**SCHEME OF TEACHING AND EXAMINATION**

**B.E. ELECTRICAL & ELECTRONICS EINGINEERING**

**V SEMESTER**

| Sl. No. | Subject Code | Title of the Subject | Teaching Dept. | Teaching Hrs / Week | | Examination | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Duration (Hrs) | Marks | | |
| | | | | | | | IA | Theory / Practical | Total |
| 01 | 06AL51 | Management and Entrepreneurship | @ | 4 | - | 3 | 25 | 100 | 125 |
| 02 | 06EE52 | Signals and Systems | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 03 | 06EE53 | Transmission and Distribution | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 04 | 06EE54 | D.C. Machines and Synchronous Machines | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 05 | 06EE55 | Modern Control theory | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 06 | 06EE56 | Linear IC's and Applications | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 07 | 06EEL57 | Circuit Simulation and Measurements Laboratory | E&EE | - | 3 | 3 | 25 | 50 | 75 |
| 08 | 06EEL58 | Transformers and Induction Machines Laboratory | E&EE | - | 3 | 3 | 25 | 50 | 75 |
| **TOTAL** | | | | **24** | **06** | **24** | **200** | **700** | **900** |

@ Any Engineering department or department of Business study.



**SCHEME OF TEACHING AND EXAMINATION**

**B.E. ELECTRICAL & ELECTRONICS EINGINEERING**

**VI SEMESTER**

| Sl. No. | Subject Code | Title of the Subject | Teaching Dept. | Teaching Hrs / Week | | Examination | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Duration (Hrs) | Marks | | |
| | | | | | | | IA | Theory / Practical | Total |
| 1 | 06EE61 | Power System Analysis and Stability | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 2 | 06EE62 | Switchgear & Protection | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 3 | 06EE63 | Electrical Machine Design | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 4 | 06EE64 | Digital Signal Processing | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 5 | 06EE65 | Electrical Drawing and CAD | E&EE | 4 | | 3 | 25 | 100 | 125 |
| 6 | 06EE66x | **Elective-I (Group A)** | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 7 | 06EEL67 | D.C. Machines and Synchronous Machine Laboratory | E&EE | - | 3 | 3 | 25 | 50 | 75 |
| 8 | 06EEL68 | Control Systems Laboratory | E&EE | - | 3 | 3 | 25 | 50 | 75 |
| **TOTAL** | | | | **24** | **06** | **24** | **200** | **700** | **900** |

**Elective-I (Group A)**

06EE661 - Network Synthesis and Active Filter Design
06EE662 - Advanced Power Electronics
06EE663 - Electronic Instrumentation
06EE664 - Intellectual Property Rights
06EE665 - Object Oriented Programming using C++
06EE666 - Fuzzy Logic
06EE667 - Artificial Neural Network

**SCHEME OF TEACHING AND EXAMINATION**

**B.E. ELECTRICAL & ELECTRONICS EINGINEERING**

**VII SEMESTER**

| Sl. No. | Subject Code | Title of the Subject | Teaching Dept. | Teaching Hrs / Week | | Examination | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Duration (Hrs) | Marks | | |
| | | | | | | | IA | Theory / Practical | Total |
| 1 | 06EE71 | Computer Techniques in Power System Analysis | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 2 | 06EE72 | Electrical Power Utilization | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 3 | 06EE73 | High Voltage Engineering | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 4 | 06EE74 | Industrial Drives and Applications | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 5 | 06EE75x | **Elective-II (Group B)** | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 6 | 06EE76x | **Elective-III (Group C)** | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 7 | 06EEL77 | Relay and High Voltage Laboratory | E&EE | - | 3 | 3 | 25 | 50 | 75 |
| 8 | 06EEL78 | Power System Simulation Laboratory | E&EE | - | 3 | 3 | 25 | 50 | 75 |
| **TOTAL** | | | | **24** | **06** | **24** | **200** | **700** | **900** |

**Elective-II (Group B)**

06EE751 - Power System Planning
06EE752 - Over Voltages in Power Systems
06EE753 - Testing and Commissioning of Electrical Equipment
06EE754 - Electrical Engineering Materials
06EE755 - Digital System Design using VHDL
06EE756 - Embedded Systems
06EE757 - Reliability Engineering

**Elective-III (Group C)**

06EE761 - Reactive Power Management
06EE762 - Microelectromechanical Systems (MEMS)
06EE763 - Energy Auditing & Demand Side Management
06EE764 - Insulation Engineering
06EE765 - Discrete Control Systems
06EE766 - VLSI Circuits and Design
06EE767 - Operating System



**SCHEME OF TEACHING AND EXAMINATION**

**B.E. ELECTRICAL & ELECTRONICS EINGINEERING**

**VIII SEMESTER**

| Sl. No. | Subject Code | Title of the Subject | Teaching Dept. | Teaching Hrs / Week | | Examination | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Duration (Hrs) | Marks | | |
| | | | | | | | IA | Theory / Practical | Total |
| 1 | 06EE81 | Industrial Management, Electrical Estimation and Economics | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 2 | 06EE82 | Power System Operation and Control | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 3 | 06EE83x | Elective-IV (Group D) | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 4 | 06EE84x | Elective-V (Group E) | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 5 | 06EEP85 | Project Work | E&EE | - | 6 | 3 | 100 | 100 | 200 |
| 6 | 06EES86 | Seminar | E&EE | - | 3 | - | 50 | - | 50 |
| **TOTAL** | | | | **16** | **09** | **15** | **250** | **500** | **750** |

**Elective-IV (Group-D)**

06EE831 - Modern Power System Protection
06EE832 - Electrical Distribution Systems
06EE833 - Operation Research
06EE834 - Programmable Logic Controllers
06EE835 - Software Engineering
06EE836 - Fixable A.C. Transmission Systems (FACTS)
06EE837 - Data communications and Networking

**Elective-V (Group-E)**

06EE841 - Power Systems Dynamics and Stability
06EE842 - Electromagnetic Compatibility
06EE843 - Renewable Energy Sources
06EE844 - HVDC Transmission
06EE845 - Electrical Power Quality
06EE846 - Computer Control of Electrical Drives
06EE847 - Data Base Management Systems (DBMS)

**SCHEME OF TEACHING AND EXAMINATION**

**VII SEMESTER** **B.E. ELECTRICAL & ELECTRONICS EINGINEERING**

| Sl. No. | Subject Code | Title of the Subject | Teaching Dept. | Teaching Hrs / Week | | Examination | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Duration (Hrs) | Marks | | |
| | | | | | | | IA | Theory / Practical | Total |
| 1 | 06EE71 | Computer Techniques in Power System Analysis | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 2 | 06EE72 | Electrical Power Utilization | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 3 | 06EE73 | High Voltage Engineering | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 4 | 06EE74 | Industrial Drives and Applications | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 5 | 06EE75x | Elective-II (Group-B) | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 6 | 06EE76x | Elective-III (Group-C) | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 7 | 06EEL77 | Relay and High Voltage Laboratory | E&EE | - | 3 | 3 | 25 | 50 | 75 |
| 8 | 06EEL78 | Power System Simulation Laboratory | E&EE | - | 3 | 3 | 25 | 50 | 75 |
| **Total** | | | | **24** | **06** | **24** | **200** | **700** | **900** |

| Sl. No. | Elective-II (Group-B) | | Elective -III (Group-C) | |
|---|---|---|---|---|
| | **Sub. Code** | **Subject Title** | **Sub. Code** | **Subject Title** |
| 1 | 06EE751 | Power System Planning | 06EE761 | Reactive Power Management |
| 2 | 06EE752 | Over Voltages in Power Systems | 06EE762 | Microelectromechanical Systems (MEMS) |
| 3 | 06EE753 | Testing and Commissioning of Electrical Equipment | 06EE763 | Energy Auditing and Demand Side Management |
| 4 | 06EE754 | Electrical Engineering Materials | 06EE764 | Insulation Engineering |
| 5 | 06EE755 | Digital System Design using VHDL | 06EE765 | Discrete Control Systems |
| 6 | 06EE756 | Embedded Systems | 06EE766 | VLSI Circuits and Design |
| 7 | 06EE757 | Reliability Engineering | 06EE767 | Operating System |

**SCHEME OF TEACHING AND EXAMINATION**

**VIII SEMESTER** **B.E. ELECTRICAL & ELECTRONICS EINGINEERING**

| Sl. No. | Subject Code | Title of the Subject | Teaching Dept. | Teaching Hrs / Week | | Examination | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Duration (Hrs) | Marks | | |
| | | | | | | | IA | Theory / Practical | Total |
| 1 | 06EE81 | Industrial Management, Electrical Estimation and Economics | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 2 | 06EE82 | Power System Operation and Contro | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 3 | 06EE83x | Elective-IV (Group D) | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 4 | 06EE84x | Elective-V (Group E) | E&EE | 4 | - | 3 | 25 | 100 | 125 |
| 5 | 06EEP85 | Project Work | E&EE | - | 6 | 3 | 100 | 100 | 200 |
| 6 | 06EES86 | Seminar | E&EE | - | 3 | - | 50 | - | 50 |
| **Total** | | | | **16** | **09** | **15** | **250** | **500** | **750** |

| Sl. No. | Elective-IV (Group-D) | | Elective-V (Group-E) | |
|---|---|---|---|---|
| | **Sub. Code** | **Subject Title** | **Sub. Code** | **Subject Title** |
| 1 | 06EE831 | Modern Power System Protection | 06EE841 | Power Systems Dynamics and Stability |
| 2 | 06EE832 | Electrical Distribution Systems | 06EE842 | Electromagnetic Compatibility |
| 3 | 06EE833 | Operation Research | 06EE843 | Renewable Energy Sources |
| 4 | 06EE834 | Programmable Logic Controllers | 06EE844 | HVDC Transmission |
| 5 | 06EE835 | Software Engineering | 06EE845 | Electrical Power Quality |
| 6 | 06EE836 | Fixable A.C. Transmission Systems (FACTS) | 06EE846 | Computer Control of Electrical Drives |
| 7 | 06EE837 | Data communications and Networking | 06EE847 | Data Base Management Systems (DBMS) |

**V SEMESTER**

**MANAGEMENT AND ENTREPRENEURSHIP**

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06AL51** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

**PART - A**

**UNIT - 1**

**MANAGEMENT:** Introduction- meaning nature & characteristic of management, scope & functional areas of management. Management as a science, art or profession, management and Administration, Role of management, levels of management, Development of management thought – early management approaches – modern management and approaches

**7 Hours**

**UNIT - 2**

**PLANNING:** Nature, Importance and purpose of planning process, objectives, types of plans (meaning only), decision – making, importance of planning, steps in planning and planning premises, Hierarchy of plans

**6 Hours**

**UNIT - 3**

**ORGANIZING AND STAFFING:** Nature and purpose of organization, principles of organization, Types of organization – Departmentation – committees – centralization v/s decentralization of authority and responsibility, span of control- MBO and MBE (meaning only), nature and importance of staffing, process of selection and recruitment (in brief)

**6 Hours**

**UNIT - 4**

**DIRECTING & CONTROLLING**: Meaning and nature of directing, leadership styles, motivation theories, communication- meaning and importance, co-ordination, meaning and importance, techniques of co-ordination, Meaning and steps in controlling, essentials of a sound control system, methods of establishing control (in brief)

**7 Hours**

**PART - B**

**UNIT - 5**

**ENTREPRENEUR:** Meaning of entrepreneur, evaluation of the concept, function of an entrepreneur types of entrepreneur, evolution of entrepreneurship, development of entrepreneurship, stages in entrepreneurial

process, role of entrepreneurs in economic development entrepreneurship in India, entrepreneurship - its barriers

**6 Hours**

**UNIT - 6**

**SMALL SCALE INDUSTRY:** Definition, characteristics, need and rationale, objectives, scope, role of SSI in economic development, advantages of SSI, steps to start an SSI – Govt policy towards SSI, different policies of SSI, Govt support for SSI during 5 year plans. Impact of liberalization, privatization, globalization on SSI, effect of WTO/ GATT, supporting agencies of Govt for SSI, meaning; nature of support, objectives, and functions, types of help, ancillary industry and tiny industry (Definition only)

**7 Hours**

**UNIT - 7**

**INSTITUTIONAL SUPPORT:** Different Schemes, TECKSOK, KIADB, KSSIDC, KSIMC, DIC single window Agency SISI, NSIC, SIDBI, KSFC

**6 Hours**

**UNIT - 8**

**PREPARATION OF PROJECT-**Meaning of Project; Project Identification Project Selection Project Report, Need and significance of Report, Contents, Formulation Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report, Project Appraisal, Identification of Business Opportunities. Market Feasibility Study, Technical Feasibility study, Financial Feasibility Study & Social Feasibility study.

**7 Hours**

**TEXT BOOKS:**


1. **Principles of Management** - PC Tripati, P N Reddy,–THM Hill,
2. **Dynamics of Entrepreneurial Development & Management** - Vasant Desai Himalaya Publishing House –
3. **Entrepreneurship Development** – small Business Enterprises Poornima M Charanthmath Pearson Education – 2005


**REFERENCE BOOKS**:


1. **Management Fundamentals** - Robert Lusier,– Concepts, Application, Skill Development" Thomson
2. Entrepreneurship Development - S S Khanka S Chand & Co
3. **Management** - Stephan Robbins Pearson Education/PHI 17th Edition 2003.

## SIGNALS AND SYSTEMS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE52** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION-**Definitions of signals and a system, classification of signals, basic operations on signals. elementary signals viewed as interconnections of operations, properties of systems.

**10 Hours**

**UNIT - 2**

**TIME – DOMAIN REPRESENTATIONS FOR LTI SYSTEMS-** Convolution, impulse response, properties, solution of differential and difference equations, block diagram representation.

**10 Hours**

**UNIT - 3**

**FOURIER REPRESENTATION OF PERIODIC SIGNALS-** Introduction, Fourier representation of continuous-time periodic signals (FS), properties of continuous-time Fourier series (excluding derivation of defining equations for CTFS), Fourier representation of discrete-time periodic signals, properties of discrete-time Fourier series (DTFS)

**8 Hours**

### PART - B

**UNIT - 4**

**THE CONTINUOUS-TIME FOURIER TRANSFORM-**Representation of a periodic signals: continuous-time Fourier transform (FT), Properties of continuous-time Fourier transform

**4 Hours**

**UNIT - 5**

**THE DISCRETE-TIME FOURIER TRANSFORM-**Representations of periodic signals: The discrete-time Fourier transform (DTFT), Properties of DTFT.

**4 Hours**

**UNIT - 6**

**APPLICATION OF FOURIER REPRESENTATIONS-**Frequency response of LTI systems, solution of differential and difference equations using system function, sampling of continuous time signals and signal reconstruction(only low pass).

**8 Hours**

**UNIT - 7**

**Z- TRANSFORMS-**Introduction, Z-transform, properties of ROC properties of Z-transforms, inversion of Z-transforms methods - power series and partial expansion, Transforms analysis of LTI systems, transfer function, stability and causality, unilateral Z-transform and its application to solve difference equations

**8 Hours**

**TEXT BOOKS:**

1. **Signals and Systems-** Simon Haykin and Barry Van Veen, John Wiley & Sons, 2001. Reprint 2002.
2. **Signals and Systems**- Hsuetal Schaums Outline Series, TMH.

**REFERENCE BOOKS:**

1. **Signals and Systems Analysis of signals through linear systems**- Michel J Roberts, THM, 2003.
2. **Signals and Systems**- Alan V Oppenheim, Alan S. Willsky and S. Hamid Nawab- Pearson Education Asia, 2nd edition, 1997. Indian Reprint 2002.

## TRANSMISSION AND DISTRIBUTION

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE53** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**TYPICAL TRANSMISSION & DISTRIBUTION SYSTEMS SCHEME**- Standard voltages for transmission. Advantage of high voltage transmission. Feeders, distributors & service mains.

**5 Hours**

**UNIT - 2**

**OVERHEAD TRANSMISSION LINES-** sag calculation in conductors a) suspended on level supports b) support at different levels. Effect of wind & ice tension & sag at erection. Stringing chart

**5 Hours**

**UNIT - 3**

**CORONA**- Phenomena, expression for disputative & visual critical voltages & corona power loss

**4 Hours**

**UNIT - 4**

**INSULATORS**- Types, potential distribution over a string of suspension insulators. String efficiency & methods of increasing strings efficiency, testing of insulators.

**6 Hours**

**UNIT - 5**

**UNDERGROUND CABLES-** Types, material used, insulation resistance, thermal rating of cables, charging current, grading of cables, capacitance grading & inter sheath grading, testing of cables.

**6 Hours**

**PART - B**

**UNIT - 6**

**Line parameters**: calculation of inductance of single phase, 3phase lines with equilateral & unsymmetrical spacing. Inductance of composite conductor lines. Capacitance-calculation for two wires & three phase lines, capacitance calculation for two wire three-phase line with equilateral & unsymmetrical spacing.

**10 Hours**

**UNIT - 7**

**Performance of power transmission lines-** Short tr.-lines, medium tr.-lines, nominal T method, end condenser method, π method and long transmission lines, ABCD constants of transmission lines, Power flow through lines, P-V & Q-V coupling.

**10 Hours**

**UNIT - 8**

**Distribution-** radial & ring main systems, ac to dc distribution: calculation for concentrated loads and uniform loading

**6 Hours**

**TEXT BOOKS:**

1. **A Course in Electrical Power-** Soni Gupta & Bhatnaagar, Dhanpat Rai & Sons (New Delhi)
2. **Electrical Power Systems**- C. L. Wadhwa Wiley Eastern.

**REFERENCE BOOKS:**

1. **Elements of Power System Analysis**- W.D. Stevenson, Mc. Graw - Hill. Comp. Ltd.
2. **Electric power generation Transmission & Distribution**- S. M. Singh, PHI, 2007.
3. **Transmission & Distribution Hand Book** - Westing House Corporation.
4. **Electrical Power-** Dr. S. L. Uppal, Khanna Publications
5. **Electrical Power-** J.B Gupta,

## D.C. MACHINES AND SYNCHRONOUS MACHINES

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE54** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**DC GENERATOR**-Classification of DC generator, types of armature winding, EMF equation, armature reaction, commutation, No load & load characteristics, use of interlopes & compensating winding (only qualitative treatment).

**8 Hours**

**UNIT - 2**

**DC Motors-** Classification, Back EMF equation, Torque equation, Characteristics of shunt, series & compound motors, speed control of shunt & series compound motors, losses in DC machines both generator and motor

**9 Hours**

**UNIT - 3**

**LOSSES AND EFFICIENCY**, direct & indirect methods of testing of DC machines, permanent magnet DC motors and brushless DC motors, applications of DC motors, Power flow diagram (all tests to be discussed).

**9 Hours**

### PART - B

**UNIT - 4**

**SYNCHRONOUS MACHINES-** Basic principle of operation, construction of salient & non-salient pole synchronous machines, generated EMF, effect of distribution of winding and use of chorded coils.

**4 Hours**

**UNIT - 5**

**VOLTAGE REGULATION**: Voltage regulation by EMF, MMF, ZPF & ASA method

**6 Hours**

**UNIT - 6**

Synchronizing to infinite bus bars, parallel operation of alternators. Operating characteristics, power angle characteristics excluding armature resistance, operating for fixed input and variable excitation and vice-versa for both generating and motoring modes, V curves of synchronous machines, power

flow equations including armature resistance, capability curves of synchronous generators hunting in synchronous machines, damper winding starting methods for hunting in synchronous machines.

**12 Hours**

**UNIT - 7**

Salient pole synchronous machines, two-reaction theory, power angle diagram, reluctance power, slip test

**4 Hours**

**TEXT BOOKS:**

1. **Performance & Design of Alternating Current machines**, M. G. Say, CBS publishers.
2. **Performance & Design of DC machines** A.E Clayton & Hancock ELBS Publication.
3. **Electrical Machines** Ashfaq Hussain, Dhanpat Rai Publications 2003 Edition.

**REFERENCE BOOKS:**

1. **Electrical machines**-Nagarath & DP Kothari, 2nd edition, TMH.
2. **Theory of alternating** -current machines. Alexander Langsdorf,
3. **Electrical machinery**- P.S Bhimbra, Khanna Publishers.

## MODERN CONTROL THEORY

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE55** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

STATE VARIABLE ANALYSIS AND DESIGN: Introduction, concept of state, state variables and state model, state modeling of linear systems, linearization of state equations.

**5 Hours**

**UNIT - 2**

State space representation using physical variables, phase variables & canonical variables

**5 Hours**

**UNIT - 3**

Derivation of transfer function from state model, digitalization, Eigen values, Eigen vectors, generalized Eigen vectors.

**6 Hours**

**UNIT - 4**

Solution of state equation, state transition matrix and its properties, computation using Laplace transformation, power series method, Cayley-Hamilton method, concept of controllability & observability, methods of determining the same

**10 Hours**

**PART - B**

**UNIT - 5**

POLE PLACEMENT TECHNIQUES: stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement, state regulator design, and design of state observer, Controllers- P, PI, PID.

**10 Hours**

**UNIT - 6**

Non-linear systems: Introduction, behavior of non-linear system, common physical non linearity-saturation, friction, backlash, dead zone, relay, multi variable non-linearity.

**3 Hours**

U**NIT - 7**

Phase plane method, singular points, stability of nonlinear system, limit cycles, construction of phase trajectories.

**7 Hours**

**UNIT - 8**

Liapunov stability criteria, Liapunov functions, direct method of Liapunov & the linear system, Hurwitz criterion & Liapunov's direct method, construction of Liapunov functions for nonlinear system by Krasvskii's method.

**6 Hours**

**TEXT BOOKS:**


1. **Digital control & state variable methods-** M. Gopal - 2nd edition, THM Hill 2003
2. **Control system Engineering-** I. J. Nagarath & M. Gopal, - 3rd edition, New Age International (P) Ltd.


**REFERENCE BOOKS:**


1. **State Space Analysis of Control Systems-** Katsuhiko Ogata - Prentice Hall Inc
2. **Automatic Control Systems-** Benjamin C. Kuo & Farid Golnaraghi, 8th edition, John Wiley & Sons 2003.
3. **Modern Control Engineering**- Katsuhiko Ogata- PHI 2003
4. **Control Engineering theory and practice-** M. N. Bandyapadhyay PHI, 2007
5. **Modern control systems**- Dorf & Bishop- Pearson education, 1998

## LINEAR IC'S AND APPLICATIONS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE56** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**OP-AMPS AS AC AMPLIFIER:** Capacitor coupled voltage follower, high Zin capacitor coupled voltage follower, capacitor coupled non-inverting amplifier, high Zin capacitor coupled non-inverting amplifier, capacitor coupled inverting amplifier, setting upper cut off frequency, capacitor coupled difference amplifier, and use of single polarity supply.

**8 Hours**

**UNIT 2**

**OP-AMPS FREQUENCY RESPONSE AND COMPENSATION:** Op amp circuits stability, frequency and phase response, frequency compensating methods ,manufacturer's recommended compensation, op-amp circuit band width, slew rate effects ,stray capacitance effects, load capacitance effects, Zin mod compensation, circuit stability precautions.

**8 Hours**

**UNIT - 3**

**SIGNAL PROCESSING CIRCUITS:** Precision half wave & full wave rectifiers, limiting circuits, clamping circuits, peak detectors, sample &hold circuit.

**6 Hours**

**UNIT - 4**

**OPAMPS AND NONLINEAR CIRCUITS:** Op-amps in switching circuits, crossing detectors, inverting Schmitt trigger circuits, non-inverting Schmitt circuits, astable multivibrator, and monostable multivibrator.

**6 Hours**

### PART - B

**UNIT - 5**

**SIGNAL GENERATOR:** Triangular/rectangular wave generator, waveform generator design, phase shift oscillator, oscillator amplitude stabilization, wein bridge oscillator, signal generators output controllers

**6 Hours**

**UNIT - 6**

**ACTIVE FILTERS:** First and second order high pass and low pass filters, band pass filter, band stop filter.

**6 Hours**

**UNIT - 7**

**SPECIALIZED IC APPLICATIONS:** Universal active filter, switched capacitor filter, phase locked loops, power amplifiers.

**6 Hours**

**UNIT - 8**

**DC VOLTAGE REGULATORS:** Voltage regulators basics, voltage follower regulator adjustable output regulator, precision voltage regulators, and integrated circuit voltage regulators.

**6 Hours**

**TEXT BOOKS:**


1. **Operational amplifiers and linear IC's**– David A Bell, -PHI 2008
2. **Operational amplifiers and linear** - Ramakanth A Gayakwad,-IC's Pearson, 4th edition, 2007.
3. **Operational amplifier and linear integrated circuits** - K.Lal kishore -Pearson education


**REFERENCE BOOKS:**


1. **Operational amplifiers and linear IC's**- Roy & Choudhry, - New age International
2. **Operational amplifiers and linear IC's-** Stanley William D, **-** 4th edition, Pearson Education.


## CIRCUIT SIMULATION & MEASUREMENTS LAB

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EEL57** | IA Marks | : | 25 |
| No. of Practical Hrs./ Week | : | 03 | Exam Hours | : | 03 |
| Total No. of Practical Hrs. | : | 42 | Exam Marks | : | 50 |

1. Measurement of low resistance using Kelvin's double bridge.
2. Measurement of cable insulation and earth resistance using Meggar
3. Measurement of inductance using Maxwell Inductance-Capacitance bridge & determination of Q-factor
4. Measurement of capacitance using De-Sauty's bridge & determination of dissipation factor.
5. Determination of ratio & phase angle error in CT and PT.
6. Adjustment & calibration of 1-phase energy meter.
7. Measurement of active and reactive power in balanced 3-phase circuit using two-watt meter method.
8. a) Inverting, non-inverting & scale changing of signals using op -amps
   b) RC phase shift oscillator using op amps (Both using simulation package)

9. RC coupled amplifier-frequency response for variation of bias & coupling using simulation package
10. Rectifier circuits-Bridge rectifier, diode clipping & clamping circuits using simulation package.
11. Schmitt –trigger- inverting and non-inverting.
12. Signal generator- triangular, saw tooth and rectangular wave generation

## TRANSFORMERS AND INDUCTION MACHINES LAB

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EEL58** | IA Marks | : | 25 |
| No. of Practical Hrs./ Week | : | 03 | Exam Hours | : | 03 |
| Total No. of Practical Hrs. | : | 42 | Exam Marks | : | 50 |

1. OC, SC test on 1- phase transformer: predetermination of efficiency & regulation. Experimental determination of Equivalent circuit constants and calculation of efficiency and regulation to be done to correlate results obtained earlier.
2. Sumpner's test.
3. Parallel operation of two dissimilar (different KVA) 1-phase transformers. Preferably the experiment to be conducted on two dissimilar transformers.
4. Polarity test & connection of 3 single phase transformers in star – delta and determination of efficiency & regulation – for balanced direct loading for UPF. Polarity test to be conducted on both AC and DC supply.
5. Scott connection- for balanced and unbalanced two phases UPF loads.
6. Load test on 3-phase induction motor- performance evaluation (Torque-speed, HP- efficiency, HP-PF, slip-HP).
7. Circle diagram of 3-phase induction Motor- performance evaluation.
8. Draw the equivalent circuit diagram of a 3-phase I.M after obtaining its circle diagram after conducting OC and SC test. from equivalent circuit, obtain the machine performance parameters.
9. Speed control of 3-phase induction motor by rotor resistance control only (for two different values of rotor resistance).
10. Load test on- induction generator.
11. Load test on 1 phase induction motor.
12. NL and SC test on 1-phase Induction motor.

## VI SEMESTER

## POWER SYSTEM ANALYSIS AND STABILITY

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE61** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**REPRESENTATION OF POWER SYSTEM COMPONENTS:** Circuit models of Transmission line, Synchronous machines, Transformer and load. One line diagram, impedance and reactance diagram. Per unit system, per unit impedance Diagram of power system, Y-bus by inspection method.

**8 Hours**

**UNIT - 2**

**SYMMETRICAL 3 - PHASE FAULTS**: Transients on a transmission line, Short-Circuit currents and the reactance of synchronous machines on load and on no load.

**6 Hours**

**UNIT - 3 & 4**

**SYMMETRICAL COMPONENTS:** Analysis of unbalanced load against balanced Three-phase supply, neutral shift, Resolution of unbalanced phasors into their symmetrical components, Phase shift of symmetrical components in star-delta transformer bank, Power in terms of symmetrical components, Analysis of balanced and unbalanced loads against unbalanced 3 phase supply, Sequence impedances and networks of power system elements (alternator, transformer and transmission line) Sequence networks of power systems.

**12 Hours**

### PART - B

**UNIT - 5 & 6**

**UNSYMMETRICAL FAULTS:** L-G, L-L, L-L-G faults on an unbalanced alternator with and without fault impedance. Unsymmetrical faults on a power system with and without fault impedance. Open conductor faults in power system.

**14 Hours**

**UNIT - 7 & 8**

**STABILITY STUDIES:** Steady state and transient stability. Rotor dynamics and the swing equation. Power angle equation for salient and non-salient pole machines, Equal area criterion for transient stability evaluation and its applications.

**12 Hours**

**TEXT BOOKS:**

1. **Elements of Power System Analysis**- W.D.Stevenson, -TMH,
2. **Modern Power System Analysis**-.I. J. Nagrath and D.P.Kothari- TMH, New Delhi

**REFERENCE BOOKS:**

1. **Power System Analysis**- Hadi Sadat- TMH
2. **Power system Analysis**- R.Bergen, and Vijay Vittal- Pearson publications, second edition.
3. **Computer Aided Power system analysis**- G.L., Kusic- PHI.
4. **Power System Analysis**- W.D.Stevenson & Grainger- TMH

## SWITCHGEAR AND PROTECTION

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE62** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**SWITCHES AND FUSES:** Isolating switch, load breaking switch, Fuse law, cut -off characteristics,: Time current characteristics, fuse material, HRC fuse, liquid fuse, Application of fuse

**4 Hours**

**UNIT - 2**

**PRINCIPLES OF CIRCUIT BREAKERS:** Principles of AC Circuit breaking, Principles of DC Circuit breaking, problems encountered in DC breaking, Initiation of arc, maintenance of arc, Arc interruption - high resistance and low resistance interruption, Arc interruption theories – slepian's theory and energy balance theory, Re striking voltage, recovery voltage, Rate of rise of Re striking voltage, current chopping, capacitance switching, resistance switching, Rating of Circuit breakers.

**10 Hours**

**UNIT - 3 & 4**

**CIRCUITS BREAKERS:** Air Circuit breakers – Air break and Air blast Circuit breakers, oil Circuit breakers - Single break, double break, minimum OCB SF6 breaker - Preparation of SF6 gas, Puffer and non Puffer type of SF6 breakers.

**VACUUM CIRCUIT BREAKERS -** Construction, principle of operation, advantages and disadvantages of different types of Circuit breakers, Testing of Circuit breakers, Unit testing, synthetic testing short circuit test lay out

**12 Hours**

## PART - B

**UNIT - 5**

**PROTECTIVE RELAYING:** Requirement of Protective Relaying, Zones of protection, primary and backup protection, Essential qualities of Protective Relaying, Classification of Protective Relays

**4 Hours**

**UNIT - 6**

**INDUCTION TYPE RELAY:** Non-directional and directional over current relays, IDMT and Directional characteristics. Differential relay – Principle of operation, percentage differential relay, bias characteristics, distance relay – Three stepped distance protection, Impedance relay, Reactance relay, Mho relay, Buchholz relay, Negative Sequence relay, Microprocessor based over current relay – block diagram approach.

**10 Hours**

**UNIT - 7 & 8**

**PROTECTION SCHEMES:** Generator Protection - Merz price protection, prime mover faults, stator and rotor faults, protection against abnormal conditions – unbalanced loading, loss of excitation, over speeding.

Transformer Protection - Differential protection, differential relay with harmonic restraint, Inter turn faults Induction motor protection - protection against electrical faults such as phase fault, ground fault, and abnormal operating conditions such as single phasing, phase reversal, over load

**12 Hours**

**TEXT BOOKS:**


1. **Switchgear & Protection**- Sunil S.Rao -Khanna Publishers.
2. **Power System Protection & Switchgear**- Badriram & Viswa Kharma -TMH.
3. **Fundamentals of Power System protection**- Y G. Painthankar and S R Bhide-PHI publication, 2007.


**REFERENCE BOOKS:**


1. **A Course in Electrical Power**- Soni, Gupta & Bhatnagar-Dhanapatirai. Publication -
2. **Power System Protection & Switchgear**- Ravindarnath & Chandra -New age Publications.
3. **Electrical Power-** Dr S. L. Uppal- Khanna Publishers.

## ELECTRICAL MACHINE DESIGN

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE63** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**PRINCIPLES OF ELECTRICAL MACHINE DESIGN:** Introduction, considerations for the design of electrical machines, limitations. Different types of materials and insulators used in electrical machines.

**4 Hours**

**UNIT - 2**

**DESIGN OF DC MACHINES:** Output equation, choice of specific loadings and choice of number of poles, design of Main dimensions of the DC machines, Design of armature slot dimensions, commutators and brushes, magnetic circuit - estimation of ampere turns, design of yoke and pole, field windings – shunt, series and inter poles.

**10 Hours**

**UNIT - 3 & 4**

**DESIGN OF TRANSFORMERS** (Single phase and three phase)**:** Output equation for single phase and three phase transformer, choice of specific loadings, expression for volts/turn, determination of main dimensions of the core, types of windings and estimation of number of turns and cross sectional area of Primary and secondary coils, estimation of no load current, expression for leakage reactance and voltage regulation. Design of tank and cooling tubes (round and rectangular)

**12 Hours**

### PART - B

**UNIT - 5 & 6**

**DESIGN OF INDUCTION MOTORS:** Output equation, Choice of specific loadings, main dimensions of three phase induction motor, Stator winding design, choice of length of the air gap, estimation of number of slots for the squirrel cage rotor, design of Rotor bars and end ring, design of Slip ring induction motor, estimation of No load current, leakage reactance, and circle diagram

**14 Hours**

**UNIT - 7 & 8**

**DESIGN OF SYNCHRONOUS MACHINES:** Output equation, Choice of specific loadings, short circuit ratio, design of main dimensions, armature slots and windings, slot details for the stator of salient and non salient pole

synchronous machines. Design of rotor of salient pole synchronous machines, magnetic circuits, dimensions of the pole body, design of the field winding, and design of rotor of non-salient pole machine

**12 Hours**

**TEXT BOOKS:**

1. **A Course In Electrical Machine Design**"- A.K.Sawhney
2. **Design Of Electrical Machines**- V. N. Mittle- 4/e edition

**REFERENCE BOOKS:**

1. **Performance And Design Of AC Machine**s- M.G.Say
2. **Principles Of Electrical Machine Design-** R.K.Aggarwal
3. **Design Data Handbook-** Sanmug Sundarm

## DIGITAL SIGNAL PROCESSING

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE64** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1 & 2**

**Discrete Fourier Transforms:** Definitions, properties-linearity, shift, symmetry etc, circular convolution – periodic convolution, use of tabular arrays, circular arrays, stock hams's methods, linear convolution – two finite duration sequence, one finite & one infinite duration, overlap add and save methods**.**

**12 Hours**

**UNIT - 3**

**FAST FOURIER TRANSFORMS ALGORITHMS:** Introduction, decimation in time algorithm, first decomposition, number of computations, continuation of decomposition, number of multiplication, computational efficiency, decimation in frequency algorithms, decomposition for 'N<=9' a composite number inverse FFT.

**8 Hours**

**UNIT - 4**

**REALIZATION OF DIGITAL SYSTEMS:** Introduction, block diagrams and SFGs, matrix representation, realization of IIR systems- direct form, parallel form, ladder structures for equal degree polynomial, realization of FIR systems – direct form, cascade form, linear phase realization.

**8 Hours**

## PART - B

**UNIT - 5**

**DESIGN OF IIR DIGITAL FILTERS:** Introduction, impulse invariant & bilinear transformations, all pole analog filters- Butterworth & chebyshev, design of digital Butterworth & chebyshev, frequency transformations

**12 Hours**

**UNIT - 6**

**DESIGN OF FIR DIGITAL FILTERS:** Introduction, windowing, rectangular, modified rectangular, Hamming, Hanning, blackman window(excluding Kaiser window), frequency sampling techniques.

**8 Hours**

**UNIT - 7**

**DSP PROCESSORS TMS FAMILY:** Architecture & features, modes and architecture.

**4 Hours**

**TEXT BOOKS:**

1. **Digital Signal Processing Principle,** Algorithm & application- Proakis, -Pearson education/PHI
2. **Introduction To Digital Signal Processing**- Johnny R. Johnson- PHI
3. **Digital Signal Processing**- Li – Tan - Ist edition, Elsevier, 2008
4. **Digital Signal Processing-** Sanjeet. K. Mitra –TMH

**REFERENCE BOOKS:**

1. **Discrete Time Signal Processing** – Openheim - person education/PHI
2. **Digital Signal Processing-** Salivatanan Vallarajgnanpriya-TMH.
3. **Digital Signal Processing**- Ifeachor Emmauel- Pearson education.
4. **Digital Signal Processing**- Steven .W. Smith -Elsevier, 2006.

## ELECTRICAL DRAWING AND CAD

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE65** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

## PART - A

1) Single Line Diagrams of generating stations and substations, layout of power plants – Hydel, Thermal & Nuclear.

**6 Hours**

2) Electrical Machine Assembly Drawing using Design Data and sketches

a) Transformer: Assembly and Sectional views of single phase and three phase Core and Shell Types.
b) DC Machine: Assembly and Sectional views of yoke, field systems, armature and commutator of DC machine dealt separately.
c) Alternator: Assembly and Sectional views of Stator and Rotor dealt separately

**20 Hours**

**PART - B**

3) Winding Diagram:
   a) Developed Winding Diagram for DC machines: Simplex and duplex, Lap and Wave Single and Double Layer.
   b) Developed winding diagram for AC machines:
   c) Integral slot single layer and double layer full-pitched lap and wave winding.
   d) Integral slot single layer and double layer fractional pitched lap and wave winding. Fractional slot lap and wave winding

**14 Hours**

4) Study of auto CAD graphics package. Exercises on computer aided electrical drawing - single line diagram for a typical substation, simplex single layer, lap and wave DC armature winding, sectional views of single-phase core type transformer.

**12 Hours**

**TEXT BOOKS:**


1. **Electrical Drafting -**Devalapur, S. F., Eastern Book Promoters, Belgaum, 2006.
2. **Electrical Engineering Drawing -**Bhattacharya, S. K., Wiley Eastern Ltd (Part A).
3. **Introduction to Auto CAD 2000-**Mark Dix Paul Riley, Pearson Education.


**REFERENCE BOOKS:**


1. **Electrical Engineering Drawing -**Naranga, K. L., Satya Prakashan, ND Publications.
2. **Principles of Interactive Computer Graphics -**Newman, and Sporule, TMH Publishers.
3. **Teach yourself Auto- CAD –**Gibbs.
4. **Auto-CAD -**Cohn, TMH.

## ELECTIVE-I (GROUP A)

## NETWORK SYNTHESIS & ACTIVE FILTER DESIGN

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE661** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1, 2 & 3**

**ELEMENTS OF PASSIVE NETWORK SYNTHESIS:** Hurwitz polynomials, LC admittances, LC ladders, realization & Foster test for Hurwitz, LC- RC transformation and RC synthesis, L ladder N/W & its transmission poles, transmission zeros of LC&RC ladders dual of ladder network & OF RC ladder, positive real functions, synthesis of RLC N/W by Darlington method, determination of driving point impedance from its real part.

**18 Hours**

**UNIT - 4**

**IMAGE IMPEDANCE:** Image impedances, L sections- Relation to symmetrical T and π networks, propagation constant for iterative networks, propagation constant for image terminated networks

**9 Hours**

### PART - B

**UNIT - 5**

**CLASSICAL FITTERS**: classical filters & low pass prototype, m derived filters, impedance & frequency scaling frequency transformation: high pass & band pass filters

**9 Hours**

**UNIT - 6, 7 & 8**

**MODERN FILTER THEORY & ACTIVE RC FILTERS**: Approximation to ideal LP filter, maximally flat magnitude function, Butterworth functions & synthesis, chebychev's filter, operations using OPAMP configuration, Active RC networks, and low pass active filters, GC-CG transformations, parameter variations & sensitivity consideration for active RC circuits

**16 Hours**

**TEXT BOOKS**:


1. **Introduction to Modern Network Synthesis** - E. V. Vanvalkenburg, Wiley Eastern ltd.
2. **Network Analysis & Synthesis** - Franklin.F .Kuo 2/e Wiley International Edition.

**REFERENCE BOOKS**:


1. **Networks & Systems** -- D. Roy Choudhury, new age international.
2. **Circuit Theory** - TSKV Iyer 1996, Tata McGraw-Hill publications.
3. **Analog Signal Processing With Laplace Transform & Active Filter Design**, Meador, Thomson learning.
4. **Analog Filter Design** by Vanvalkenberg


## ADVANCED POWER ELECTRONICS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE662** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1 & 2**

**DC-DC SWITCHED MODE CONVERTERS:** Topologies, Buck, boost, buck-boost, and Cuk converters, Full Bridge DC-DC converter-detailed theory, working principles, modes of operation, with detailed circuits and wave forms, applications, merits and demerits

**16 Hours**

**UNIT - 3 & 4**

**DC-AC SWITCHED MODE INVERTERS:** Single-phase inverter, three phase inverters. SPWM inverter, detailed theory, working principles, modes of operation with circuit analysis, applications, merits and demerits, problems based on input output voltage relationship.

**10 Hours**

### PART - B

**UNIT - 5**

**RESONANT CONVERTERS**: Zero voltage and zero current switching, resonant switch converters, and comparison with hard switching, switching locus diagrams, and working principle

**6 Hours**

**UNIT - 6, 7 & 8**

**HIGH FREQUENCY INDUCTOR AND TRANSFORMERS**: Design principles, definitions, comparison with conventional design and problems.

**10 Hours**

**POWER SUPPLIES**: Introduction, DC power supplies: fly back converter, forward converter, push-pull converter, half bridge converter, full bridge converter, AC power supplies: switched mode ac power supplies, resonant ac power supplies, bidirectional ac power supplies.

**10 Hours**

**TEXT BOOKS**:


1. **Power Electronics-** converters, application & design**-** Mohan N, Undeland T.M., Robins, W.P-John Wiley 1989
2. **Power Electronics-Circuits, Devices,** Applications**-** Rashid M.H.- 3rd Edition, Prentice Hall India, 2008.
3. **Power Electronics and A.C. Drives-** Bose B.K.-Prentice Hail 1986.
4. **Digital Power Electronics And Applications-** Muhammad Rashid. first edition, 2005, Elsevier.


## ELECTRONIC INSTRUMENTATION

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE663** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

Introduction, Performance, characteristics, static characteristics, error in measurement, source of error, type of error, dynamic characteristics.

**4 Hours**

**UNIT - 2**

Transistor voltmeter, micro voltmeter, solid state voltmeter, Differential v voltmeters, RMS voltmeter, RMS meter, Ohm meter, multimeter, Digital voltmeter, Dual slope integrating type and integrating type DBM.

**8 Hours**

**UNIT - 3**

Digital voltmeter, frequency meter, measurement of time, frequency digital tachometer, phase meter, capacitance meter, and μP based instruments.

**8 Hours**

**UNIT - 4**

Strip chart recorder, galvanometer type, null type circulars, chart recorder, x-y recorder

**6 Hours**

### PART - B

**UNIT - 5**

Fixed frequency AF Oscillator, Variable AFO, standard signal generator, AF Sine & square wave generator, function generator, and square & pulse generator.

**8 Hours**

**UNIT - 6**

Output power meters, field strength meter, stroboscope phase meter, direct reading impedance meters, Q meter, LC or bridge R X meters, automatic bridges, transistor tester, and megger.

**8 Hours**

**UNIT - 7**

Electrical transducers, differential output transducers, LVDT, pressure inductive transducers, capacitive transducers.

**6 Hours**

**UNIT - 8**

Digital display system and indicators, classification of displays, display devices, LEDs, LCDs and other displays.

**4 Hours**

**TEXT BOOKS:**

1. **Electronic Instrumentation-** H.S.Kalsi-Tata McGraw-Hill Publishing Company Limited. New Delhi, 9th reprint 2000
2. **Modern Electronic Instrumentation & Measurement Technique**- D. Heifric, William. D. Cooper - PHI

**REFERENCE BOOKS:**

1. **Elements of Electronic Instrumentations & Measurement-** Carr Joseph - 3/e Pearson Education.
2. **Electronic Instrumentations**- - BELL, PHI publications.

## INTELLECTUAL PROPERTY RIGHTS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE664** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

**PART - A**

**UNIT - 1 & 2**

**BASIC PRINCIPLES OF IPR LAWS**: Introduction, concept of property, Mar'x theory of property, constitutional aspects of intellectual property, Basic principles of patent laws ; Historical background in UK, US and India Basis for IP Protection, Criteria for patentability; Novelty Utility and Inventive step, Non – obviousness, Non patentable invention.

**12 Hours**

**UNIT - 3 & 4**

**PATENT APPLICATIONS PROCEDURE AND DRAFTING**: Specification, priority date publication of application, Examination of

application, opposition of gratis and sealing of patents, patent specification, kinds of patent specifications parts of the complete specifications Claims Patentable aspects of the invention to be considered in the specification, Novelty inventiveness manner of manufacture utility and usefulness of invention restriction on patentability case studies.

**12 Hours**

**PART - B**

**UNIT - 5**

**UNDERSTANDING COPYRIGHT LAW:** Evolution of copyright law in India, Justifications. Subject matter of copyright, Terms of protection, concepts – originality/novelty idea expression, fixation and fair use, Copyrights in software protection, infringement of copyright and acquisition in Indian context.

**10 Hours**

**UNIT - 6**

**TRADE MARK:** Introduction, Justification, concepts subject matter acquisition Implication and benefit of registration Terms of protection Geographical indication of goods Infringements of trademark

**8 Hours**

**UNIT - 7 & 8**

**INDUSTRIAL DESIGN:** Introduction, Justification, Subject matter of design law Definition, Excluded subject matter Law relating to industrial design and registration in India, Infringement of design rights semiconductor topography design rights

**10 Hours**

**TEXT BOOKS:**

1. **Basic Principles and Acquisition of IPR-** T Ramakrishna-CIPRA NLSIU, Bangalore 2003.
2. **Ownership And Enforcement Of Intellectual Property Rights**- T Ramakrishna,- CIPRA NLSIU Bangalore 2003.
3. **Law Relating To Patents, Trademark, Design, Geographical Indicators**- Wadhera BL-Universal Law Press 2000.

**REFERENCE BOOKS:**

1. **Intellectual property law**- P Narayan- 3rd edition, Estern Law House, 2001
2. **Intellectual property-** David Bainbridge- 5th edition, Indian reprint 2003, Pearson Education.
3. **World Intellectual Property Organizations** (WIPO) Handbook/ Notes

## OBJECTED ORIENTED PROGRAMMING USING C++

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE665** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**PRINCIPLES OF OBJECT-ORIENTED PROGRAMMING**: Review of Procedure Oriented Programming, Basic concepts of Object Oriented Programming – Object, Class, Encapsulation, Inheritance, Polymorphism; Benefits of OOPs, Applications of OOP.

**4 Hours**

**UNIT - 2**

**THE BASIC LANGUAGE C++:** A comparison of C and C++, Structure of C++ program with Class, Preprocessor directives, C++ Statements – Input/Output, Comments, Tokens, Keywords, Identifiers, Constants, Data types – string, pointer, reference, boole, enumeration, array, complex number; typedef names, type compatibility, type conversion, qualifier – const, volatile; Operators in C++, Operator Precedence and Operator Overloading; C++ expressions – New and Delete.

**6 Hours**

**UNIT - 3**

**FUNCTIONS IN C++:** Introduction, The main() function, Function prototype, Call by reference, Return by reference, Inline functions, Default arguments, const Arguments, Function Overloading, Friend and Virtual functions, pointer to functions.

**8 hours**

**UNIT - 4**

**CLASSES AND OBJECTS**: Introduction – declaration and definition of a Class, defining member functions, C++ program with a Class, Making an outside function Inline, Nesting of member functions, Arrays within a class, Static data members, static member functions, Objects – global & local objects, scope & lifetime, memory allocation for objects, dynamically allocated objects, pointers to objects, arrays of objects, function arguments with objects, returning objects; const member functions

**8 Hours**

### PART - B

**UNIT - 5**

**CONSTRUCTORS AND DESTRUCTORS**: Introduction, Constructors, Parameterized Constructors, Multiple constructors in a class, Constructors

with default arguments, Dynamic initialization of objects, Copy constructor, Constructing two-dimensional arrays, const Objects, Destructors.

**4 Hours**

**UNIT - 6**

**OPERATOR OVERLOADING AND TYPE CONVERSION**: Introduction, Defining operator overloading, Overloading unary operators, Overloading binary operators, Overloading binary operators using Friends, Rules for overloading operators, overloading a comma operator, overloading the output operator <<, overloading the input operator>>, Type conversion.

**7 Hours**

**UNIT - 7**

**INHERITANCE**: Introduction, Defining derived classes, Single inheritance, Making a private member Inheritable, Multilevel inheritance, Multiple inheritance, Hierarchical inheritance, Hybrid inheritance, Virtual base classes, Abstract classes, Constructors & Destructors in base & derived classes.

**6 Hours**

**UNIT - 8**

**POINTER, VIRTUAL FUNCTIONS AND POLYMORPHISM**: Introduction, Pointers, Pointers to Objects, this pointer, Pointers to derived classes, type-checking pointers, pointers to members, Virtual functions, Pure virtual functions.

**MANAGING CONSOLE I/O AND FILE I/O**: C++ streams, C++ stream classes, examples of formatted and unformatted I/O operations, Classes for file stream operations, Methods of Opening and Closing a File, Examples of Opening file using constructor open(), file modes (simple programming exercises).

**9 Hours**

**TEXT BOOKS**:

1. **Object Oriented Programming with C++**- Balagurusamy, E. - TMH, 3rd edition, 2007.
2. **C++, The Complete Reference -**Herbert Schildt**,** , TMH, 3rd edition
3. **Standard C++**- 2nd edition, Thomson Learning, Vikas Publishing House.

**REFERENCE BOOKS:**

1. **"The C++ programming language"-**Bjarne Stroustrup, Pearson Education, 3rd edition.
2. **"Objected oriented programming with C++"-**Bhave, Pearson Education.

## FUZZY LOGIC

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE666** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**THE MATHEMATICS OF FUZZY CONTROL:** Fuzzy sets, Properties of fuzzy sets, operation in fuzzy sets, fuzzy relations, the extension principle

**8 Hours**

**UNIT - 2, 3 & 4**

**THEORY OF APPROXIMATE REASONING:** Linguistic variables, Fuzzy proportions, Fuzzy if- then statements, inference rules, compositional rule of inference.

**NON-LINEAR FUZZY CONTROL:** FKBC as a linear transient element, PID like FKBC, sliding mode FKBC, Sugeno FKBC.

**20 Hours**

### PART - B

**UNIT - 5 & 6**

**FUZZY KNOWLEDGE BASED CONTROLLERS (FKBC):** Basic concept structure of FKBC, choice of membership functions, scaling factors, rules, fuzzyfication and defuzzyfication procedures. Simple applications of FKBC (washing machines, traffic regulations, lift control, etc).

**12 Hours**

**UNIT - 7 & 8**

**ADAPTIVE FUZZY CONTROL:** Process performance monitoring, adaption mechanisms, membership functions, tuning using gradient descent and performance criteria. Set organizing controller model based controller.

**12 Hours**

**TEXT BOOKS:**


1. **An Introduction to Fuzzy Control**- D. Diankar, H. Hellendoom and M. Reinfrank- Narosa Publishers India, 1996.
2. **Fuzzy Sets Uncertainty and Information**- G. J. Klir and T. A. Folger- PHI IEEE, 1995.


**REFERENCE BOOKS:**


1. **Essentials of Fuzzy Modeling and Control**- R. R. Yaser and D. P. Filer -John Wiley, 1994.
2. **Fuzzy Logic With Engineering Applications-** Timoty Ross,- McGraw Hill.
3. **Fuzzy Logic Intelligence Control And Information-** Yen- Pearson education.

## ARTIFICIAL NEURAL NETWORK

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE667** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

Introduction, history, structure and function of single neuron, neural net architectures, neural learning, use of neural networks.

**7 Hours**

**UNIT - 2**

Supervised learning, single layer networks, perceptrons, linear separability, perceptron training algorithm, guarantees of success, modifications.

**6 Hours**

**UNIT - 3**

Multiclass networks-I, multilevel discrimination, back propagation, setting parameter values, theoretical results

**6 Hours**

**UNIT - 4**

Accelerating learning process, application, Madaline adaptive multilayer networks.

**7 Hours**

### PART - B

**UNIT - 5**

Prediction networks, radial basis functions, polynomial networks, regularization, unsupervised learning, winner-take-all networks

**7 Hours**

**UNIT - 6**

Learning vector quantizing, counter propagation networks, adaptive resonance theorem, toplogically organized networks, distance based learning, recognition.

**6 Hours**

**UNIT - 7**

Associative models, Hop Field networks, brain state networks, Boltzmann machines, hetero associations.

**7 Hours**

**UNIT - 8**

Optimization using Hopfiled networks, simulated annealing, random search, evolutionary computation.

**6 Hours**

**TEXT BOOKS:**

1. **Elements Of Artificial Neural Networks -**Kishan Mehrotra, C. K. Mohan, Sanjay Ranka, , Penram, 1997
2. **Neural Network Design**- Hagan, Demuth and Beale- Thomson learning, 1996.

**REFERENCE BOOKS:**

1. **Artificial Neural Networks**- R, Schalkoff, - McGraw Hill, 1997.
2. **Introduction To Artificial Neural Systems**- J. Zurada,- Jaico, 2003
3. **Neural Networks -**Haykins, PHI, 1999. Hertz, Krogh, Palmer, Introduction to theory of neural computation, Addison Wesley, 1991.

## DC MACHINE AND SYNCHRONOUS MACHINES LAB

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EEL67** | IA Marks | : | 25 |
| No. of Practical Hrs./ Week | : | 03 | Exam Hours | : | 03 |
| Total No. of Practical Hrs. | : | 42 | Exam Marks | : | 50 |

1. Load characteristics of a D.C. shunt and compound generator. Compound generator
   i) Short shunt-Cumulative and Differential
   (ii) Long shunt-Cumulative and Differential.
2. Load test on a DC motor- determination of speed-torque and HP-efficiency characteristics.
3. Swinburne's Test.
4. Hopkinson's Test.
5. Fields test on series motors.
6. Retardation test- electrical braking method.
7. Speed control of DC motor by armature voltage control and flux control.
8. Ward Leonard method of speed control of D.C. motor.
9. Voltage regulation of an alternator by EMF and MMF method.
10. Voltage regulation of an alternator by ZPF method.
11. Slip test.
12. Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa.
13. V and Inverted V curves of a synchronous motor.

## CONTROL SYSTEMS LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EEL68** | IA Marks | : | 25 |
| No. of Practical Hrs./ Week | : | 03 | Exam Hours | : | 03 |
| Total No. of Practical Hrs. | : | 42 | Exam Marks | : | 50 |

1. Simulation of a typical second order system and determination of step response and evaluation of time- domain specifications
2. (a) To design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response.
   (b) To determine experimentally the transfer function of the lead compensating network.
3. (a) To design RC lag compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response.
   (b) To determine experimentally the transfer function of the lag compensating network.
4. Experiment to draw the frequency response characteristic of a given lag-lead compensating network.
5. To study the effect of P, PI, PD and PID controller on the step response of a feedback control system (using control engineering trainer/process control simulator). Verify the same by simulation.
6. a) Experiment to draw the speed – torque characteristic of a two - phase A.C. servomotor.
   b) Experiment to draw speed torque characteristic of a D.C. servomotor.
7. To determine the frequency response of a second -order system and evaluation of frequency domain specifications.
8. Simulate a D. C. position control system using MATLAB/SCILAB and obtain its step response.
9. Obtain the phase margin and gain margin for a given transfer function by drawing bode plots. Verify the same using (i) MATLAB/SCILAB and (ii) The rltool command of MATLAB or equivalent in SCILAB.
10. (a) To draw the root loci for a given transfer function and verification of breakaway point and imaginary axis crossover point using (i) MATLAB/SCILAB (ii) The rltool command of MATLAB or equivalent in SCILAB (b) To draw the Nyquist plot for a given transfer function using MATLAB/SCILAB.
11. To draw and study syncro pair characteristics.

## VII SEMESTER

## COMPUTER TECHNIQUES IN POWER SYSTEM ANALYSIS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE71** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**NETWORK TOPOLOGY**: Introduction, Elementary graph theory – oriented graph, tree, co-tree, basic cut-sets, basic loops; Incidence matrices – Element-node, Bus incidence, Tree-branch path, Basic cut-set, Augmented cut-set, Basic loop and Augmented loop; Primitive network – impedance form and admittance form.

**6 Hours**

**UNIT - 2**

**NETWORK MATRICES:** Introduction, Formation of $Y_{BUS}$ – by method of inspection (including transformer off-nominal tap setting), by method of singular transformation ($Y_{BUS} = A^T y A$); Formation of Bus Impedance Matrix by step by step building algorithm (without mutual coupling elements).

**6 Hours**

**UNIT - 3 & 4**

**LOAD FLOW STUDIES:** Introduction, Power flow equations, Classification of buses, Operating constraints, Data for load flow; Gauss-Seidal Method – Algorithm and flow chart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence; Newton Raphson Method – Algorithm and flow chart for NR method in polar coordinates (numerical problem for one iteration only); Algorithm for Fast Decoupled load flow method; Comparison of Load Flow Methods.

**14 Hours**

### PART - B

**UNIT - 5 & 6**

**ECONOMIC OPERATION OF POWER SYSTEM:** Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses; Iterative techniques; Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula; Optimal scheduling for Hydrothermal plants – problem formulation, solution procedure and algorithm.

**12 Hours**

**UNIT - 7 & 8**

**TRANSIENT STABILITY STUDIES:** Numerical solution of Swing Equation – Point-by-point method, Modified Euler's method, Runge-Kutta method, Milne's predictor corrector method. Representation of power system for transient stability studies – load representation, network performance equations. Solution techniques with flow charts.

**14 Hours**

**TEXT BOOKS:**

1. **Computer Methods in Power System Analysis-** Stag, G. W., and EI-Abiad, A. H.- McGraw Hill International Student Edition. 1968
2. **Computer Techniques in Power System Analysis**- Pai, M. A- TMH, 2nd edition, 2006.

**REFERENCE BOOKS:**

1. **Modern Power System Analysis-** Nagrath, I. J., and Kothari, D. P., -TMH, 2003.
2. **Advanced Power System Analysis and Dynamics**- Singh, L. P., New Age International (P) Ltd, New Delhi, 2001.
3. **Computer Aided Power System Operations and Analysis**"- Dhar, R. N- TMH, New Delhi, 1984.
4. **Power System Analysis-** Haadi Sadat, -TMH, 2nd , 12th reprint, 2007

## ELECTRICAL POWER UTILIZATION

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE72** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**HEATING AND WELDING:** Advantages and methods of electric of heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of building, electric welding, resistance and arc welding, control device and welding equipment

**10 Hours**

**UNIT - 2**

**ELECTROLYTIC PROCESS:** Fundamental principles, extraction, refining of metals, electroplating. Factors affecting electro deposition process, power supply for electrolytic process.

**6 Hours**

**UNIT - 3 & 4**

**ILLUMINATION:** Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps, incandescent, fluorescent, vapor and CFL and their working, Glare and its remedy

**10 Hours**

## PART - B

**UNIT - 5, 6 & 7**

**ELECTRIC TRACTION:** System of traction, speed time curve, tractive effort at /co-efficient of adhesions, selection of traction motors, method of speed control, energy saving by series parallel control, ac traction equipment. AC series motor, characteristics, regenerative braking, linear induction motor and their use. AC traction, diesel electric equipment, train lighting system, specific energy, factors affecting specific energy consumption.

**20 Hours**

**UNIT - 8**

**INTRODUCTION ELECTRIC AND HYBRID VEHICLES:** Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption

**6 Hours**

**TEXT BOOKS:**

1. **Utilization Of Electric Energy-** Openshaw Taylor
2. **Modern Electric, Hybrid Electric and Fuel Cell Vechiles**- Mehrdad, Ehsani, Yimin Gao, Sabastien. E. Gay, Ali Emadi- CRC Press.

**REFERENCE BOOKS:**

1. **A Course in Electrical Power**- Soni Gupta and Bhatnager- Dhanapat Rai & sons.
2. **Electrical Power** by Dr. S.L.Uppal Khanna Publications

## HIGH VOLTAGE ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE73** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

## PART - A

**UNIT - 1**

**INTRODUCTION:** Introduction to HV technology, advantages of transmitting electrical power at high votages, need for generating high voltages in laboratory. Important applications of high voltage.

**4 Hours**

**UNIT - 2 & 3**

**BREAKDOWN PHENOMENA:** Classification of HV insulating media. Properties of important HV insulating media under each category. Gaseous dielectrics: Ionizations: primary and secondary ionization processes. Criteria for gaseous insulation breakdown based on Townsend's theory. Limitations of Townsend's theory. Streamer's theory breakdown in non uniform fields.

Corona discharges. Breakdown in electro negative gasses. Paschen's law and its significance. Time lags of Breakdown. Breakdown in solid dielectrics: Intrinsic Breakdown, avalanche breakdown, thermal breakdown, and electro mechanic breakdown. Breakdown of liquids dielectric dielectrics: Suspended particle theory, electronic Breakdown, cavity breakdown (bubble's theory), electro convection breakdown.

**12 Hours**

**UNIT - 4**

**GENERATION OF HV AC AND DC VOLTAGE:** HV AC-HV transformer; Need for cascade connection and working of transformers units connected in cascade. Series resonant circuit- principle of operation and advantages. Tesla coil. HV DC- voltage doubler circuit, cock croft- Walton type high voltage DC set. Calculation of high voltage regulation, ripple and optimum number of stages for minimum voltage drop

**8 Hours**

**PART - B**

**UNIT - 5**

**GENERATION OF IMPULSE VOLTAGE AND CURRENT:** Introduction to standard lightning and switching impulse voltages. Analysis of single stage impulse generator-expression for Output impulse voltage. Multistage impulse generator working of Marx impulse. Rating of impulse generator. Components of multistage impulse generator. Triggering of impulse generator by three electrode gap arrangement. Triggering gap and oscillograph time sweep circuits. Generation of switching impulse voltage. Generation of high impulse current.

**6 Hours**

**UNIT - 6**

**MEASUREMENT OF HIGH VOLTAGES:** Electrostatic voltmeter-principle, construction and limitation. Chubb and Fortescue method for HV AC measurement. Generating voltmeter- Principle, construction. Series resistance micro ammeter for HV DC measurements. Standard sphere gap measurements of HV AC, HV DC, and impulse voltages; Factors affecting the measurements. Potential dividers-resistance dividers capacitance dividers mixed RC potential dividers. Surge current measurement-Klydanograph and magnetic links.

**12 Hours**

**UNIT - 7**

**NON-DESTRUCTIVE INSULATION TESTING TECHNIQUES:** Dielectric loss and loss angle measurements using Schering Bridge, Transformer ratio Arms Bridge. Need for discharge detection and PD measurements aspects. Factor affecting the discharge detection. Discharge detection methods-straight and balanced methods.

**6 Hours**

**UNIT - 8**

**HIGH VOLTAGE TESTS ON ELECTRICAL APPARATUS:** Definitions of terminologies, tests on isolators, circuit breakers, cables insulators and transformers

**4 Hours**

**TEXT BOOKS:**


1. **High Voltage Engineering Fundamentals**- E. Kuffel and W.S. Zaengl- 2nd edition, Elsevier, press, 2005.
2. **High Voltage Engineering**- M.S.Naidu and Kamaraju- 3rd Edition, THM, 2007.
3. **High Voltage Engineering** -C.L.Wadhwa, New Age International Private limited, 1995.


**REFERENCE BOOKS:**


1. **Extra High Voltage AC Transmission Engineering -**Rakosh Das Begamudre, Wiley Eastern limited, 1987.
2. **Transmission and Distribution Reference Book**-Westing House.
3. **High Voltage Technology**- L. L. Alston- BSB Publication, 2007.


## INDUSTRIAL DRIVES & APPLICATIONS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE74** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

**PART - A**

**UNIT - 1**

**AN INTRODUCTION TO ELECTRICAL DRIVES & ITS DYNAMICS**: Electrical drives. Advantages of electrical drives. Parts of electrical drives, choice of electrical drives, status of dc and ac drives, Dynamics of electrical drives, Fundamental torque equation, speed torque conventions and multiquadrant operation. Equivalent values of drive parameters, components of low torques, nature and classification of load torques, calculation of time and energy loss in transient operations, steady state stability, load equalization.

**9 Hours**

**UNIT - 2**

**SELECTION OF MOTOR POWER RATING:** Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating.

**5 Hours**

**UNIT - 3 & 4**

**D C MOTOR DRIVES:**

**(a)** Starting braking, transient analysis, single phase fully controlled rectifier, control of dc separately excited motor, Single-phase half controlled rectifier control of dc separately excited motor.

**(b)** Three phase fully controlled rectifier control of dc separately excited motor, three phase half controlled controlled rectifier control of dc separately excited motor, multiquadrant operation of dc separately excited motor fed form fully controlled rectifier. Rectifier control of dc series motor, chopper controlled dc drives, chopper chopper control of separately excited dc motor. Chopper control of series motor.

**12 Hours**

**PART - B**

**UNIT - 5 & 6**

**INDUCTION MOTOR DRIVES:**

**(a)** Operation with unbalanced source voltage and single phasing, operation with unbalanced rotor impedances, analysis of induction motor fed from non-sinusoidal voltage supply, starting braking, transient analysis.

**(b)** Stator voltage control variable voltage frequency control from voltage sources , voltage source inverter control, closed loop control, current source inverter control, current regulated voltage source inverter control, rotor resistance control, slip power recovery, speed control of single phase induction motors.

**12 Hours**

**UNIT - 7**

**SYNCHRONOUS MOTOR DRIVES:** Operation form faced frequency supply, synchronous motor variable speed drives, variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thruster inverter.

**10 Hours**

**UNIT - 8**

**INDUSTRIAL DRIVES**: Rolling mill drives, cement mill drives, paper mill dries and textile mill drives.

**4 Hours**

**TEXT BOOK:**


1. **Fundamentals of Electrical Drives**"- G.K Dubey -2 Edition, 5th reprint Narosa publishing house Chennai, 2002.


**REFERENCE BOOKS:**


1. **Electrical Drives**- N.K De and P.K. Sen- PHI, 2007
2. **A First Course On Electric Drives**- S.K Pillai-Wiley Eastern Ltd 1990.
3. **Power Electronics, Devices, Circuits and Industrial Applications**- V.R. Moorthi, "Oxford University Press, 2005.

## ELECTIVE-II (GROUP B)

## POWER SYSTEM PLANNING

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE751** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION OF POWER PLANNING**, National and regional planning, structure of power system, planning tools, electricity regulation, Load forecasting, forecasting techniques, modeling

**8 Hours**

**UNIT - 2 & 3**

**GENERATION PLANNING**, Integrated power generation, co-generation / captive power, power pooling and power trading, transmission & distribution planning, power system economics, power sector finance, financial planning, private participation, rural electrification investment, concept of rational tariffs

**10 Hours**

**UNIT - 4**

**COMPUTER AIDED PLANNING:** Wheeling, environmental effects, green house effect, technological impacts, insulation co-ordination, reactive compensation

**8 Hours**

### PART - B

**UNIT - 5 & 6**

**POWER SUPPLY RELIABILITY**, reliability planning, system operation planning, load management, load prediction, reactive power balance, online power flow studies, test estimation, computerized management. Power system simulator**.**

**10 Hours**

**UNIT - 7 & 8**

Optimal Power system expansion planning, formulation of least cost optimization problem incorporating the capital, operating and maintenance cost of candidate plants of different types (thermal hydro nuclear non conventional etc), Optimization techniques for solution by programming

**16 Hours**

**TEXT BOOK:**

1. **"Electrical Power System Planning"** A.S.Pabla, Macmillan India Ltd, 1998

## OVER VOLTAGES IN POWER SYSTEM

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE752** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1 & 2**

Introduction to over voltages phenomenon in power system: transient on transmission lines: infinite line definition and its transient behavior, finite line analyses, analysis for different line terminations, problems. Bewely lattice diagram, problems.

**15 Hours**

**UNIT - 3 & 4**

Use of transients network analyzer, digital and hybrid computers for solving large scale problems, characteristics of lightning discharges, theory of cloud formation origin of lightning, iso-Keronic level, leader development, return stroke, different types of lightning interaction, back flash over

**11 Hours**

### PART - B

**UNIT - 5 & 6**

Shielding angle calculation for line, grounding rods, counter poise, problems, origin and characteristics of switching over voltages and temporary over voltages, problems of switching surges.

**11 Hours**

**UNIT - 7 & 8**

Behavior of apparatus and line insulation under all types of over voltages, concept of BIL, protection of apparatus against over voltages, surge arresters, insulation co-ordination

**15 Hours**

**TEXT BOOK:**


1. **"Power System Transients"-**Greenwood, , Orient Longman 1987


**REFERENCE BOOKS:**


1. **Extra High Voltage AC Transmission Engineering -**Rakesh Das Begamudre, Willey Eastern Limited. 1987
2. **"High Voltage Engineering Fundamentals"** E.Kuffel and W.S.Zaengal, and J. Kuffel 2nd Edition, Elsevier, 2005.
3. **High Voltage Engineering -**M.S.Naidu and V.Kamaraju, 3rd Edition, TMH, 2007.
4. **"High Voltage Engineering" -**R. S. Jha "High Voltage Engineering", Khanna publishers
5. **"High Voltage Engineering"-** C.L.Wadhwa, New age international

## TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE753** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1 & 2**
**TRANSFORMERS:**

**a. Specifications:** Power and distribution transformers as per BIS standards.

**b. Installation:** Location, site, selection, foundation details (like bolts size, their number, etc), code of practice for terminal plates, polarity & phase sequence, oil tanks, drying of windings and general inspection.

**5 Hours**

**c. Commissioning tests:** Following tests as per national & International Standards, volt ratio test, earth resistance, oil strength, Bucholz & other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index, load & temperature rise test.

**7 Hours**

**d. Specific Tests:** Determination of performance curves like efficiency, regulation etc, and determination of mechanical stress under normal &abnormal conditions.

**3 Hours**

**UNIT - 3 & 4**
**SYNCHRONOUS MACHINES:**

**a. Specifications:** As per BIS standards.

**b. Installation:** Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out.

**c. Commissioning Tests:** Insulation, Resistance measurement of armature & field windings, waveform & telephone interference tests, line charging capacitance.

**4 Hours**

**d. Performance tests:** Various tests to estimate the performance of generator operations, slip test, maximum lagging current, maximum reluctance power tests, sudden short circuit tests, transient & sub transient parameters, measurements of sequence impedances, capacitive reactance, and separation of losses, temperature rise test, and retardation tests.

**6 Hours**

**e. Factory tests:** Gap length, magnetic eccentricity, balancing vibrations, bearing performance

**2 Hours**

**PART - B**

**UNIT - 5, 6 & 7**
**INDUCTION MOTORS:**
a. **Specifications** for different types of motors, Duty, I.P. protection.

**2 Hours**

**b. Installation:** Location of the motors (including the foundation details) & its control apparatus, shaft & alignment for various coupling, fitting of pulleys & coupling, drying of windings.

**4 Hours**

**c. Commissioning Test:** Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations & balancing.

**5 Hours**

**Electrical Tests:** Insulation test, earth resistance, high voltage test, starting up, failure to speed up to take the load, type of test, routine test, factory test and site test (in accordance with ISI code

**4 Hours**

**d. Specific Tests:** Performance & temperature raise tests, stray load losses, shaft alignment, and re-rating & special duty capability.

**4 Hours**

**UNIT - 8**
**SWITCH GEAR & PROTECTIVE DEVICES:** Standards, types, specification, installation, commissioning tests, maintenance schedule, type & routine tests.

**6 Hours**

**TEXT BOOKS:**

1. **Testing & Commissioning Of Electrical Equipment -**S. Rao,
2. **Testing & Commissioning Of Electrical Equipment** -B .V. S. Rao,

**REFERENCE BOOKS:**

1. Relevant Bureau of Indian Standards
2. **"A Handbook on Operation and Maintenance of Transformers"-**H. N. S. Gowda,
3. **Transformer & Switch Gear Handbook** -Transformers-BHEL, J &P, J & P

## ELECTERICAL ENGINEERING MATERIALS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE754** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**CONDUCTING MATERIALS:** Review of metallic conduction on the basis of free electron theory Fermi-Dirac distribution – variation of conductivity with temperature and composition, materials for electric resistors- general electric properties; brushes of electrical machines, lamp filaments, fuses and solder.

**6 Hours**

**UNIT - 2**

**SEMICONDUCTORS:** Mechanism of conduction in semiconductors, density of carriers in intrinsic semiconductors, the energy gap, types of semiconductors. Hall effect, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic materials: Classification of magnetic materials- origin of permanent magnetic dipoles, ferromagnetism, hard and soft magnetic materials magneto materials used in electrical machines, instruments and relays.

**10 Hours**

**UNIT - 3 & 4**

**DIELECTRICS:** Dielectrics polarization under static fields- electronic ionic and dipolar polarizations, behavior of dielectrics in alternating fields, Factors influencing dielectric strength and capacitor materials. Insulating materials, complex dielectric constant, dipolar relaxation and dielectric loss.

**INSULATING MATERIALS:** Inorganic materials (mica, glass, porcelain, asbestos), organic materials (paper, rubber, cotton silk fiber, wood, plastics and bakelite), resins and varnishes, liquid insulators (transformer oil) gaseous insulators (air, SF6 and nitrogen) and ageing of insulators.

**10 Hours**

### PART - B

**UNIT - 5**

**MATERIALS FOR SPECIAL APPLICATIONS:** Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, sintered alloys for breaker and switch contacts.

**6 Hours**

**UNIT - 6**

**MODERN TECHNIQUES FOR MATERIALS STUDIES:** Optical microscopy, Electron microscopy, Photo electron spectroscopy, Atomic absorption spectroscopy, magnetic resonance, nuclear magnetic resonance, electron spin resonance and ferromagnetic resonance.

**6 Hours**

**UNIT - 7**

Introduction Properties and Application of Piezoelectric materials, Eletrostrictive materials, Ferromagnetic materials, Magnetosrtictive materials, Shape memory alloys, Electro archeological fluids, Magneto archeological fluids, Smart hydrogels

**6 Hours**

**UNIT - 8**

**Ceramics:** properties, application to conductors, insulator & capacitors
**Plastics:** Thermoplastics, rubber, thermostats, properties.

**8Hours**

**TEXT BOOKS:**


1. **"An Introduction to Electrical Engineering"-** Indulkar C.S. & Thiruvengadam. S.
2. **"Electrical Engineering Materials"-**Yu Koritsky, MIR
3. **"Materials Science for Electrical & Electronics Engineering"**-Ian P.Jones. Oxford University Press,2007
4. **"Materials Science"-**Arumugam M, Anuradha Publishers, 1990
5. **"Applied Solar Energy"**-An Introduction -Meinal A.B Meinal M P, – An Introduction., Addison Wesley Publications,
6. **"Electrical Engineering Materials"-**Kapoor P L., Khanna Publications.


## DIGITAL SYSTEM DESIGN USING VHDL

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE755** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION:** VHDL description of combinational networks, Modeling flip-flops using VHDL, VHDL models for a multiplexer, Compilation and simulation of VHDL code, Modeling a sequential machine, Variables, Signals and constants, Arrays, VHDL operators, VHDL functions, VHDL procedures, Packages and libraries, VHDL model for a counter.

**7 Hours**

**UNIT - 2**

**DESIGNING WITH PROGRAMMABLE LOGIC DEVICES**: Read-only memories, Programmable logic arrays (PLAs), Programmable array logic (PLAs), Other sequential programmable logic devices (PLDs), Design of a keypad scanner.

**6 Hours**

**UNIT - 3**

**DESIGN OF NETWORKS FOR ARITHMETIC OPERATIONS:** Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, Design of a binary divider.

**6 Hours**

**UNIT - 4**

**DIGITAL DESIGN WITH SM CHARTS**: State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines.

**6 Hours**

**PART - B**

**UNIT - 5**

**DESIGNING WITH PROGRAMMABLE GATE ARRAYS AND COMPLEX PROGRAMMABLE LOGIC DEVICES**: Xlinx 3000 series FPGAs, Designing with FPGAs, Xlinx 4000 series FPGAs, using a one-hot state assignment, Altera complex programmable logic devices (CPLDs), Altera FELX 10K series COLDs.

**6 Hours**

**UNIT - 6**

**FLOATING-POINT ARITHMETIC**: Representation of floating-point numbers, Floating-point multiplication, Other floating-point operations.

**7 Hours**

**UNIT - 7**

**ADDITIONAL TOPICS IN VHDL**: Attributes, Transport and Inertial delays, Operator overloading, Multivalued logic and signal resolution, IEEE-1164 standard logic, Generics, Generate statements, Synthesis of VHDL code, Synthesis examples, Files and TEXTIO.

**7 Hours**

**UNIT - 8**

**VHDL MODELS FOR MEMORIES AND BUSES**: Static RAM, A simplified 486 bus model, interfacing memory to a microprocessor bus.

**7 Hours**

**TEXT BOOKS:**

1. **Digital Systems Design Using VHDL,-** Thomson Learning **-** Charles H. Roth. Jr: Inc, 2002.
2. **Digital Electronics And Design With VHDL -** A. Pedroni, Volnet Elsevier, 1st edition, 2008

**REFERENCE BOOKS:**

1. **Fundamentals of Digital Logic with VHDL Design -**Stephen Brwon & Zvonko Vranesic, Tata McGraw-Hill, New Delhi, 2003
2. **Digital Fundamentals using VHDL -**Floyd, Pearson Education, 2003,
3. **VHDL Primer**, -J. Bhaskar Pearson / PHI, NewDelhi, 2003

## EMBEDDED SYSTEMS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE756** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1 & 2**

**CONCEPT OF EMBEDDED SYSTEM DESIGN:** Components, classification, skills required.Embedded Micro controller cores: Architecture of 6808 and 6811.Embedded Memories ROM variants, RAM.Applications of embedded system: Examples of Embedded systems SOC for cellless bar code scanner.

**10 Hours**

**UNIT - 3**

**TECHNOLOGICAL ASPECTS OF EMBEDDED SYSTEM:** Interfacing between analog and digital blocks, Signal conditioning, digital signal processing, DAC & ADC interfacing, Sample & hold, multiplexer interface Internal ADC interfacing (excluding 6805 & 6812), Data Acquisition System and Signal conditioning using DSP.

**12 Hours**

**UNIT - 4**

**DESIGN TRADE OFFS DUE TO PROCESS INCOMPATIBILITY, THERMAL CONSIDERATIONS:** Issues in embedded system design. Design challenge, design technology, trade offs. Thermal considerations

**6Hours**

**PART - B**

**UNIT - 5 & 6**

Software aspects of Embedded Systems, real time programming Languages, operating systems. Programming concepts and embedded programming in C.Round Robin, Round Robin with interrupts, function queue-scheduling architecture, Real time OS architecture, selecting architecture. Introduction to RTOS.

**12 Hours**

**UNIT - 7 & 8**

Subsystem interfacing with external systems user interfacing, Serial I/O devices, Parallel port interfaces: Input switches, Key boards and Memory interfacing.

**12 Hours**

**TEXT BOOKS:**

1. **"Embedded Microcomputer systems : Real time interfacing"-** Valvano, J.W, Brooks/Cole, 2000
2. "**The Art of Designing Embedded systems**"- Ganssle, Jack, Newness
3. **"Embedded System, Architecture, Programming and Design"-** Raj Kamal TMH 2003.

**REFERENCE BOOKS:**

1. **"A Unified Hardware/Software Introduction"-**Frank Vahid/Tony Givargis, Wiely student edition 2002
2. **Motorola and Intel Manuals**

**RELIABILITY ENGINEERING**

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE757** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

**PART - A**

**UNIT - 1**

**INTRODUCTION:** Concept of reliability, reliability indices, component reliability –Introduction, non repairable component, hazard models, components with preventive maintenance, repairable components.

**8 Hours**

**UNIT - 2**

**SYSTEM RELIABILITY**: network methods, Introduction; series configuration parallel configuration, mixed configuration, the r out of n

configuration d composition method minimal-tie and minimal –cut methods logic diagrams.

**8 Hours**

**UNIT - 3 & 4**

System reliability state space method system representation basic concepts state probability state frequency and duration system of two independent component two components with dependent failures combining states failure effect analysis state enumeration methods

**10 Hours**

**PART - B**

**UNIT - 5**

System reliability other methods dependent failure models for non repairable components fault tree analysis monte- carlo simulation

**8 Hours**

**UNIT - 6 & 7**

Basic probability theory probability concepts permutation and combination practical engineering concepts venn diagram rules for combining probabilities, probability distribution random variables density and distribution

**10 Hours**

**UNIT - 8**

System reliability evaluation using probability distribution series system parallel system partially redundant system mean time to failure stand by system

**8 Hours**

**TEXT BOOKS:**

1. **"Concepts in reliability engineering"-** L S Srinath, East West Press Ltd, 2nd edition.
2. **"Reliability modeling in electrical power system"-** J. Endrenyi, John Wiley & Sons

**REFERENCE BOOK:**

1. **"Reliability Evaluation of Engineering Systems"-** Roy Billintan & Ronald. N. Allar, 2nd Edition, 1992.

## ELECTIVE-III (GROUP C)

## REACTIVE POWER MANAGEMENT

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE761** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**
Introduction, importance of reactive power control in EPS.

**8 Hours**

**UNIT - 2 & 3**
Load compensation, objectives, practical considerations, Transmission line compensation: types, passive/active, Fixed/ regulated series/shunt compensation, compensation by sectioning.

**10 Hours**

**UNIT - 4**
Static Compensator and synchronous condensers

**8 Hours**

### PART - B

**UNIT - 5 & 6**
Harmonics effects, resonance, shunt capacitors and filters

**10 Hours**

**UNIT - 7**
Telephone interferences

**8 Hours**

**UNIT - 8**
Reactive power coordination, reactive power management, transmission benefits, reactive power dispatch & equipment impact

**8 Hours**

**TEXT BOOKS:**

1. **"Reactive power control in electric power systems"-** T. J. E. Miler, John Wiley & Sons NY 1982.
2. **"Power Generation Operating & Control"-** A J Wood & B.F Woolenberg, John Wiley & Sons 1984.

**REFERENCE BOOK:**

1. IEEE "**Guide on Harmonic control & reactive compensation of power converters'** IEEE student 519-1981.

## MICRO ELECTRO MECHANICAL SYSTEMS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE762** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION TO MEMS TECHNOLOGY:** Introduction to MEMS and motivation, Basic definitions, history of

**SCALING IN MICRODOMAIN:** How small is different- some natural examples, Scaling laws in electrostatic, electromagnetic, rigidity of structures, heating & cooling, Fluid viscosity and fluid interfaces, etc. Scaling in overall system performance considering multiple physical domains

**7 Hours**

**UNIT - 2**

**MEMS MATERIALS:** Mechanical and other properties of materials used in MEMS

**MICROFABRICATION / MICROMACHINING:** Overview of microfabrication, Review of microelectronics fabrication processes like photolithography, deposition, doping, etching, structural and sacrificial materials, other lithography methods,. MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods.

**9 Hours**

**UNIT - 3 & 4**

**TRANSDUCTION PRINCIPLES:** Transduction principles in microdomain

**MEMS MODELING:** Basic modeling elements in electrical, mechanical, thermal and fluid systems, analogy between $2^{nd}$ order mechanical and electrical systems. Modeling elastic, electrostatic, electromagnetic systems.

**10 Hours**

### PART - B

**UNIT - 5**

**RADIO FREQUENCY (RF) MEMS:** Introduction, Review of RF-based communication systems, RF –MEMS like MEMS inductors, varactors, tuners, filters, resonators, phase shifters, switches

**7 Hours**

**UNIT - 6**

**OPTICAL MEMS:** Preview, passive optical components like lenses and mirrors, actuators for active optical MEMS.

**5 Hours**

**UNIT - 7 & 8**

**CASE STUDIES**: Case studies of microsystems including microcantilever based sensors and actuators with appropriate selection of material properties: thermal; mechanical properties. Static and dynamic mechanical response with different force mechanisms: electrostatic, electromagnetic, thermal etc. Tutorials: The above case study examples are to be implemented in either CoventorWare or ANSYS Multiphysics.

**NANOTECHNOLOGY AND MEMS:** Relation between micro and nanotechnologies. Need and issues in handling nano products with the help of MEMS

**14 Hours**

**REFERENCE BOOKS:**


1. **"MEMS and Microsystems Design and Manufacture"**-Tai, Ran Hsu, TMH, 2002, ISBN 0-07-239391-2.
2. **"Foundations of MEMS"-** Chang Liu, Pearson International Edition, 2006, ISBN 0-13-199204-X
3. **"Modeling MEMS and NEMS"-** John A. Pelesko, David H. Bernstein, Chapman & Hall/CRC, 2003, ISBN 1-58488-306-5
4. **"MEMS"**-Nitaigour Premchand Mahalik, TMH, 2007, ISBN 13:978-0-07-063445-9
5. **"The Science and Engineering of Microelectronic Fabrication"**-Second Edition, Campbell, Oxford, 2001, ISBN 0-19-513605-5. (General Microfabrication Reference.)
6. **"Fundamentals of Microfabrication"** - Madou, CRC Press, 1997, ISBN 0-8493-9451-1. (Microfabrication for MEMS + some information on materials and devices.)
7. **"Micromachined Transducers Sourcebook"**-Kovacs, McGraw-Hill, 1998, ISBN 0-07-290722-3. (General MEMS reference with an emphasis on a very large number of transduction methods.)
8. **"An Introduction to Microelectromechanical Systems Engineering"**- Nadim Maluf, Artech House, 2000
9. **"Introduction to Microelectromechanical** "(MEM) Microwave Systems H.J. De Los Santos, Artech, 1999.
10. **"Smart Sensors and MEMS"**- Edtd. By Sergey Y. Yurish, Maria Teresa, S R Gomes, Nato Science Series-Kluwer Academic Publishers, London, 20.

## ENERGY AUDITING AND DEMAND SIDE MANAGEMENT

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE763** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION**: Energy situation – world and India, energy consumption, conservation, Codes, standards and Legislation.

**6 Hours**

**UNIT - 2**

**ENERGY ECONOMIC ANALYSIS:** The time value of money concept, developing cash flow models, payback analysis, depreciation, taxes and tax credit – numerical problems.

**7 Hours**

**UNIT - 3**

**ENERGY AUDITING:** Introduction, Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results.

**8 Hours**

**UNIT - 4**

**ELECTRICAL SYSTEM OPTIMIZATION:** The power triangle, motor horsepower, power flow concept.

**4 Hours**

### PART - B

**UNIT - 5 & 6**

**ELECTRICAL EQUIPMENT AND POWER FACTOR** –correction & location of capacitors, energy efficient motors, lighting basics, electrical tariff, Concept of ABT.

**10 Hours**

**UNIT - 7 & 8**

**DEMAND SIDE MANAGEMENT:** Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning, load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment. Management and Organization of Energy Conservation awareness Programs.

**16 Hours**

**TEXT BOOKS:**

1. "**Industrial Energy Management Systems" -** arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York.
2. **"Fundamentals of Energy Engineering" -** Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey.
3. **Electrical distribution**, Pabla TMH, 2004.

**REFERENCE BOOKS:**

1. "**Recent Advances in Control and Management of Energy Systems**"- D.P.Sen, K.R.Padiyar, Indrane Sen, M.A.Pai, Interline Publisher, Bangalore, 1993.
2. **"Energy Demand – Analysis, Management and Conservation"-** Ashok V. Desai, Wiley Eastern.
3. **"Demand Side Management"-**Jyothi Prakash, TMH Publishers.
4. **Hand book on energy auditing** - TERI (Tata Energy Research Institute)

## INSULATION ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE764** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**ELECTROSTATIC FIELD, THEIR CONTROL AND ESTIMATIONS**: Electric Field Intensity, Electric Strength, Classification of Electric Fields, Degree of Uniformity of Electric Fields, control of Electric field Intensity (stress control), Estimation of Electric Field Intensity, Basic Equations for potential and Field Intensity in Electrostatic Fields, Analysis of Electric Field Intensity in Homogeneous Isotropic single dielectric only direct solution of Laplace equation, Analysis of Electric field Intensity in Isotropic Multidielectric system.

**7 Hours**

**UNIT - 2**

**INSULATION SYSTEM IN POWER SYSTEM APPARATUS**: Insulation system in capacitors, bushings, and transformers modes of failure of insulation systems. Insulation in rotating machines.

**6 Hour**

**UNIT - 3**

**DIELECTRIC PHENOMENA**: Dielectric phenomena in in solid insulation. Macroscopic approach for describing the Dielectric phenomena microscopic treatment for Dielectric phenomena

**7 Hours**

**UNIT - 4**

**PROPERTIES OF INSULATION MATERIALS:** Introduction to properties of solid insulating materials (both of natural origin and synthetic types) Properties of liquid insulating materials,

**6 Hours**

**PART - B**

**UNIT - 5**

**GASEOUS INSULATION:** Requirement of gaseous insulation. Breakdown process: types of collision, Elastic and inelastic, collision cross-section, Mobility of ions, Diffusion of charges, Emission of radiation and excitation, various secondary process and recombination, Mobility controlled and diffusion controlled breakdown.

**9 Hours**

**UNIT - 6**

**AGEING PHENOMENA:** Failure of electric insulation due to ageing. Ageing mechanisms- Thermal ageing, Electrical ageing, combined thermal and electrical ageing.

**9 Hours**

**UNIT - 7**

Analysis of insulation failure date Power law model, Graphical estimation of power law constants, ageing date, plotting position and cumulative probability.

**8 Hours**

**TEXT BOOKS:**


1. "**Fundamentals of gaseous ionization and plasma electronics"-** Nasser E. John Wiley Interscience, New York, 1971.
2. "**Methods of statistical analysis and life data"-** Hann N.R. Schafer R.E. and Singapore wall N.D. John Wiley and sons, New York, 1974.
3. "**Theory of electric polarization**"- Bother C.J.F. Elsevier Publications.
4. **"High Voltage Insulation Engineering"** -Ravindra Arora, Wolfgang Mosch, New age International Publishers Ltd.

**REFERENCE BOOKS:**


1. **"Electrical insulation"-** Bradwell A. Peter Peregrinus Ltd, London, 1993.
2. **Electrical breakdown of gass"-** J.M. Meek and J.D. Craggs, "Oxford university press, 11953
3. **,"High voltage Engineering fundamentals"-**E. Kufell and W.S. Zaengl, and J. Kufell, 2nd edition, Elsevier 2005
4. **"High voltage Engineering"**-M.S. Naidu and V Kamaraju, 3rd edition, TMH, 2007.


## DISCRETE CONTROL SYSTEM

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE765** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1 & 2**

**Z-PLANE ANALYSIS OF DISCRETE-TIME CONTROL SYSTEMS:** Impulse Sampling and data Hold, obtaining the Z-transform by convolution integral method, reconstruction the original signals from sampled signals, the pulse transfer function, realization of digital controllers and digital filters

**10 Hours**

**UNIT - 3 & 4**

**DESIGN OF DISCRETE TIME CONTROL SYSTEMS BY CONVOLUTION METHODS:** Mapping between the s-plane and the z-plane, stability analysis of closed loop systems in the z-plane, transient and steady state response analysis design based on the root locus method, design based on frequency response method, analytical design method.

**16 Hours**

### PART - B

**UNIT - 5 & 6**

**STATE SPACE ANALYSIS:** State space representation of discrete time systems, solution of discrete time state space equations, pulse transfer functions matrix, discretization of continuous time state space equations, Liapunov stability analysis.

**12 Hours**

**UNIT - 7 & 8**

**POLE PLACEMENT AND OBSERVER DESIGN:** Controllability, observability, useful transformations in state space analysis and design, design via pole placement, state observers, and servo systems.

**14 Hours**

**TEXT BOOK:**

1. **"Discrete-Time Control Systems"**-Kutsuhiko Ogata, 2nd Edition, Pearson Education, 2003.

**REFERENCE BOOKS:**

1. **"Digital Control and State Variable Methods"-**M. Gopal, 2nd Edition, TMH, 2007.
2. **"Modern Control System"-** Richard C. Dorf, Robert H. Bishop, 11th Edition Pearson Education, 2008.
3. **"Discrete Control Systems"-**John F. Dorsey, TMH.
4. **"Digital Control System"-** Moudalya, K.M., John Wiley & Sons, 2007

## VLSI CIRCUITS AND DESIGN

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE766** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**A REVIEW OF MICROELECTRONIC 3 AND AN INTRODUCTION TO MOS TECHNOLOGY:** Introduction to integrated circuit technology, Production of E-beam masks. Introduction, VLSI technologies, MOS transistors, fabrication, thermal aspects, production of E-beam masks.

**6 Hours**

**UNIT - 2**

**BASIC ELECTRICAL PROPERTIES OF MOS AN BICMOS CIRCUIT:** Rain to source current Ids versus Vds relationships-BICMOS latch up susceptibility. MOS transistor characteristics, figure of merit, pass transistor NMOS and COMS inverters, circuit model, latch up.

**8 Hours**

**UNIT - 3**

**MOS AND BICMOS CIRCUIT DESIGN PROCESSES:** Mass layers, strick diagrams, design, symbolic diagrams

**8 Hours**

**UNIT - 4**

**BASIC CIRCUIT CONCEPTS:** Sheet resistance, capacitance layer inverter delays, wiring capacitance, choice of layers.

**6 Hours**

**PART - B**

**UNIT - 5**

**SCALING OF MOS CIRCUITS:** Scaling model and scaling factors- Limit due to current density.

**8 Hours**

**UNIT - 6**

**SUBSYSTEM DESIGN AND LAYOUT:** Some architecture issues- other systems considerations. Examples of structural design, clocked sequential circuits

**8 Hours**

**UNIT - 7**

**SUBSYSTEM DESIGN PROCESSES:** Some general considerations, an Illustration of design process, observations

**4 Hours**

**UNIT - 8**

**ILLUSTRATION OF THE DESIGN PROCESS:** Observation on the design process, Regularity Design of an ALU subsystem. Design of 4-bit adder, implementing ALU functions.

**4 Hours**

**TEXT BOOKS:**


1. **"Basic VLSI Design" -3rd** Edition, PHI
2. **"Fundamentals of Modern VLSI Devices"-**Yuan Taun Tak H Ning Cambridge Press, South Asia Edition 2003,
3. **"ModernVLSI Design Wayne wolf", Pearson Education Inc. 3rd edition"-**Wayne wolf 2003.


## OPERATING SYSTEMS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE767** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

**PART - A**

**UNIT - 1**

**INTRODUCTION TO OPERATING SYSTEMS AND THEIR CLASSIFICATIONS:** What is an operating system, Main frame systems, Desktop systems, Multiprocessor system, Distributed system, Clustered system, Real time system, Hand held system, Feature migration, Computing environments.

**5 Hours**

**UNIT - 2**

**OPERATING SYSTEM STRUCTURES:** System components, OS services, System calls, System programs, System structure, Virtual machines.

**3 Hours**

**UNIT - 3**

**PROCESS, INTER PROCESS COMMUNICATION, THREADS & CPU SCHEDULING:** Process concept, Process scheduling, Operation on processes, Co-operating processes, Inter Process communication. Threads – Overview, Multithreading models, Threading issues, P threads, Java threads. CPU Scheduling – Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor Scheduling, Real time Scheduling.

**8 Hours**

**UNIT - 4**

**PROCESS SYNCHRONIZATION AND HANDLING DEADLOCKS:** The critical section problem, Synchronization hardware, Semaphores, Classical problems of Synchronization, Critical regions, Monitors. Deadlock-System model, Dead lock characterization, Methods for handling Dead locks-Deadlock prevention, dead lock avoidance, Dead lock detection and recovery from deadlock.

**10 Hours**

**PART - B**

**UNIT - 5**

**STORAGE MANAGEMENT:** Main memory management – Background, Swapping, Contiguous allocations, Paging, Segmentation, Segmentation with paging.

**5 Hours**

**UNIT - 6**

**VIRTUAL MEMORY –** Background, Demand paging, Process creation, Page replacement algorithms, Allocation of frames, Thrashing.

**5 Hours**

**UNIT - 7**

**FILE SYSTEM INTERFACE** - File concept, Access methods, Directory structure, File system mounting, File system implementation, Directory implementation, Allocation methods, free space management.

**5 Hours**

**PROTECTION AND SECURITY:** Goals of protection, Domain of protection, Access matrix, Implementation of access matrix, Revocation of access rights, The security problem, Authentication, Program threats, System threats, Securing systems and facilities, Intrusion detection, Cryptography.

**4 Hours**

**UNIT - 8**

**INTRODUCTION TO DISTRIBUTED OPERATING SYSTEMS:** Background, Topology, Network types, Communication, Co-protocols, Robustness, design issues.

**4 Hours**

**CASE STUDY- LINUX OPERATING SYSTEM:**Design principles, Kernel modules, Process management, Memory management, and File systems, Input and Output, Communication.

**3 Hours**

**TEXT BOOK:**

1. **"Operating System Concepts"-**Abraham Silberschatz, Peter Baer Galvin, Greg Gagne 6th Edition, Wiley Indian Edition, reprint 2007.

**REFERENCES BOOKS:**

1. **"Operating System Concepts and design"-** 2nd edition, Milan Milankovic McGrawhill 1992.
2. **"Operating system"**- Harvey M Deital, Addison Wesley 1990.
3. **Operating System** –A Concept Based Approch – D.M.Dhamdhere.TMH,2002.
4. **Godbole Operating System Concepts** –Achyut's

## RELAY AND HIGH VOLTAGE LAB

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EEL77** | IA Marks | : | 25 |
| No. of Practical Hrs./ Week | : | 03 | Exam Hours | : | 03 |
| Total No. of Practical Hrs. | : | 42 | Exam Marks | : | 50 |

**(Total 10 experiments are to be conducted)**

**PART - A**

**(Choose at least two experiments)**

**1.** Over current relay **:**
   (a) IDMT non-directional characteristics
   (b) Directional features
   (c) IDMT directional
2. IDMT characteristics of over voltage or under voltage relay. .(solid stare or electromechanical type
3. (a) To determine 50% probability flashover voltage for air insulation subjected to impulse voltage.
   (b) Generation of standard lightning impulse voltage and to determine efficiency and energy of impulse generator.

Operating characteristics of over voltage or under voltage relay. (Solid stare or electromechanical type).

4. Operation of negative sequence relay.
5. Bias characteristics of differential relay.
6. Current-time characteristics of fuse.

**PART - B**

**(Choose at least one experiment)**

1. Operating characteristics of microprocessor based (numeric) over –current relay.
2. Operating characteristics of microprocessor based (numeric) distance relay.
3 Operating characteristics of microprocessor based (numeric) over/under voltage relay.

**PART - C**

**(Choose at least one experiment)**

1. Generator protection –Merz-Price- protection scheme.
2. Feeder protection scheme-fault studies.
3. Motor protection scheme-fault studies.

**PART - D**

**(Choose at least two experiments)**

1. Spark over characteristics of air insulation subjected to high voltage AC with spark over voltage corrected to STP.
2 Spark over characteristics of air insulation subjected to high voltage AC, with spark over voltage corrected to STP for uniform and non-uniform field configuration.
3 Spark over characteristics of air insulation subjected to high voltage dc –
4 Measurement of HVAC and HVDC using standard spheres.
5 Breakdown strength of transformer oil using oil-testing unit.
6 Field mapping using electrolytic tank for any one-model cable/capacitor/transmission line/ Sphere gap models.

## POWER SYSTEM SIMULATION LAB

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EEL78** | IA Marks | : | 25 |
| No. of Practical Hrs./ Week | : | 03 | Exam Hours | : | 03 |
| Total No. of Practical Hrs. | : | 42 | Exam Marks | : | 50 |

Power system simulation using MATLAB/ C or C ++ Sie lab /octave

1. a) Y Bus formation for p systems with and without mutual coupling, by singular transformation and inspection method.
   b) Determination of bus currents, bus power and line flow for a specified system voltage (Bus) Profile
2. Formation of 2-bus, using 2-bus build Algorithm without mutual.
3. ABCD parameters: Formation for symmetric II/I configuration. Verification of AD-BC=1 Determination of coefficient and regulation
4. Determination of power angle diagrams for salient and non-salient pole synchronous m/c s, reluctance power, excitation, emf and regulation.
5. To determine I) Swing curve II) critical clearing time for a single m/c for connected to infinity bus through a pair of identical transmission lines, 3-phase fault on one of the lines for variation of inertia constant/line parameters /fault location/clearing time/pre-fault electrical output.
6. Formation of Jacobian for a system not exceeding 4 buses *(no PV buses) in polar coordinates
7. Write a program to perform load using Gaus- Seidel method (only p q bus)
8. To determine fault currents and voltages in a single transmission line systems with star-delta transformers at a specified location for SLGF, DLGF.
9. Load flow analysis using Gauss Siedel method, NR method, Fast decoupled flow method for both pq and pv buses.
10. Optimal Generator Scheduling for Thermal power plants.

**Note:** 1,2,3,5,7… Simulation Experiments using MATLAB/C or C++/Sielab/Octave
4,6,9-use suitable Standard Package

**VIII SEMESTER**

## INDUSTRIAL MANAGEMENT, ELECTRICAL ESTIMATION & ECONOMICS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE81** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION:** Historical prospective, contribution of Taylor, Henry foyol, Gilberth and HL Gnatt to the evolution of management as a scientific discipline concept of scientific management and it relevance in the Indian context.

**5 Hours**

**ORGANIZATION:** Types of organization; their merits and demerits

**4 Hours**

**UNIT - 2**

**MANAGEMENT FUNCTIONS:** Planning, organizing, staffing, directing, controlling.

**4 Hours**

**UNIT - 3**

**MANAGEMENT AND BEHAVIORAL APPROACH:** contribution of Elton mayo and skinner and others to behavioral science, skills of a manager at various levels in an organization and inter related systems, under standing past behavior, predicting future behavior, directing, changing and controlling behavior; Maslow's hierarchy of needs and satisfaction, goal oriented behavior, integration of organizational goals and needs of employees, Hawthorn's studies and its finding, theory X and Y

**10 Hours**

**UNIT - 4**

**PERSONAL MANAGEMENT:** Recruitment and selection, training of personel employer and employee relationship, causes and settlement of disputes.

**4 Hours**

### PART - B

**UNIT - 5**

**PRODUCTION MANAGEMENT:** Plant location, plant lay-out, CPM and PERT strategies, line balancing, automation statistical quality control; control chart, motion study.

**7 Hours**

**UNIT - 6**

**INTERIOR WIRING SYSTEM:** Wiring system, earthing, and estimation of wiring installation.

**4 Hours**

**UNIT - 7**

**POWER INSTALLATION:** Load calculation, wire size selection, wiring materials for power circuits, and the estimate for motor installation, pump set, workshop, theater etc.,

**8 Hours**

**UNIT - 8**

Depreciation and valuation of machinery, Inventory, Economic order quantity, break-ven analysis

**6 Hours**

**TEXT BOOKS:**

1. **"Introduction to Management"-**S. S. Chatterjee**,**
2. **"Engineering Economics and Management"** - N. Narasimhaswamy,
3. **"Electrical Estimation and Electrical Wiring Systems"**- Raghavendra Rao.

**REFERENCE BOOKS:**

1. **"Industrial Organization and Engineering Economics"-**T. R. Banga & S. C. Sharma.

## POWER SYSTEM OPERATION AND CONTROL

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE82** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**CONTROL CENTER OPERATION OF POWER SYSTEMS:** Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model.

**8 Hours**

**UNIT - 2 & 3**

**AUTOMATIC GENERATION CONTROL:** Automatic voltage regulator, automatic load frequency control, A VR control loops of generators, performance of A VR, ALFC of single area systems, concept of control area, multi-area systems, POOL operation-two area systems, tie-line bias control.

**10 Hours**

**UNIT - 4**

**CONTROL OF VOLTAGE AND REACTIVE POWER:** Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse.

**8 Hours**

**PART - B**

**UNIT - 5**

**POWER SYSTEM OPTIMIZATION:** Optimal system operation with thermal plants, incremental production cost for steam power plants, analytical form of generating cost of thermal plants, constraints in economic operation, flow chart, transmission loss as a function of plant generation, the B-coefficients, examples.

**8 Hours**

**UNIT - 6**

**UNIT COMMITMENT:** Statement of the problem, need and importance of unit commitment, methods-priority lists method, dynamic programming method, constraints, spinning reserve, and examples.

**8 Hours**

**UNIT - 7 & 8**

**POWER SYSTEM SECURITY:** Introduction, factors affecting power system security, power system contingency analysis, detection of network problems, network sensitivity methods, calculation of network sensitivity factor, cotingency ranking.

**10 Hours**

**TEXT BOOKS:**


1. **"Computer Aided Power System Analysis"-** G.L.Kusic, PHI.
2. **"Modern Power System Analysis"-** I J Nagarath and D P Kothari, TMH, 1993.
3. **"Power generation, operation and control"**- Wood & B A J F Woollenberg. John Wiley and Sons, 1984.
4. **"Electric Power Systems"-**B. M. Weedy,

## ELECTIVE-IV (GROUP D)

## MODERN POWER SYSTEM PROTECTION

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE831** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**STATIC RELAYS:** Introduction, Basic construction, Classification, Basic Circuits, Smoothing Circuits, Voltage regulation, square wave Generator, Time delay Circuits, Level Detectors, Summation device, Sampling Circuits, Zero crossing detector, output devices.

**8 Hours**

**UNIT - 2 & 3**

**COMPARATORS:** Replica impedance, Mixing Transformers, General equation of phase and Amplitude, Comparators, Realization of ohm, mho, Impedance and offset impedance characteristics, Duality principle, Static amplifier comparator – Rectifier bridge circulations current type, sampling comparator, static phase comparator coincidence circuits type Rectifier phase comparator, Block split comparator, Zener diode phase comparator,

**12 Hours**

**UNIT - 4**

**PRINCIPLES OF DIGITAL/ NUMERICAL RELAYS:** Definition of Numerical Protection System, Advantages of Numerical relays, Block diagram of Numerical Relays, Processing Unit, non machines Interface, communication in protective relays, Information handling with sub station monitoring system.

**6 Hours**

### PART - B

**UNIT - 5**

**STATIC OVER CURRENT, TIMER AND VOLTAGE RELAYS:** Instantanense over current Relay, Definite time lag relay, inverse time over current relay, static timer relay, Basic relay circuits, monostable delay circuits Single phase Instantaneous over voltage and under voltage relays, instantaneous over voltage relay using Op-amp.

**10 Hours**

**UNIT - 6 & 7**

**DISTANCE RELAY:** general Principle of operation, Zone discrimination, Fault area on impedance diagram, Basic measuring elements, Different

characteristics used in distance relaying- Impedance, Reactance, Admittance. Ohm, Distance relay settings, Distance measurement Problems.

**10 Hours**

**UNIT - 8**

**DIGITAL RELAYS:** Block Schematic approach of microprocessor based relays, over current relay Protection, Transformer differential protection, Directional relay scheme, Impedance relay scheme.

**6 Hours**

**TEXT BOOKS:**


1. **"Power System Protection, Static Relays with Microprocessor applications"-** T.S. Madava Rao, TMH, Second editon, 2004.
2. **"Protective Relays and Protection"** -Van Warrington A. R. and Van C, Vol, I & II Chapman and Hall, 1968.


**REFERENCE BOOKS:**


1. **"Power System Protection"-**Patra. S.P. Basu. S.K. Choudhari.S. Oxford, and IBH Publications Co-1983.
2. **"Power System Protection and switchgear"-**Ravindranath. B and Chanda M. New age International
3. **"Power system protectonand switchgear"**-B.Ram and D.N Vishwa karma- TMH, 1997.
4. **"Fundamentals of Power System Protection"-** Y.G. pasthankar. S.R. Bhide PHI, 2007.


## ELECTRICAL DISTRIBUTION SYSTEM

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE832** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION TO POWER SYSTEM PLANNING AND AUTOMATION:** Factors affecting system planning, present planning techniques, planning models, future trends in planning, systems approach, distribution automation

**8 Hours**

**UNIT - 2**

**LOAD CHARACTERISTIC:** Basic definition, relation between load and load factor, load growth.

**6 Hours**

**UNIT - 3 & 4**

**3. SYSTEM PLANNING:** Planning process, planning criteria, system developers, disperced generation, distribution systems, economics and finance, mapping.

**12 Hours**

**PART - B**

**UNIT - 5 & 6**

**DESIGN AND OPERATION:** Engineering design, operation criteria, substation and feeder, voltage control, harmonics, load variations, system losses, energy management.

**10 Hours**

**UNIT - 7**

**DISTRIBUTION AUTOMATION:** Definitions, communication, sensors, SCADA.

**8 Hours**

**UNIT - 8**

**OPTIMIZATION:** Introduction, costing of schemes, typical network configurations, planning terms, network cost modeling, synthesis of optimum line network.

**8 Hours**

**TEXT BOOKS:**


1. **"Electric power distribution system engineering"-**Turan Gonen, Mc GrawHill, 1986.
2. **"Electric power distribution"**-A S. Pabla, TMH, 5th edition, 2004.


## OPERATION RESEARCH

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE833** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

**PART - A**

**UNIT - 1 & 2**

Introduction, definition, OR models characteristics and phases of OR. Modeling with linear programming: Two variable LP model, Graphical LP solution, model in equation form graphical to algebraic solution, simplex method artificial starting solution, Special cases in simplex method, sensitivity analysis.

**10 Hours**

**UNIT - 3**

**DUALITY:** Definition of the dual problem primal to dual relationships, economic interpretation of duality, additional implex algorithms.

**6 Hours**

**UNIT - 4**

**TRANSPORTATION MODEL:** definition of transportation model basic feasible solution by different methods, finding optimal solutions, stepping stone method, MODI method, the assignment model, traveling salesman problem.

**10 Hours**

**PART - B**

**UNIT - 5**

**ADVANCED LINEAR PROGRAMMING:** revised simplex method, dual simplex method, Bounded variable algorithm, parametric linear programming.

**8 Hours**

**UNIT - 6**

**GAME THEORY:** Formulation of two - person, zero sum games, solving simple games, the Max-min min-max principles, graphical solution procedure, solving by linear programming

**8 Hours**

**UNIT - 7 & 8**

**PERT & CPM TECHNIQUES:** Network representation, critical path computation, construction of the time schedule, variation under probabilistic models, crassing of simple networks, PERT calculations.

**10 Hours**

**TEXT BOOKS:**

1. "**Operation Research An Introduction"**-Hamdy A Thoha, Pearson Education, 8th edition, 2007
2. "**Operations Research – Concept and Cases"-**Fredrick S Hillier and Lieverman TMH, 8th edition, 2007.

**REFERENCE BOOK:**

**1**. **"Optimization Techniques"-**S. S. Rao,

## PROGRAMMABLE LOGIC CONTROLLERS

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE834** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUTION:** Introduction to Programmable logic controller (PLC), role in automation (SCADA), advantages and disadvantages, hardware, internal architecture, sourcing and sinking, characteristics of I/O devices, list of input and output devices, examples of applications. I/O processing, input/output units, signal conditioning, remote connections, networks, processing inputs I/O addresses.

**7 Hours**

**UNIT - 2**

**ROGRAMMING:** Ladder programming- ladder diagrams, logic functions, latching, multiple outputs, entering programs, functional blocks, programme examples like location of stop and emergency switches

**8 Hours**

**UNIT - 3 & 4**

**PROGRAMMING LANGUAGES:** Instruction list, sequential functions charts & structured text, jump and call subroutines**.**

**10 Hours**

### PART - B

**UNIT - 5**

**INTERNAL RELAYS:** ladder programmes, battery- backed relays, one - shot operation, set and reset, master control relay.

**5 Hours**

**UNIT - 6 & 7**

Timers and counters: Types of timers, programming timers, ON and OFF-delay timers, pulse timers, forms of counter, programming, up and down counting, timers with counters, sequencer.

**12 Hours**

**UNIT - 8**

Shift register and data handling: shift registers, ladder programs, registers and bits, data handling, arithmetic functions, temperature control and bottle packing applications.

**10 Hours**

Note: Discussing the programming should be restricted to only one type of PLC (Mitsubhishi)

**TEXT BOOKS:**

1. **"Programmable Logic controllers"-**W Bolton, 4th edition, Elsevier- newness, 2006.
2. **"Programmable logic controllers - principles and applications"-** John W Webb, Ronald A Reis, **-5**th edition, 2nd impression, Pearson education, 2007.

**REFERENCE BOOKS:**

1. **"Programmable Controller Theory and Applications**"-L. A Bryan, E. A Bryan, -2nd edition, An industrial text company publication, 1997.
2. **"Programmable Controllers – An Engineers Guide"**-E. A Paar, 3rd edition, newness, 2003.

## SOFTWARE ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE835** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**OVERVIEW:** Introduction to software engineering

**Software processes:** software processes, Model process, iteration, software specification, software design and implementation software validation, software evolution, automated process support.

**6 Hours**

**UNIT - 2 & 3**

**REQUIREMENTS ENGINEERING:**

**Software Requirements:** Functional and non-functional requirements, user requirements, system requirements, the software-required documents.

**Requirements of Engineering:** processes feasibility studies, requirements elicitation and analysis, requirements validation, requirement, requirements management.

**System Model:** Context Model, Behavior Models, Data Models, Object models, CASE workbench

**Software Prototyping:** Prototyping in Software Processes, Rapid Prototyping Technique, and User-Interface Prototyping.

**12 Hours**

**UNIT - 4**

**SOFTWARE DESIGN:**

**Architectural Design:** System Structuring, Control Models, Modular Decomposition, And Domain Specific architecture.

**Object Oriented Design:** Object and Object Classes, An object oriented design process, Design Evolution.

**User Interface Design:** User interface design principles, User Interaction, Information Presentation User Support, Interface Evaluation.

**10 Hours**

**PART - B**

**UNIT - 5**

**VERIFICATION VALIDATION:**

Verification and validation Planning, Software Inspection, Automated Static Analysis, Clean Room Software Development.

**Software Testing:** Defect Testing, Integration Testing, Object oriented testing, testing workbenches.

**7 Hours**

**UNIT - 6**

**CRITICAL SYSTEM:**

**Critical System:** Critical System, Availability and Reliability, Safety and Security.

**Critical System Specification:** Software reliability specification, Safety Specification.

**4 Hours**

**UNIT - 7**

**SOFTWARE MANAGEMENT:**

**Project Management:** Management Activities, Project Planning, Project Scheduling, and Risk Management.

**Software Cost Estimation:** Productivity, Estimation Techniques, Algorithmic Cost Modeling, Project Duration and staffing.

**Quality Management:** Quality Assurance and standards, Quality Planning, Quality Control, Software Measurements and Metrics.

**9 Hours**

**UNIT - 8**

**SOFTWARE EVOLUTION:**

**Legacy System:** Legacy System Structure, Legacy System Design and Assessment.

**Software Re-Engineering:** Source Code Translation, Reverse Engineering, Program Structure Improvement, and Program Modularization, Data Re-engineering.

**4 Hours**

**TEXT BOOK:**

1. **"Software Engineering"-**an Sommerville**,** 7th Edition, Pearson education, 2005.

**REFERENCE BOOKS:**

1. **"Software Engineering – A Practitioners Approach"-**ogers S.Pressen. TMH, 6th Edition, 2007
2. **"An Integrated Approach to Software Engineering"-**Pankaj Jalote, Narosa Publication.
3. **"Object Oriented & Classical software Engineering"-**Stephen R. Schach**,** TMH, Indian edition, 2007.

## FLEXIBLE AC TRANSMISSION SYSTEMS (FACTS)

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE836** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1 & 2**

Facts, Concepts and general system configuration. Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration, of a transmission interconnection, relative importance of controllable parameters, basic types of FACTs controllers, shunt, series, combined shunt and series connected controllers.

**10 Hours**

**UNIT - 3**

**POWER SEMICONDUCTOR DEVICES:** types of high power devices, principle of high power device characteristics and requirements, power device material, diode, MOSFET, MOS turn OFF thryrirstor, emitter turn OFF thryristor, integrated gate commuted thyristor (GCT & IGCT).

**10 Hours**

**UNIT - 4**

**VOLTAGE SOURCED CONVERTERS:** basic concepts, single phase full wave bridge converter operation, square wave voltage harmonics for a single phase bridge 3 phase full wave bridge converter.

**6 Hours**

### PART - B

**UNIT - 5**

**SELF AND LINE COMMUTATED CURRENT SOURCE CONVERTER:** basic concepts, 3 phase full wave diode rectifier, thyristor

based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter.

**6 Hours**

**UNIT - 6**

**STATIC SHUNT COMPENSATORSVC AND STATCOM:** objective of shunt compensation, methods of controllable Var generation, static Var compensator, SVC and STATCOM, comparison between, SVCandSTATCOM.

**10 Hours**

**UNIT - 7 & 8**

**STATIC SERIES COMPENSATORS:** GCSC, TSSC, TCSC and SSSC, objectives of series compensation; variable impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators.

**10 Hours**

**TEXT BOOK:**

1. **"Understanding Facts - Concepts and technology of flexible AC Transmission system"-** Narayan Hungorian & Laszlo gyugyi IEEE Press, standard publisher, 2001.

**REFERENCE BOOK:**

1. **"EHV – AC, HVDC Transmission & Distribution Engineering" 3rd edition-**S. Rao Khanna publishers, 2003.

## DATA COMMUNICATION AND NETWORKING

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE837** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

**PART - A**

**UNIT - 1**

**INTORDUCTION:** Data Communication, Data representation, Data Flow,

**4 Hours**

**NETWORKS:** Network Criteria's, Physical Strictures, Physical Topology, Network Models, LAW VAN MAN Internet, Protocol & Standers.

**6 Hours**

**UNIT - 2**

**NETWORK MODELS:** Layered Tasks Layers in OSI Model TCI Protocol Suite Addressing. Physical Layer and Media- Data & Signal Analog & Digital Signal Transmission inspiration Data rate limits, performance

**8 Hours**

**UNIT - 3**

**DIGITAL TRANSMISSION:** Digital to digital conversion analog to digital conversion, Transmission modes.

**4 Hours**

**UNIT - 4**

**Analog transmission:** digital to analog conversion and analog to anlog conversion band width utilization y multiplexing.

**4 Hours**

**PART - B**

**UNIT - 5**

**TRANSMISSION MEDIA:** guided media, wireless, the medium access sub layers aloma protocols, LAN protocols IEEE standard 802 Ethernet LAN fiber optic networks, satellite network pocket radio network

**8 Hours**

**UNIT - 6**

**THE DATA LINK LAYER:** Introduction types of error, reducing detection verses correction, elementary data link protocols performance sliding window protocol

**6 Hours**

**UNIT - 7**

**THE NETWORK LAYER INTERNETWORKING,** datagram containerless network conjession control open & close loop conjession control tropic shaping leakay bucket token bucket algorithems interact as datagram network and connection less network

**8 Hours**

**UNIT - 8**

**TRANSPORT LAYER:** Process to process layer delivery claint server pardiagam connection less verses connection orient user data gram protocall (UDP) UDP operation TCP services and features.

**4 Hours**

**TEXT BOOKS:**

1. **"Data Communication And Networking"-** 4th edition**,** Beurouz Fafrouz Zan,
2. **"Computer Networks"** - Tanenbaum**,** PHI 3rd edition, Pearson

**REFERENCE BOOKS:**

1. **"Network for Computer Scientist And Engineers"-**Youn Zhen, Oxford press 2002.
2. "**Data & Computer Networks"**U Stallings, 5th edition, PHI 1998.
3. **"Computer Networks"-** James F Kurose and K W Ross, Pearson.

## ELECTIVE -V (GROUP – E)

## POWER SYSTEM DYNAMICS AND STABILITY

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE841** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION:** Basic concepts, Review of classical methods.

**2 Hours**

**UNIT - 2 & 3**

**SYSTEM MODELING AND DYNAMICS OF SYNCHRONOUS GENERATOR:** Modeling of synchronous machine, Swing equation, Park's transformation – Park's voltage equation, Park's mechanical equation (torque). Applications – (a) Voltage build up in synchronous machine, and (b) Symmetrical short circuit of generator. Solution for transient analysis, Operational impedance, Relationship between Tdo/ and Tdo//, Algebraic constraints.

**14 Hours**

**UNIT - 4**

**EXCITATION AND PRIME MOVER CONTROLLERS:** Introduction, Types of excitation, AVR with and without ESS, TGR, Amplifier PSS, Static exciters.

**8 Hours**

### PART - B

**UNIT - 5**

**MODELING OF PRIME MOVERS:** Introduction, Three major components, Block diagram, Hydraulic turbine, Steam turbine.

**8 Hours**

**UNIT - 6**

**LOAD MODELING:** Introduction, Two approaches – Polynomial model and Exponential model. Small Signal Angle Stability: Small signal angle stability with SMIB system, detailed model of SMIB.

**10 Hours**

**UNIT - 7 & 8**

**TRANSIENT STABILITY ANALYSIS:** Simulation for Transient stability Evaluation, Transient stability controllers.

**10 Hours**

**TEXT BOOKS:**

1. **"Power System Dynamics, Stability and Control"**-Padiyar K.R., Interline Publications.
2. "**Power System Stability and Control"-** Prabha Kundur. McGraw-Hill Publishing Company, NY.

**REFERENCE BOOKS:**

1. **"Dynamics and Control of Large Electric Power Systems"-** Marija Ilic; John Zaborszky, , IEEE Press and John Wiley & Sons, Inc.
2. **"Power System Control and Stability Revised Printing"-**Paul M. Anderson and A. A. Fouad, IEEE Press and John Wiley & Sons, Inc.
3. Selected topics from IEEE Transaction and Conference Proceedings.

## ELECTROMAGNETIC COMPATIBILITY

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE842** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION:** Designing of electromagnetic compatibility, EMC regulation, typical noise path, and use of network theory, method of noise coupling, miscellaneous noise sources, and method of eliminating interference.

**8 Hours**

**UNIT - 2 & 3**

**CABLING:** Capacitive coupling, effect of shield on magnetic coupling, mutual inductance calculations, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, shield transfer impedance, experimental data, example of selective shielding, co-axial cable versus shielded twisted pair braided shields, effect of pig tails, ribbon cable, electrically long cables.

**10 Hours**

**UNIT - 4**

**GROUNDING:** Safety grounds, signal grounds, single point ground systems, hybrid grounds, multipoint ground systems, functional ground layout, practical low frequency grounding, hardware grounds, single ground reference for a circuit amplifier shields, grounding of cable shields, ground loops, low frequency analysis of common mode choke, high frequency

analysis of common mode choke, differential amplifiers, shields grounding at high frequencies, guard shields guarded meters.

**10 Hours**

**PART - B**

**UNIT - 5**

**BALANCING AND FILTERING:** Balancing, power supply decoupling, decoupling filters, amplifier decoupling driving capacitive loads, high frequency filtering, system bandwidth, and modulation and coding.

**8 Hours**

**UNIT - 6 & 7**

**SHIELDING:** Near field and far fields, characteristic and wave impedance's shielding effectiveness, absorption loss, reflection loss, composite adsorption and reflection loss, summary of shielding equation, shielding with magnetic material, experimental data, apertures, wave guide below cutoff, conductive gaskets, conductive windows, conductive coatings, cavity resonance, brooding of shields.

**10 Hours**

**UNIT - 8**

**ELECTROSTATIC DISCHARGE:** State generation, human body model, static discharge, and ESD protection in equipment design, software and ESD protection, ESD versus EMC.

**6 Hours**

**TEXT BOOK:**

1. **"Noise reduction techniques in electronic systems"**- 2nd edition, Henry W. Ott, John Wiley, 1988

## RENEWABLE ENERGY SOURCES

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE843** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

**PART - A**

**UNIT - 1**

**ENERGY SOURCES:** Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario.

**4 Hours**

**UNIT - 2**

**SOLAR ENERGY BASICS:** Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems); Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer.

**6 Hours**

**UNIT - 3**

**SOLAR THERMAL SYSTEMS:** Principle of Conversion of Solar Radiation into Heat, Solar Water Heaters (Flat Plate Collectors), Solar Cookers – Box type, concentrating dish type, Solar driers, Solar Still, Soalr Furnces, Solar Green Houses

**6 Hours**

**UNIT - 4**

**SOLAR ELECTRIC SYSTEMS:** Solar Thermal Electric Power Generation – Solar Pond and Concentrating Solar Collector (parabolic trough, parabolic dish, Central Tower Collector). Advantages and Disadvantages; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems – stand-alone and grid connected; Applications – Street lighting, Domestic lighting and Solar Water pumping systems.

**7 Hours**

**ENERGY STORAGE:** Introduction, Necessity of Energy Storage, and Methods of Energy Storage (classification and brief description using block diagram representation only).

**3 Hours**

**PART - B**

**UNIT - 5**

**WIND ENERGY:** Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of a WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, Advantages and Disadvantages of WECS.

**8 Hours**

**UNIT - 6**

**BIOMASS ENERGY:** Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants – KVIC and Janata model; Biomass program in India.

**6 Hours**

**UNIT - 7**

**ENERGY FROM OCEAN:** Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Estimation of Energy – Single basin and Double basin type TPP (no derivations. Simple numerical problems), Advantages and Limitation of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages & Limitation of OTEC.

**6 Hours**

**UNIT - 8**

**EMERGING TECHNOLOGIES:** Fuel Cell, Small Hydro Resources, Hydrogen Energy, and Wave Energy. (Principle of Energy generation using block diagrams, advantages and limitations).

**6 Hours**

**TEXT BOOKS:**


1. **"Non-Conventional Sources of Energy"- 4th Edition,**Rai, G. DKhanna Publishers, New Delhi, 2007
2. **"Non-Conventional Energy Resources"-** Khan, B. H., TMH, New Delhi, 2006.


**REFERENCE BOOK:**


1. **"Fundamentals of Renewable Energy Systems"** Mukherjee, D., and Chakrabarti, S., New Age International Publishers, 2005.


## HVDC TRANSMISSION

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE844** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1 & 2**

**GENERAL ASPECTS OF DC TRANSMISSION AND COMPARISON OF IT WITH AC TRANSMISSION:** Historical sketch, constitution of EHV AC and DC links, Limitations and Advantages of AC and DC Transmission**.**

**12 Hours**

**UNIT - 3 & 4**

**CONVERTER CIRCUITS:** Valve Characteristics, Properties of converter circuits, assumptions, single phase, three phase converters, choice of best circuits for HV DC circuits

**12 Hours**

## PART - B

**UNIT - 5**

**ANALYSIS OF THE BRIDGE CONVERTER:** Analysis with grid control but no over lap, Analysis with grid control and with over lap less than 60 deg, Analysis with overlap greater than 60 deg, complete characteristics of rectifier, Inversion

**10 Hours**

**UNIT - 6 & 7**

**CONTROL OF HVDC CONVERTERS AND SYSTEMS:** grid control, basic means of control, power reversal, limitations of manual control, constant current versus constant voltage, desired feature of control, actual control characteristics, constant -minimum -Ignition –angle control, constant –current control, constant –extinction –angle control, stability of control

**10 Hours**

**UNIT - 8**

**PROTECTION:** General, DC reactor, voltage oscillations and valve dampers, current oscillations and anode dampers, DC line oscillations and line dampers, clear line faults and reenergizing the line.

**8 Hours**

**TEXT BOOKS:**


1. **"Direct current Transmission"-**EW Kimbark,
2. **"Power system stability and control"-** Prabha Kundur, TMH, 9th reprint, 2007.


## ELECTRICAL POWER QUALITY

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE845** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

## PART - A

**UNIT - 1**

**INTRODUCTION, POWER QUALITY-VOLTAGE QUALITY, POWER QUALITY EVALUATION PROCEDURES TERM AND DEFINITIONS:** general classes of power quality problems, Transients, long duration voltage variation, short duration voltage variations, voltage imbalance, waveform distortion, power quality terms.

**8 Hours**

**UNIT - 2**

**VOLTAGE SAGS AND INTERRUPTIONS:** Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, monitoring sags.

**6 Hours**

**UNIT - 3 & 4**

**TRANSIENTS OVER VOLTAGES:** Sources of transient over voltages, principles of over voltages protection, utility capacitor switching transients, Fundamentals of harmonics: Harmonic distortion, voltage versus transients, harmonic indexes, harmonic sources from commercial loads, harmonic sources from Industrial loads, effects of harmonic distortion, intraharmonics

**10 Hours**

**PART - B**

**UNIT - 5**

**APPLIED HARMONICS:** Harmonic distortion evaluations, principles for controlling harmonics, harmonic studies, devices for controlling harmonic distortion, harmonic filters, standards of harmonics

**10 Hours**

**UNIT - 6**

**POWER QUALITY BENCHMARK:** introduction, benchmark process, power quality contract, power quality state estimation, including power quality in distribution planning, Interface to utility system, power quality issues, interconnection standards

**10 Hours**

**UNIT - 7 & 8**

**POWER QUALITY MONITORING:** Monitoring considerations, power quality measurement equipments, assement of power quality measurement data, application of intelligent systems, power quality monitoring standards.

**8 Hours**

**TEXT BOOK:**

1. **"Electric Power Quality"-**Dugan, Roger C, Santoso, Surya, McGranaghan, Mark F/ Beaty, H. Wayne McGraw-Hill professional publication 2003.

**REFERENCE BOOKS:**

1. **"Electric Power Quality" -** G.T.Heydt, stars in a circle publications 1991.
2. **"Modern Power Electronics"-** M.H.Rashid TATA McGraw Hill 2002.
3. **"Understanding power quality problems voltage sags and interruptions"-**Math H. J. Bollen. IEEE Press, 2000.

## COMPUTER CONTROL OF ELECTRICAL DRIVES

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE846** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**REVIEW OF MICRO CONTROLLERS IN INDUSTRIAL DRIVES SYSTEM:** Typical Micro controller's 8 bit 16 bit (only block diagram) Digital Data Acquisition system, voltage sensors, current sensors, frequency sensors and speed sensors.

**4 Hours**

**UNIT - 2**

**EVOLUTION OF POWER ELECTRONICS IN DRIVES:** Power semiconductors devices used for drives control, GTO, BJT, power MOSFET, IGBT, MCT and IGCT structures, Ratings, comparison and their applications. Block diagram of power integrated circuit for D C motor drives.

**4Hours**

**UNIT - 3**

**A C MACHINE DRIVES:** general classification and National Electrical Manufacturer Association (NEMA) classification, Speed control of Induction motors with variable voltage constant frequency, constant voltage variable frequency, (v/f) constant operation, drive operating regions. Variable stator current operation. Effect of Harmonics.

**9 Hours**

**UNIT - 4**

**SYNCHRONOUS MACHINE DRIVES:** Wound field machine, comparison of Induction and wound field synchronous machines, Torque angle characteristics of salient pole synchronous machines, synchronous reluctance permanent magnet synchronous machines (SPM), variable reluctance machines (VRM).

**8 Hours**

### PART - B

**UNIT - 5**

**PHASE CONTROLLED CONVERTERS:** Converter controls, Linear firing angle control, cosine wave crossing control, phase locked Oscillator principle, Electrro magnetic Interference (EMI) and line power quality problems, cyclo converters, voltage fed converters, Rectifiers, Current fed converters.

**7 Hours**

**UNIT - 6**

**PRINCIPALS OF SLIP POWER RECOVERY SCHEMES**: Static Kramer's drive system, block schematic diagram, phasor diagram and limitations, Static Scherbins scheme system using D.C link converters with cyclo converter modes of operation, modified Scherbins Drive for variable source, constant frequency (VSCF) generation

**6 Hours**

**UNIT - 7**

**PRINCIPLE OF VECTOR CONTROL OF A C DRIVES:** Phasor diagram, digital Implementation block diagram, Flux vector estimation, indirect vector control block diagram with open loop flux control, synchronous motor control with compensation.

**6 Hours**

**UNIT - 8**

**EXPERT SYSTEM APPLICATION TO DRIVES (ONLY BLOCK DIAGRAM):** Expert system shell, Design methodology, ES based P-I tuning of vector controlled drives system, Fuzzy logic control for speed controller in vector control drives,, structure of fuzzy control in feedback system.

**8 Hours**

**TEXT BOOKS:**

1. **"Power Electronics & Motor Drives"-**Bimal Bose, Elsevier 2006
2. **"Modern Power Electronics & Drives"-**Bimal K. Bose, Pearson Education 2003.

**REFERENCE BOOK:**

1. **"Advanced Microprocessor and Interfacing"-** Badri Ram TMH,

## DATA BASE MANAGEMENT SYSTEMS (DBMS)

| | | | | | |
|---|---|---|---|---|---|
| Subject Code | : | **06EE847** | IA Marks | : | 25 |
| No. of Lecture Hrs./ Week | : | 04 | Exam Hours | : | 03 |
| Total No. of Lecture Hrs. | : | 52 | Exam Marks | : | 100 |

### PART - A

**UNIT - 1**

**INTRODUCTION TO DATA BASE SYSTEMS:** Managing data, a historical perspective, File systems versus DBMS, Advantages of DBMS, Describing and Storing Data in DBMS, Queries in DBMS, Transaction management, Structure of DBMS, People who work with databases.

**4 Hours**

**UNIT - 2**

**ENTITY – RELATIONSHIP MODEL:** Using high-Level Conceptual Data Models for Database Design, An example of Database Application, Entity types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY database, ER Diagrams, Naming Conventions and Design Issues

**5 Hours**

**UNIT - 3**

**RELATIONAL MODEL AND RELATIONAL ALGEBRA:** Relational model concepts, relational model constraints and relational database schemes, update operations and dealing with Constraint Violations, Unary relational Operations, SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations, JOIN and DIVISION, Additional Relational Operations, examples of Queries in Relational algebra, relational database design using ER – to-Relational mapping

**8 Hours**

**UNIT - 4**

**SQL-THE RELATIONAL DATABASE STANDARD:** SQL Data definition and data types, specifying basic constraints in SQL, Schemes, Change statements in SQL, basic Queries in SQL, more complex SQL queries, Insert, Delete and update statements in SQL, additional features of SQL, specifying general constraints as assertion, views (virtual tables) in SQL, database Programming, issues and Techniques, Embedded SQL, Dynamic SQL.

**9 Hours**

**PART - B**

**UNIT - 5**

**DATABASE DESIGN:** Informal Design Guidelines for Relation Schemes, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Properties of Relational Decompositions, Algorithms for Relational Database Scheme Design, Multivalued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Inclusion Dependencies, Other Dependencies and Normal Forms.

**10 Hours**

**UNIT - 6**

**DATABASE SECURITY:** Introduction Security, Access control, Discretionary Access, Mandatory Access Control

**3 Hours**

**UNIT - 7 & 8**

**TRANSACTION MANAGEMENT:** The ACID properties, Transactions and Schedules, Concurrent Execution of transactions, Lock-based Concurrency control, performance of locking, Transaction support In SQL, Introduction to crash recovery; 2PL, ss for 4rializability and recoverability, Introduction to lock management, Lock Conversions, Dealing with Deadlocks, Specialized locking Techniques, Concurrency control without locking, Introduction to ARIES, The log, Other Recovery related Data Structures, The write-ahead log Protocol, Check pointing, Recovering from a System Crash, Media Recovery, Other Algorithms and Interaction with Concurrency control.

**13 Hours**

**TEXT BOOKS:**

1. **"Database Management Systems"** 3rd Edition, Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill, 2003.
2. **"Fundamentals of Database Systems"-**Elmasri and Navathe**,** 4th Edition, Pearson Education, 2003.