voltages: Sources of Transient Over Voltages, Principle of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor-Switching Transients, Utility System Lightning Protection, Managing Ferro-resonance, Switching Transient Problems with Loads, Computer Tools for Transient Analysis.

Fundamentals of Harmonics: Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Locating Harmonic Sources, System Response Characteristics, Effects of Harmonic Distortion, Inter-harmonics.

(Chapter-4: 4.1 to 4.8 and Chapter-5: 5.1 to 5.11)

MODULE-III **(10 Lectures)**

Long Duration Voltage Variations: Principles of Regulating the Voltage, Devices for Voltage Regulation, Utility Voltage Regulator Application, Capacitors for Voltage Regulation, End-User Capacitor Application, Regulating Utility Voltage with Distributed resources, Flicker.

Power Quality Monitoring: Monitoring Considerations, Historical Perspective of Power Quality Measuring Instruments, Power Quality Measurement Equipments, Assessment of Power Quality Measurement Data, Application of Intelligent Systems, Power Quality Monitoring Standards.

(Chapter-7: 7.1 to 7.7 and Chapter-11: 11.1 to 11.6)

TEXT BOOK:

1."***Electrical Power Systems Quality***" By Roger C. Dugan, Mark F. Mcgranaghan, Surya Santoso & H.Wayne Beaty, 2nd Edition, TMH Education Private Ltd., New Delhi.

Reference Book:

1. Power System Quality Assesment, J.Arrilaga, N.R.Watson, S.Chen, John Wiley & Sons.
2. Understanding Power Quality Problems: Voltage Sags & Interruptions, M.H.J. Boller IEEE, 1999

OPTIMAL CONTROL

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

Performance Indices: Selection of Performance Index, Calculus of variations: Variation and its properties, Euler-Lagrange Equation.

Linear Quadratic Regulator: Formulation of Algebraic Riccati Equation (ARE), Solving the ARE using the Eigenvector Method, Optimal systems with prescribed poles, Linear Quadratic Regulator for Discrete Systems on an infinite Time Interval.

Book-1: 5.1, 5.2, 5.2.1, 5.2.2, 5.3, 5.3.1, 5.3.2, 5.3.3, 5.3.5.

Module -II : ***(10 Hours)***

Dynamic Programming: Discrete Time Systems, Discrete Linear Quadratic Regulator Problem, Continous Minimum Time Regulator Problem, The Hamilton Jacobi Belman Equation.

Pontryagin's Minimum Principle: Optimal control with constraints on inputs.

Book-1: 5.4, 5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.5, 5.5.1.

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

Optimal Observers-the Kalmanfilter: The linear Quadratic Gaussian (LQG) problem, Loop Transfer Recovery (LTR). H_∞ Control: H_∞ Control Solution, Sub-optimal linear regulators: Continuous Time Systems, Discrete Time Systems, Introduction to Stochastic Optimal Linear Estimation and Control.

Book-2: 10.3, 10.4, 10.6, 10.7, 10.7.1, 10.7.2, 10.7.3.

Book-3: 11.7, 12.1, 12.2.

Text Books:

1. Systems and Control by Stanislaw h.Zak, Oxford University Press, Publication (2003).
2. Design of Feedback Control Systems by Raymond T. Stefani, B.Shahian, Clement J.Savant, Jr. Gene H. Hostetter, 4th edition (2002), Oxford University Press Publication.
3. Modern Control System Theory by M.Gopal, Second edition (2000), New Age International (P) Ltd. Publishers.

Reference:

1. Linear Optimal Control by Jeffrey B.Burl, Prentice Hall Publication (1999).
2. Control Theory (Multivariable and Non linear Methods) by Torkel Glad and Lennart Ljung, Taylor & Francis Publications (2009).
3. Control Systems Theory (with Engineering Application) by Sergey, Edward Lysters (2006).

SATELLITE COMMUNICATION SYSTEMS

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/T ratio, 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 on FDMA, TDMA and CDMA. Spread Spectrum Transmission and Reception. Estimating Channel requirements, SPADE, Random access

Application of Satellite communication: Network distribution and direct broad casting TV, fundamentals of mobile communication satellite

Module – III **(12 Hours)**

Propagation on satellite: Earth paths and influence on link design: Quantifying attenuation 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 – Cassegrain antennas, optimizing gain of large antenna, antenna temperature, feed system for large cassegrain antennas,

Design of small earth station antennas: Front fed paraboloid reflector antennas, offset fed 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
2. Satellite Communication by Robert M. Gagliardi, CBS Publishers

DIGITAL IMAGE PROCESSING

Module: 1 (12 hours)

Introduction: Digital Image fundamentals: Image sampling and quantization, relationship between pixels, Intensity transformations and spatial filtering, some basic intensity transformation functions, Histogram processing, spatial filters for smoothing and sharpening (Chapt: 2 & 3 of Text book 1)

Module: 2 (12 hours)

Filtering in the Frequency Domain: preliminary concepts, 2D DFT and its properties, basic filtering in the frequency domain, image smoothing and sharpening (Chapt: 4 of Text book 1)

Image Restoration and Reconstruction: Image restoration/degradation model, noise models, restoration in the presence of noise only, estimating the degradation function (Chapt: 5 of Text Book 1)

Module: 3 (12 hours)

Color Image Processing: color models, Color transformation (Chapt: 6 of Text book 1)

Wavelets and Multi-resolution Processing: multiresolution expansions, wavelet transforms in one and two dimension (Chapt: 7 of Text book 1)

Image Compression: Fundamentals, Some basic compression methods (Chapt: 8 of Text book 1)

Morphological Image Processing: Erosion and Dilation, opening and closing (Chapt: 9 of Text book 1)

Text Books:

1. R.C. Gonzalez, R.E. Woods, *Digital Image Processing*, 3rd Edition, Pearson Education
2. R C Gonzalez, Woods and Eddins, *Digital Image Processing using Matlab*, 2nd Edition, Tata McGraw Hill

Reference Books:

1. S.Sridhar, *Digital Image Processing*, Oxford University Press, 2011

INDUSTRIAL INSTRUMENTATION

Module 1 **18 Hours**

Introduction: Functional Units, Classification, Performance characteristics, Dynamic Calibration, Errors: An Overview, Statistical Error Analysis, Reliability and Related Topics (Chapter 1 of Text book)

Instruments for Analysis: Introduction, Gas Analysers, Liquid Analysers, X-ray Methods, Chromatography (Chapter 8 of Text Book)

Module II: **10 Hours**

Telemetry: Introduction, Pneumatic Means, Electrical Means, Frequency Telemetring, Multiplexing, Modulation, Modulation of Digital Data, Transmission Channels, Briefing of a Telemetry System in Operation, Wireless I/O (Chapter 10 of Text Book)

Module III: **10 Hours**

Power Plant Instruments: Introduction, The Power Plant Scheme, Pressure, Temperature, Flow and Level, Vibration and Expansion, Analysis, Flue Gas Analysis (Chapter 12 of Text Book)

Hazard and Safety: Initial consideration, Enclosures, Intrinsic Safety, Prevention of Ignition, Methods of Production, Analysis Evaluation and Construction (Chapter 13 of Text Book)

Text Book:

1. Principles of Industrial Instrumentation, Third Edition, D Patranabis, Tata McGraw Hill Education Private Limited, New Delhi

Reference Books:

1. Process/Industrial Instruments and Controls Handbook, Gregory K. Mc Millian Editor-in-Chief, Douglas M. Considine Late Editor-in-Chief

EMBEDDED SYSTEMS

MODULE – I **10 Hours**

Embedded System: Understanding the Basic Concepts:

Introduction to Embedded System: Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, 'Smart' running shoes from Adidas – The Innovative bonding of Life Style with Embedded Technology.

The Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components, PCB and Passive Components.

Characteristics and Quality Attributes of Embedded System: Characteristics of Embedded System, Quality Attributes of Embedded System.

Embedded Systems – Application and Domain Specific: Washing Machine – Application Specific Embedded System, Automotive – Domain Specific Example for Embedded System.

Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language (UML), Hardware Software Trade-offs.

MODULE – II **12 Hours**

Design and Development of Embedded Product:

Embedded Hardware Design and Development: Analog Electronic Components, Digital Electronic Components, VLSI and Integrated Circuit Design, Electronic Design Automation (EDA) Tools.

Embedded Firmware Design and Development: Embedded firmware Design Approaches, Embedded firmware Development Languages, Programming in Embedded 'C'.

Real Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronisation, Device Drivers, How to choose an RTOS.

MODULE – III **14 Hours**

Design and Development of Embedded Systems:

An Introduction to Embedded System Design with VxWorks and MicroC/OS-II (μCOS-II) RTOS: VxWorks, MicroC/OS-II (μCOS-II).

Integration and Testing of Embedded Hardware and Firmware: Integration of Hardware & Firmware, Board Power up.

The Embedded System Development Environment: Integrated Development Environment (IDE), Types of files generated on cross-compilation, Disassembler/Decompiler, Simulators, Emulators & Debugging, Target Hardware Debugging, Boundary Scan.

Product Enclosure Design & Development: Product Enclosure Design Tools, Product Enclosure Development Techniques.

Embedded Product Development Life Cycle (EDLC): Definition and Objectives of EDLC, Different Phases of EDLC, EDLC Approaches (Modeling the EDLC).

Trends in the Embedded Industry: Processor Trends in Embedded System, Embedded OS Trends, Development Language Trends, Open standards, Frameworks and Alliances, Bottlenecks.

Text Book:

1. Shibu K.V., *Introduction to Embedded Systems*, Tata McGraw Hill Education Private Limited, New Delhi, 2009.

Reference Book:

1. Peter Marwedel, *Embedded System Design*, Springer, 2006 http://ls12-www.cs.uni-dortmund.de/~marwedel/kluwer-es-book/
2. Wayne Wolf, *Computers as Components*, Morgan Kaufmann, 2001 http://www.ee.princeton.edu/~wolf/embedded-book
3. G. De Micheli, Rolf Ernst and Wayne Wolf, eds, Readings in Hardware/Software Co-Design, Morgan Kaufmann, Systems-on-Silicon Series Embedded
4. Frank Vahid and Tony D. Givargis, System Design: A Unified Hardware/Software Introduction, Addison Wesley, 2002.
5. Michael Barr, Programming Embedded Systems in C and C++, O'Reilly, 1999.
6. David E. Simon, An Embedded Software Primer, Addison Wesley, 1999.
7. Jack Ganssle, The Art of Designing Embedded Systems, Newnes, 2000.
8. K. Short, *Embedded Microprocessor System Design*, Prentice Hall, 1998.
9. C. Baron, J. Geffroy and G. Motet, *Embedded System Applications*, Kluwer, 1997.
10. Raj Kamal, *Embedded Systems – Architecture, Programming and Design*, Tata McGraw Hill Publishing Company Limited, New Delhi,

POWER STATION ENGINEERING AND ECONOMY

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)

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.

MARKETING MANAGEMENT (3-0-0)

Objective of the Course: The course aims at introducing the basic concepts of marketing to the undergraduate students in engineering. The learning shall help the students in better designing, manufacturing and selling product/ service packages keeping competitive market, customers and cost in view.

Module – I **(10 hours)**

Marketing Management: Concept, Process, Functions and relevance in the current context.

Marketing Environment: Elements of micro and macro environment

Competition Analysis: Factors contributing to competition, porter's five forces model, Identifying and analyzing competitors.

Marketing Planning : Exploring Opportunity, Product –market selection, Marketing Planning Process.

Market Research and Information Systems: Research Process, The Internet and World Wide Web based Information collection and processing, Database, Data Warehouses and Data Mining, Global Market Research.

Consumer Behavior: Factors influencing consumer behavior, consumer decision process. Organizational buying behavior.

Module II **(10 hours)**

Market Segmentation, Targeting and Positioning: Definition, Bases of segmenting consumer and Industrial markets. Target Market strategies: Market Positioning.

Market Demand Forecasting: Key Terms, Forecasting Tools: Short term tools: Moving average and Exponential smoothing methods, Long-term forecasting Tools: Time series analysis, Econometrics methods, Qualitative tools : Buying Intention Survey, Sales Force Opinion and Delphi Techniques.

Product Planning : Product Life Cycle, New Product Development Process, Branding Strategy, Positioning a Brand, Brand Equity, Packaging and Labeling, Product-mix and Product Line, Planned Obsolescence.

Module – III **(10 hours)**

Pricing Decision: Objectives and Factors influencing pricing, Pricing method and strategies.

Integrated Marketing Communication(IMC)- Concept of IMC, the marketing communication process, Promotion Mix, elements of promotion mix, Direct marketing.

Channels of Distributions: Types of intermediaries, functions of distribution channels, channel levels, Designing Distribution Channels, Physical Distribution, Supply Chain Management (Basic only).

Trends in Marketing: Green Marketing, Customer Relationship Management, E-marketing, Rural Marketing and Service Marketing (concepts only)

Books:

Text Book:

1. Etzel , Walker ,Stanton and Pandit, Marketing, 14/e, Tata McGraw Hill.

2. Saxena, "Marketing Management" Tata McGraw Hill, 4/e.

Reference

1. Grewal, Levy, 'Marketing' Tata McGraw Hill, special Indian edition.

2. Karunakaran "Marketing Management", Himalaya Publishing House, 2010/e.

3. Kotler, Keller,Koshy and Jha, "Marketing Management", 13/e, Pearson Education.

PRODUCTION & OPERATION MANAGEMENT

Objective : The course aims at acquainting all engineering graduates irrespective of their specializations the basic issues and tools of managing production and operations functions of an organization.

Module I

1. Operations Function in an Organization, Manufacturing Vrs Service Operations, System view of Operations, Strategic Role of Operations, Operations Strategies for Competitive Advantage, Operations Quality and Productivity Focus, Meeting Global Challenges of Production and Operations Imperatives. **(3 Hours)**

2. Designing Products, Services and Processes: New Product Design- Product Life Cycle, Product Development Process, Process Technology : Project, Jobshop, Batch, Assembly Line, Continuous Manufacturing; Process Technology Life Cycle, Process Technology Trends, FMS, CIM, CAD, CAM; Design for Services, Services Process Technology. **(4 Hours)**

3. Work Study: Methods Study- Techniques of Analysis, recording, improvement and standardization; Work Measurement : Work Measurement Principles using Stopwatch Time Study, Predetermined Motion Time Standards and Work Sampling, Standard Time Estimation. **(4 Hours)**

Module II

4. Location and Layout Planning : Factor Influencing Plant and Warehouse Locations, Impact of Location on cost and revenues. Facility Location Procedure and Models : Qualitative Models, Breakeven Analysis, location Model, centroid method.
Layout Planning: Layout Types : Process Layout, Product Layout, Fixed Position Layout Planning, block diagramming, line balancing, computerized layout planning- overview.
Group Technology **(4 Hours)**

5. Forecasting : Principles and Method, Moving Average, weighted Moving Average, Exponential Smoothing, Winter's Method for Seasonal Demand, Forecasting Error.**(4 Hours)**

6. Manufacturing Planning and Control : The Framework and Components : Aggregate Planning, Master Production Scheduling, Rough-cut-Capacity Planning, Material Requirements Planning, Capacity Requirements Planning. **(5 Hours)**

Module III

7. Sequencing and Scheduling : Single Machine Sequencing : Basics and Performance Evaluation Criteria, Methods for Minimizing Mean Flow Time, Parallel Machines : Minimization of Makespan, Flowshop sequencing : 2 and 3 machines cases : Johnson's Rule and Jobshop Scheduling : Priority dispatching Rules. **(3 Hours)**

8. Inventory Control : Relevant Costs, Basic EOQ Model, Model with Quantity discount, Economic Batch Quantity, Periodic and Continuous Review Systems, Safety Stock, Reorder Point and Order Quantity Calculations. ABC Analysis. **(4 Hours)**

9. Modern Trends in Manufacturing : Just in Time (JIT) System : Shop Floor Control By Kanbans, Total Quality Management, Total Productive Maintenance, ISO 9000, Quality Circle, Kaizen, Poka Yoke, Supply Chain Management. **(4 Hours)**

Reference Book:

1. S.N.Chary, "Production and Operations Management", Tata McGraw Hill.
2. R. Paneerselvam, "Production and Operations Management, Prentice Hall of India.
3. Aswathappa & Bhatt – Production & Operations Management, HPH.
4. Gaither & Frazier - Operations Management, Cengage Publication
5. Russell & Taylor - Operations Management, PHI Publication
6. Chase, Aquilanno, Jacob & Agarwal - Operations Management, TMH Publication.
7. E.E. Adam and R.J. Ebert "Production and Operations Management", Prentice Hall of India