## BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

### Electrical Engineering (EE)

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<th>Subjects</th>
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<tr>
<td>BSCM1205</td>
<td>Mathematics – III</td>
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<tr>
<td>BSMS1213</td>
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**Theory Credits**: 21

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**Practical/Sessional Credits**: 06

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**Total Semester Credits**: 27

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**Total Semester Credits**: 28

**Total Cumulative Credits**: 83

### 4th Semester

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**Practical/Sessional Credits**: 08

**Total Semester Credits**: 28

**Total Cumulative Credits**: 111
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:
   Reading Chapters: 11,12(except 12.10),13,14,15
   Reading chapter: 18

Reference books:
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

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
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

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
Module-I  

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  

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.


Module III  


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:**

**Reference Books:**
HSSM3204 Engineering Economics & Costing

Module-I: (12 hours)

Module-II: (12 hours)

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:

Reference Books:
4. Gupta, “ Managerial Economics”, TMH
5. Lal and Srivastav, “ Cost Accounting”, TMH
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 Followership, 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
Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

Text Books:

Reference Books:
1. Stephen P. Robbins, Organisational Behaviour, Prentice Hall of India
4. Steven L McShane, Mary Ann Von Glinow, Radha R Sharma” Organizational
   Behaviour”, TATA McGraw-Hill.
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.


Text Book:

Reference Book(s):
8. Network Theory, Smarajit Ghosh, PHI.
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)
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, $\mu$A 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.


**Reference Books:**


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.
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.
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)

6. Frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response.
8. Study of Darlington connection and current mirror circuits.
10. Application of Op-Amp as differentiator, integrator, square wave generator.
11. Square wave testing of an amplifier.
Module I (12 Lectures)
Introduction: Scope of fluid mechanics and its development as a science
Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.
Fluid static Pressure, Pascal’s Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, manometer.

Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface.

Buoyancy and flotation, Archimedes’ principle, stability of immersed and floating bodies, determination of metacentric height.

Fluid kinematics: Introduction, description of fluid flow, classification of fluid flow. Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity,

Module II (10 Lectures)
Fluid dynamics: Introduction, Euler’s equation along a streamline, energy equation, Bernoulli’s equation,

Hydraulic Measurements: Water level measurements, velocity measurements, discharge measurements, venturimeter, orifice meter, current meter, pitot tube, orifice, notch and weir.

Module III (14 Lectures)


Text Books
1. Fluid Mechanics and hydraulic machines, Modi & Seth
2. Hydraulics fluid machines and fluid machines by S. Ramamrutham

Reference Books:
1. Fluid Mechanics by A.K. Mohanty, PHI
2. Introduction to Fluid Mechanics by Fox and McDonald, Willey Publications
3. Fluid Mechanics by Kundu, Elsevier
4. An Introduction to Fluid Dynamics by G.K.Batchelor, Cambridge University Press
5. Engineering Fluid Mechanics by Garde et. al., Scitech
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, Compensatioing 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 :**

**Reference Book(s):**
1. The Performance and Design of DC Machines – A E Clayton.
2. Theory and Performance of AC Machines – M G Say
7. Electric Machines – Charles Hubert – Pearson Education.

PCEE4204 Electrical and Electronics Measurement

MODULE-I  (14 Hrs)

MODULE-II  (14 Hrs)
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 TRANSFORMER and POTENTIAL TRANSFORMER: Construction, Theory, Characteristics and Testing of CTs and PTs.
8. ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS: Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters (Block Diagrams only), Q-meter.

Text Book(s):
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):
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 Complements, 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)

Text Books:

Reference Books:
Select any 8 experiments from the list of 10 experiments

1. Determination of critical resistance and 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.

Select any 8 experiments from the list of 10 experiments

5. Testing of Energy meters (Single phase type).
8. Measurement of Power in a single phase circuit by using CTs and PTs.
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.
7. Shift Registers: Design and investigate the operation of all types of shift registers 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.
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.
      iii. Motivating subordinates / juniors (‘pep talk’)
   b. Subordinate / Junior ➔ Superior / Senior
      i. Responding to the above
      ii. Reporting problems / difficulties / deficiencies
      iii. Offering suggestions

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**TOTAL SEMESTER CREDITS** 25  **TOTAL SEMESTER CREDITS** 24

**TOTAL CUMULATIVE CREDITS** 136  **TOTAL CUMULATIVE CREDITS** 160
Module – I

Module – II
(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.

Module – III

Text Book:
2. Environmental Engineering by Prof B.K. Mohapatra, Seven Seas Publication, Cuttack

Reference Books
1. Environmental Engineering by Arcadio P. Sincero & Gregoria A. Sincero PHI Publication
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.
Module-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

Module-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.

Module-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**

**Recommended Reference books**:
**Module-I**

(12 Hours)


**Module-II**

(15 Hours)


**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.


Closed loop frequency response: Constant Mcircles, Constant N-Circles, Nichol's chart.


**Text Books:**
1. Modern Control Engineering by K. Ogata, 5th edition PHI.

**Reference Books:**
Module-1 12 Lectures
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 quadrant, first
and second quadrant, third and fourth quadrant, fourth quadrant 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:

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
MODULE-I [15 HOURS]

1. Three Phase Synchronous Generators (5 hours)
   Synchronous Generator Construction (both Cylindrical 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] (1 hour)

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 ($0^\circ$, $180^\circ$, $+30^\circ$ and $-30^\circ$), 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:**


**REFERENCE BOOKS:**


Unit 1    (10 hours)
Fundamental of fiber optics, Different generations of optical fiber communication systems. Optical fiber structure, Fiber types, step index fiber and graded index fiber, ray propagation, total internal reflection, Numerical Aperature, acceptance angle. Wave propagation in a cylindrical wave guides, modal concept, V-number, power flow in step index fiber and graded index fiber, attenuation (absorbtion, scattering and bending) and dispersion (inter and intramodal, chromatic, wave guide and polarization) in fiber, dispersion shifted and dispersion flattened fiber

Unit 2    (12 hours)
Fiber fabrication, Double crucible method, Fiber optic cables, Connector and splice. Losses during coupling between source to fiber, fiber to fiber. Schemes for coupling improvement.

Optoelectronic Sources, LED, ILD,light source materials, Radiation Pattern modulation capability.

Unit 3    (13 hours)
Optoelectronic Detector, PIN AND APD, Responsivity,Band width, Detector noise ,equivalent circuit and SNR calculation.

Optoelectronic Modulators, Basic principle, Electro optic and Acousto optic modulators, Optical Amplifier, Semiconductor optical Amplifier and Erbium Doped Fiber Amplifier, Solar cells, basic principle,heterojunction,cascaded solar cell, Schottky Barrier cells,WDM components-couplers, isolators ,circulators, filters. Optical switching-self electro optic effect Device, switching speed and energy

Text Books
1. Fiber optics and Optoelectronics, R.P.Khare, Oxford University Press(selected sections from chapters 1,2,3,4,5,6,7,8,9and10)
2. Semiconductor Optoelectronic Devices, Pallab Bhattatcharya, second edition, Pearson Education (selected sections from chapters 10 and 11)

Reference Books
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:

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:

Reference Books:
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,
Thermoelectric 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.

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. 
FESM6301 NUMERICAL METHODS

Unit –I (10 hrs)
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:

Reference Books
Module I     (13 Hours)
(i) What is bioengineering: Engineering versus Science, Bioengineering, Biochemical Engineering, Biomedical Engineering, and Career Opportunities.

(ii) Medical Instrumentation: Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical instrumentation system, use of microprocessors in medical instruments, PC based medical Instruments, general constraints in design of medical instrumentation system & Regulation of Medical devices.
(iii) Bioelectrical Signals & Electrodes: Origin of Bioelectric Signals, Electrocardiogram, Electroencephalogram, Electromyogram, Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts.
(Text Book-I-Chapter-0, Text Book-II—Chapter-1, Text book-II-Chapter-2)

Module -II     (14 Hours)
(iv) Electrodes for ECG: Limb Electrode, Floating Electrodes, Prejelled disposable Electrodes, Electrodes for EEG, Electrodes for EMG.
(v) Physiological Transducers: Introduction to Transducers, Classification of Transducers, Performance characteristics of Transducers, Displacement, Position and Motion Transducers.
(Text book-II-Chapter-2, Text Book-II, Chapter-3)

Module –III     (13 Hours)
(vi) Physiological Transducers: Strain gauge pressure transducers, Thermocouples, Electrical Resistance Thermometer, Thermister, Photovoltaic transducers, Photo emissive Cells & Biosensors or Biochemical sensor
(vii) Recording Systems: Basic Recording systems, General considerations for Signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling)
(Text Book-II, Chapter-3, Text Book-II-Chapter-4)

Text Books:-
1. Introduction to Biomedical Engineering by Michael M. Domach, Pearson Education Inc, 2004

Reference Books:
(1) Introduction to Biomedical equipment technology, 4e. By JOSEPH.J.CAAR & JOHN M.BROWN (Pearson education publication)
(2) Medical Instrumentation-application & design. 3e – By JOHN.G.WEBSTER
    John Wiley & sons publications
(3) Leslie. Cromwell – Biomedical instrumentation & measurements, 2e PHI
(4) Dr. M. Arumugam – Biomedical instrumentations, Anuradha Publishers.
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)
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 Education)
(3) Database management system by leon &leon (Vikas publishing House).
(4) Fundamentals of Database Management System – Gillenson, Wiley India
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.

Module - III 12 Hrs
Applets: Basics, Architecture, Skeleton, The HTML APPLET Tag, Passing Parameters to Applets, Applet context and show documents () .
Event Handling: 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:

Reference Books:
1. Balguruswamy, Programming with JAVA, TMH.
2. Programming with Java: Bhave &. Patekar, Pearson Education.
PCEC7303 CONTROL AND INSTRUMENTATION LAB (0-0-3)

List of Experiment:
Control:
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 study the characteristics of a relay and analyse the relay control system (Phase Plane)
6. To study and validate the controllers for a temperature control system
7. To study the position control system using Synchros

Instrumentation:
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.

PCEL7301 Power Electronics laboratory (0-0-3)

List of Experiment:
1. Study of the V-I characteristics of SCR, TRIAC and MOSFET.
2. Study of the V-I characteristics of UJT
3. (a) Study of the synchronized UJT triggering circuit.
   (b) Study of the cosine controlled triggering method
4. Study of the single phase half wave controlled rectifier and semi converter circuit with R and R-L Load
5. Study of single phase full wave controlled rectifier circuits(mid point and Bridge type) with R and R-L Load
6. Study of three phase full wave controlled rectifier circuits(Full and Semi converter) with R and R-L Load
7. Study of the forward converter (Buck converter) and flyback converter(boost converter) operation.
8. Study of the single phase pwm voltage source inverter.
9. Study the performance of three phase VSI with PWM control.
10. Study the performance of single phase AC Voltage controller with R and R-L Load
11. Ramp comparator scheme of regulating ac power using triac and opto isolator
12. Study of the resonant inverter.
List of Experiment:

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
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

*(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

(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.

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.
Module – I

Transmission Line Parameters: (Book – 1, Ch.4)

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)

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

Transmission Line Performances (Book – 1, Ch.6)
Short, Medium & Long Transmission Lines

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

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)
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:
Module – I (15 hours)
Co-ordinate systems & Transformation:
Cartesian, co-ordinates, circular cylindrical co-ordinates, spherical co-ordinates
Vector Calculus: Differential length, Area & volume, Line surface and volume Integrals,
Del operator, Gradient of a scalar, Divergence of a vector & divergence theorem, curl of
a vector & Stoke’s theorem, laplacian of a scalar
Electrostatic Fields: Coulomb’s Law and Field Intensity Electric Fields due to continuous
charge distributions, Electric Flux Density. Gauss’s Law – Maxwell’s Equation,
Applications of Gauss’s Law, Electric Potential, Relationship between E and V –
Maxwell’s Equation An Electric Dipole & Flux Lines, Energy Density in Electrostatic
Fields.
Book1: Ch. 1.1 to 1.4, Ch. 2.1 to 2.8, Ch. 3.1 to 3.10

Module – II (15 hours)
Electrostatic Boundary – Value Problems:
Possion’s & Laplace’s Equations, Uniqueness theorem, General procedures for solving
possion’s or Laplace’s Equation, Resistance, Capacitance, Method of Images.
Magnetostatic Fields:
Biot-Savart’s Law, Ampere’s circuit law-Maxwell Equation, applications of Ampere’s law,
Magnetic Flux Density-Maxwell’s equations. Maxwell’s equation for static fields,
Book1: Ch. 4.8, Ch. 5.1 to 5.6 Ch. 6.1 to 6.8

Module – III (10 hours)
Maxwell’s Equations:
Faraday’s Law, Transformer & Motional Electromagnetic Forces, Displacement Current,
Maxwell’s Equation in Final forms, Time Varying Potentials, Time-Harmonic Field
Electromagnetic Wave Propagation:
Wave Propagation in lossy Dielectrics, Plane Waves in loss less Dielectrics, Power &
pointing vector.
Numerical Methods: Finite element, Finite Difference & moment methods – some
applications.
Book1: Ch. 8.1 to 8.7, Ch. 9.1 to 9.3 & 9.6, Ch. 13.1 to 13.5

Text Book:
   Student Edition.

Reference Book:
1. C. R. Paul, K. W. Whites, S. A. Nasor, Introduction to Electromagnetic Fields,
   3rd, TMH.
2. Electromagnetic Field Theory, W.H. Hyat, TMH, 7th Ed.
Module-I  
(12 Hours)  
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.  
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.  
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:  

Reference Book:  
(1) Modern Power Electronics and AC drives- by B.K.Bose, Pearson Education.
PCEE4304  COMMUNICATION ENGINEERING  (3-0-0)

MODULE-I
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:

Reference Book:
1. Taub, Schilling, Saha, Taub’s Principles of Communication Systems, TMH.
Module – I
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
Module – II
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
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:
Selected portions from chapter 13 (13.1.1, 13.1.2, 13.1.5, 13.1.6, 13.2.1, 13.2.2) of Textbook – I
Text Books
Reference Book:
2. Digital Signal Processing – S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH
3. Digital Signal Processing – Manson H. Hayes (Schaum’s Outlines) Adapted by Subrata Bhattacharya, TMH.
OPERATING SYSTEM (3-0-0)

MODULE-I  12 Hours
INTRODUCTION TO OPERATING SYSTEM:
Operating System Structures: Operating System Services, System components, Protection system, Operating System Services, system calls

PROCESS MANAGEMENT:

MODULE-II  12 Hours
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.

MODULE-III  11 Hours
STORAGE MANAGEMENT:
CASE STUDIES: The LINUX System, Windows XP, Windows Vista

TEXT BOOK:

REFERENCE BOOK:
2. Operating Systems – Pabitra Pal Choudhury, PHI
Module – I  12 Hrs
Overview of Data Communications and Networking.
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:

Reference Book :
2. Computer Networks: Natalia Olifer, Victor Olifer, Willey India
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
Module – I


Module – II
3. Inverse Kinematics: Manipulator workspace, Solvable of inverse kinematic model, Manipulator Jacobian, Jacobian inverse, Jacobian singularity, Static analysis.

Module – III
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:
2. Introduction to Robotics: Mechanics and control, John J Craig, PHI

Reference Books:
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.
Module-I (10 Hrs)

**Analog Signal Conditioning**


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

**Digital Signal Conditioning**


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**


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

**Optical Sensors**

Photodetectors, Pyrometry, Lasers 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.


**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, Feedforward Control, Feedforward-feedback Control Configuration, Ratio Control.

Book-2, Ch-10.1,10.2,10.3,10.4,10.5.

**Selective and Adaptive Control Systems**

Selective Control, Adaptive Control, Adaptive Control Configuration.


**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
A) 8085 (2 hours)
1. Addition, Subtraction, Multiplication, Division two 8 bit numbers resulting 8/16 bit numbers.
2. Smallest /Largest number among n number in a given data array + Binary to Gray Code / Hexadecimal to decimal conversion. (1 hour)

B) INTERFACING (5 hours)
COMPULSORY (1 hour)
1. Generate square waves on all lines of 8255 with different frequencies (concept of delay program) 1 lecturer)
2. Study of stepper Motor and its operations (Clockwise, anticlockwise, angular movement, rotate in various speeds)

OPTIONAL (Any Two) (1 hour)
1. Study of Traffic Light controller
2. Study of Elevator Simulator
3. Generation of Square , triangular and saw tooth wave using Digital to Analog Converter
4. Study of 8253 and its operation (Mode 0, Mode 2, Mode 3)
5. Study of Mode 0, Mode 1, BSR Mode operation of 8255.
6. Study of 8279 (keyboard & Display interface)
7. Study of 8259 Programmable Interrupt controller.

C) 8051 MICROCONTROLLER (3 hours)
COMPULSORY (2 hours)
1. Initialize data to registers and memory using immediate, register, direct and indirect addressing mode

OPTIONAL (Any one) (1 lecture)
1. Addition, subtraction of 16 bit numbers.
2. Multiplication, Division of 16 bit numbers
3. Transfer a block of data to another memory location using indexing.
4. Operation of 8255 using 8051 microcontroller

D) 8086 (2 hours)
COMPULSORY (1 hour)
1. Addition, subtraction, Multiplication, Division of 16 bit nos + 2's complement of a 16 bit no.

OPTIONAL (Any One) (1 hour)
1. Finding a particular data element in a given data array.
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

Total – 13 hours

NOTE Total 10 (Ten) experiments have to be completed. Two from GP-A, four from GP- B, Two from GP – C Two from GP – D

Reference Books:
SEC-A (Design Using MATLAB) (Any one)
1. Design of single phase/3-phase transformers
2. Design of 3-phase induction motor
3. Design of 3-phase synchronous generator

SEC-B (Simulation Using SIMULINK) (Any two)
1. Simulation of 1-phase HW/FW Rectifier with R/RL Load
2. Simulation of 3-phase Controlled Rectifier with R/RL Load
3. Simulation of 1-phase/ 3-phase Inverter

SEC-C (Design/Simulation Using MATLAB/ SIMULINK) (Any two)
1. Obtaining time response of a given feedback control system to unit step/ ramp input
2. Obtaining frequency response (Bode plot & Polar Plot) of a given feedback control system
3. Design & Simulation of P / PI / PID Controller
Electrical Drives Lab (0-0-3)

(Any Eight Experiments)
1. Speed Control of Single Phase Induction Motor by using Single Phase AC to AC Converter.
2. Speed Control of Separately Excited DC Shunt Motor using Single Phase Fully Controlled AC to DC Converter.
3. Speed Control of Separately Excited DC Shunt Motor using Four-Quadrant Chopper.
4. Speed Control of Separately Excited DC Shunt Motor using Single Phase Dual Converter.
5. Speed Control of Three Phase Squirrel Cage Induction Motor using Three Phase AC to AC Controller.
6. Speed Control of Three Phase Squirrel Cage Induction Motor using Three Phase PWM Inverter.
7. Speed Control of Three Phase Slip Ring Induction Motor using Rheostatic Control Method.
8. Speed Control of DC Shunt Motor using Three Phase AC to DC Converter.
10. Determination of the Moment of Inertia of DC Shunt Motor Drive System by Retardation Test.
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.


**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.
1. Familiarization with the architecture of a standard DSP kit (Preferably TMS 320C6XXX DSP kit of Texas Instruments)

2. Generation of various types of waveforms (sine, cosine, square, triangular etc.) using MATLAB and DSP kit.

3. Linear convolution of sequences (without using the inbuilt conv. function in MATLAB) and verification of linear convolution using DSP kit.

4. Circular convolution of two sequences and comparison of the result with the result obtained from linear convolution using MATLAB and DSP kit.

5. (i) Computation of autocorrelation of a sequence, cross correlation of two sequences using MATLAB.

   (ii) Computation of the power spectral density of a sequence using MATLAB also implementing the same in a DSP kit.

6. Finding the convolution of a periodic sequence using DFT and IDFT in MATLAB.

7. (i) Implementation of FFT algorithm by decimation in time and decimation in frequency using MATLAB.

   (ii) Finding the FFT of a given 1-D signal using DSP kit and plotting the same.

8. Design and implementation of FIR (lowpass and highpass) Filters using windowing techniques (rectangular window, triangular window and Kaiser window) in MATLAB and DSP kit.

9. Design and implementation of IIR (lowpass and highpass) Filters (Butterworth and Chebyshev) in MATLAB and DSP kit.

10. (i) Convolution of long duration sequences using overlap add, overlap XXXXX using MATLAB.

    (ii) Implementation of noise cancellation using adaptive filters on a DSP kit.

Reference Books:


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# BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ORISSA

## ELECTRICAL ENGINEERING (EE)

### 7th Semester

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**Theory Credits** 15

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**Practical/Sessional Credits** 08

### 8th Semester

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**Theory Credits** 12

**Practical/Sessional**

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**Practical/Sessional Credits** 09

**TOTAL SEMESTER CREDITS** 23
**TOTAL CUMULATIVE CREDITS** 183

**TOTAL SEMESTER CREDITS** 21
**TOTAL CUMULATIVE CREDITS** 204
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:**
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
POWER SYSTEM OPERATION & CONTROL (3-0-0)

Module – I  (14 Hours)
Fundamentals of Power System  (Book No.1, Ch. 1)

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)

Book-1: Ch. 7.1, Ch. 7.2, Ch. 7.3, Ch. 7.4, Ch. 7.5.

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.

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

Book – 2: Ch. 9.3.1, Ch. 9.3.2, Ch. 9.3.3, 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.

Text Books:

Reference:
VLSI DESIGN

Module – I 08 Hours
(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.
(Chapter 5 to 7 of Text Book 1)

Module – III 18 Hours
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 IDDQ Test.

Text Books:

Reference Books:
FLEXIBLE AC TRANSMISSION SYSTEM (3-0-0)

MODULE-I  
(12 Lectures)

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

TEXT BOOK:

Reference Book:
Module – I

Introduction to Special Electrical Motors: Position Control and Stepper Motors, Switched Reluctance Motors, Brushless DC Motors, Linear Motors.

Stepper Motors: Introduction, Synchronous Inductor (or Hybrid) Stepping Motor, Essential Conditions for Satisfactory Operation of a Two Phase Hybrid Step Motor, Very Slow Speed Synchronous Motor for Servo Control, Different Configuration for Switching the Phase Windings, Control Circuits for Stepping Motors, An Open Loop Controller for a 2-Phase Stepping Motor, Variable Reluctance (VR) Stepping Motors, Open Loop Control of a 3-Phase VR Step Motor, Closed-Loop Control of a Step Motor, Characteristics of a Step Motor in Open Loop Drive, Comparison between Open Loop Position Control with Step Motor and a Position Control Servo using a Conventional (DC or AC) Servo Motor, Suitability and Areas of Application of Stepping Motors, 5-Phase Hybrid Stepping Motor, Single Phase Stepping Motor: The Construction, Operating Principle.

(Ch 0.1, 0.2, 0.3, 0.4, Ch 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15(1.15.1, 1.15.2))

Module – II


(Ch 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.8, 3.9, 3.12, Ch 4.1, 4.2, 4.3)

Module – III

Brushless DC Motor (BLDM): Types of Construction, Principle of Operation of BLDM, Sensing and Switching Logic Scheme, Drive and Power Circuits, Theory of BLDM as a Variable Speed Synchronous Motor (assuming Sinusoidal Flux Distribution), Methods of Reducing Torque Pulsations.

Linear Induction Motor (LIM): Development of a Double Sided LIM (DSLIM) from Rotary Type Induction Motor (IM), A Schematic of LIM Drive for Electric Traction, Development of one Sided LIM with Back Iron, Field Analysis of a DSLIM (Fundamental assumptions).

(Ch 5.1, 5.2, 5.3, 5.4, 5.9, 5.10, Ch 6.1, 6.2, 6.3, 6.4)

Text Book:

SOFT COMPUTING (3-0-0)

MODULE-I  

MODULE-II  
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.  

MODULE-III  

TEXT BOOK:  
2. "Neural Networks: A Classroom Approach" By Satish Kumar, TMH Education  

Reference Book:  
HIGH VOLTAGE DC TRANSMISSION (3-0-0)

MODULE-I (12 Lectures)


(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 $\alpha$ & $\mu$, 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.


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:

Reference Book:
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:

Reference Books:
3. C. Johnson, “Process Control Instrumentation Technology”, PHI, New Delhi
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 Performance 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, Performance analysis, Filtered X LMS algorithm,
Text Books:
Reference Book:
ADVANCED CONTROL SYSTEMS

Module-I: (15 Hours) Discrete - Time Control Systems:
Digital Control Systems: Sample and Hold, Analog to digital conversion, Digital to analog conversion.

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:

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.

Book No. 2: 13.1 to 13.4; 15.1 to 15.10.

Text:

Reference:
HIGH VOLTAGE ENGINEERING (3-0-0)

MODULE-I (10 Lectures)
Conduction and Breakdown in Gases: Gases as Insulating Media, Collision Processes, Ionization Processes, Townsend’s Current Growth Equation, Townsend’s Criterion for Breakdown, Experimental Determination of Coefficients $\alpha$ and $\gamma$, Breakdown in Electronegative Gases, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen’s Law, Breakdown in Non-uniform Fields and Corona Discharges, Post-Breakdown Phenomena and Applications, Practical Considerations in using Gases and Gas Mixtures for Insulating Purposes Vacuum Insulation.
(Chapter-2: 2.1 to 2.4 and 2.6 to 2.15)

MODULE-II (12 Lectures)
Conduction and Breakdown in Liquid Dielectrics: Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids.
Breakdown in Solid Dielectrics: Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown, Breakdown of Solid Dielectrics in Practice, Breakdown in Composite Dielectrics, Solid Dielectrics used in Practice.
(Chapter-3: 3.1 to 3.4, Chapter-4: 4.2 to 4.7 and Chapter-6: 6.1 to 6.4)

MODULE-III (12 Lectures)
(Chapter-7: 7.1 to 7.3, Chapter-9: 9.2 to 9.4 and Chapter-10: 10.1 to 10.5)

MECHATRONICS

Module – I:-
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.


Basic System Models:- Mathematical models, Mechanical 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:-

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.

Text Books:

Reference Books:
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), Electromyograph (EMG)

Module – III                               (14 Hours)
**Patient Monitoring Systems:** System Concepts, Measurement of Heart Rate, Blood Pressure Measurement, Measurement of Respiration Rate


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

**Text Books:**

**Reference Books:**
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.
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
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.
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
Fault analysis using symmetrical components: Symmetrical & unsymmetrical faults.
3-Phase systems, Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedance, fault calculations, Single line to ground fault, Line to ground fault with Zf, Faults in Power systems, Concept of short circuit capacity of a Bus.
Feeder Protection: Overcurrent, Distance and Pilot Protection Schemes.
Book-1: CH 5.2, 5.3, 5.4.
Book-1: CH 6.2, 6.3, 6.4, 6.5.

MODULE-III
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
Numerical relays:

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 Paiithankar and S R Bhide, PHI Publication. (Book-2)

Reference books:
1. Power System relaying by Horwitz, Phadke, Research Press.
2. Power System Protection & Switchgear by B.Oza, N.K Nair, R.Mehta,V.H.Makwana, TMH
INDUSTRIAL INSTRUMENTATION

**Module I:**
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


**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:**

**Reference Books:**
1. Process/Industrial Instruments and Controls Handbook, Gregory K. Mc Millian Editor-in-Chief, Douglas M. Considine Late Editor-in-Chief
MODULE-I  
(Chapter-2: 2.2 to 2.10 and Chapter-3: 3.1 to 3.7)  

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

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

TEXT BOOK:  
OPTIMAL CONTROL

Module-I : (15 Hours)
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)
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)
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:

Reference:
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:
2) Power Electronics: Converters, Applications and Design by Mohan, Undeland and Robbin, Wiley India Edition
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:

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:

Reference Books:
MODULE – I 10 Hours
Embedded System: Understanding the Basic Concepts:
MODULE – II 12 Hours
Design and Development of Embedded Product:
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.
Embedded Product Development Life Cycle (EDLC): Definition and Objectives of EDLC, Different Phases of EDLC, EDLC Approaches (Modeling the EDLC).
Text Book:
Reference Book:
3. G. De Micheli, Rolf Ernst and Wayne Wolf, eds, Readings in Hardware/Software Co-Design, Morgan Kaufmann, Systems-on-Silicon Series Embedded
10. Raj Kamal, Embedded Systems – Architecture, Programming and Design, TMH, New Delhi,
Module-I: (10 Hours)

- Concept of adaptive control: Adaptive Schemes: Gain Scheduling, Model Reference Adaptive Systems (MRAS), Self tuning Regulators (STR), Dual Control.
- Book-1: 1.1, 1.4, 2.1, 2.2, 2.3, 2.4, 2.5.

Module-II: (15 Hours)

- Book-1: 3.2, 3.3, 3.5, 4.2, 4.3, 4.6, 5.2, 5.3, 5.6 (P-223), 5.10.

Module-III: (15 Hours)

- Book-1: 6.1, 6.2, 6.3, 6.4 (P-288), 6.6, 6.7, 6.8, 6.9, 7.1, 7.3, 7.4, 10.1, 10.2, 10.3, 10.4.

Books:

- Reference:
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)
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:
3. M. V. Deshpande, Elements of Electrical Power Station Design, PHI
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.
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 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.

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.

Reference
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

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

Module III
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)

Reference Book:
3. Aswathappa & Bhatt – Production & Operations Management, HPH.
5. Russell & Taylor - Operations Management, PHI Publication
7. E.E. Adam and R.J. Ebert “Production and Operations Management”, Prentice Hall of India