**COURSE STRUCTURE**

**AND**

 **DETAILED SYLLABUS**

**III & IV – B.TECH – I & II - SEMESTERS**

**ELECTRICAL AND ELECTRONICS ENGINEERING**

**FOR**

**B.TECH FOUR YEAR DEGREE COURSE**

**(Applicable for the batches admitted from 2014-15)**

****

**ANURAG GROUP OF INSTITUTIONS**

**AUTONOMOUS**

**VENKATAPUR, GHATKESAR, HYDERABAD – 500 088, TELANGANA STATE.**

**ANURAG GROUP OF INSTITUTIONS**

**(AUTONOMOUS)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Subject code | Subject | Lectures | T/P | Credits |
| A55007 | IC Applications | 3 | 1 | 3 |
| A55008 | Management Science | 3 | 1 | 3 |
| A55009 | Power Electronics | 3 | 1 | 3 |
| A55010 | Power Systems –II | 4 | 1 | 4 |
| A55011 | Electrical machines –III | 4 | 1 | 4 |
| A55012 | Switching Theory and Logic Design | 4 | 1 | 4 |
| A55204 | Control Systems Lab | - | 3 | 2 |
| A55205 | Electrical machines-II Lab | - | 3 | 2 |
|  | **Total** | **21** | **12** | **25** |

**III YEAR I SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Subject code | Subject | Lectures | T/P | Credits |
| A56010 | Switch Gear and Protection | 4 | 1 | 4 |
| A56011 | Power System Operation And Control | 4 | 1 | 4 |
| A56012 | Electrical Measurements | 3 | 1 | 3 |
| A56013 | Micro Processors & Micro Controllers | 4 | 1 | 4 |
| A56014 | Digital Signal Processing | 3 | 1 | 3 |
| A56015A56016A56017 | **Open Elective**Object Oriented Programming Through JavaIntellectual Property RightsNano Technology | 3 | 1 | 3 |
| A56204 | Power Electronics Lab | - | 3 | 2 |
| A56205 | Advanced English Communication Skills lab | - | 3 | 2 |
|  | **Total** | **21** | **12** | **25** |

**III YEAR II SEMESTER COURSE STRUCTURE**

**T- Tutorial P-Practical**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Subject code | Subject | Lectures | T/P | Credits |
| A57010 | Utilization of Electrical Energy | 4 | 1 | 4 |
| A57011 | Instrumentation | 3 | 1 | 3 |
| A57012 | Computer Methods in Power Systems | 4 | 1 | 4 |
| A57013 | Power semi conductor drives | 4 | 1 | 4 |
| A57014A57015A57016 | **Elective -I**1-High Voltage Engineering2-VLSI Design3-Neural Networks and Fuzzy Logic | 3 | 1 | 3 |
| A57017A57018A57019 | **Elective -II**1-Optimization Techniques2-Electrical Distribution System3-Linear System Analysis | 3 | 1 | 3 |
| A57204 | Micro processors & Micro Controllers lab | - | 3 | 2 |
| A57205 | Electrical Measurements Lab | - | 3 | 2 |
| A57206 | Industry Oriented Mini Project | - | - | 2 |
|  | **Total** | **21** | **12** | **27** |

**IV YEAR I SEMESTER COURSE STRUCTURE**

**B.Tech IV YEAR II SEMESTER COURSE STRUCTURE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Subject code | Subject | Lectures | T/P | Credits |
| A58010 | HVDC Transmission | 3 | 1 | 3 |
| A58011A58012A58013 | **Elective -III**1-Renewable Energy Sources2-Digital Control Systems3-Power system Reliability | 3 | 1 | 3 |
| A58014A58015A58016 | **Elective -IV**1-Advanced Control Systems2-EHV AC transmission3-Computer Organization | 3 | 1 | 3 |
| A58205 | Seminar | - | 6 | 2 |
| A58206 | Comprehensive Viva- Voce | - | - | 2 |
| A58207 | Project Work | - | 15 | 10 |
|  | **Total** | **9** | **24** | **23** |

Note: All End Examinations (Theory and Practical) are of three hours duration.

**T – Tutorial P – Practical**

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year I-Semester L T C**

**3 1 3**

**IC APPLICATIONS**

**Course Objectives :**

The students will be able to

1. Study about electrical properties of analog ICs like Op-Amps, IC 555 timer, PLL.
2. Analyze and know the design concepts of various applications of ICs.
3. Study the design concepts Digital circuits using ICs.

**UNIT -I**

**Integrated Circuits**
**Introduction**: Classification. Chip Size and Circuit Complexity, Ideal and Practical Op-Amp, Op-amp characteristics-DC and AC Characteristics. 741 Op-Amp and its Features, Modes of operation-inverting, non-inverting, differential.
**Applications**: Basic Applications of Op-Amp, Instrumentation Amplifier, AC Amplifier, V to I and I to V Converters, Sample & Hold Circuits. Differentiators and Integrators. Comparators. Schmitt Trigger. Multivibrators, Introduction to Voltage Regulators Features of 723 Regulators.

**UNIT- II**

**Active Filters & Oscillators**

**Filters**: First Order and Second Order Low Pass. High Pass and Band Pass Filters. Active Band Reject and All Pass Filters.
**Oscillators**: Principle of Operation and Types of Oscillators – RC, Wien Bridge and quadrature type. Waveform Generators - Triangular. Saw Tooth, Square Wave.
**Introduction to 555 Timer**, Functional Diagram, Monostable and Astable Operations and Applications, Schmitt Trigger, PLL- Introduction, Block Schematic, Principles and Description of individual Blocks of 565, VCO.

**UNIT- III**

**D-A And A- D Converters**
Introduction, Basic DAC Techniques - Weighted Resistor Type. R-2R Ladder Type, inverted R-2R Type. Different types of ADCs - Parallel Comparator Type. Counter Type. Successive Approximation Register Type and Dual Slope Type DAC and ADC Specifications.

**UNIT- IV**

**Digital Integrated Circuits Introduction**Classification of Integrated Circuits. Standard TTL NAND Gate-Analysis & Characteristics, TTL Open Collector Outputs. Tristate TTL, MOS & CMOS open drain and tristate outputs, Comparison of Various Logic Families. IC interfacing- TTL driving CMOS & CMOS driving TTL

**UNIT -V**

**Combinational & Sequential Circuit Ics**
**Combinational Circuit ICs** :Use of TTL-74XX Series & CMOS 40XX Series ICs, TTL ICs - Code Converters, Decoders, Demultiplexers, Encoders, Priority Encoders, multiplexers & their applications. Priority Generators, Arithmetic Circuit ICs-Parallel [Binary](http://jntusyllabus.blogspot.in/2012/02/ic-applications-syllabus_03.html) Adder/Subtractor Using 2's Complement System, Magnitude Comparator Circuits.
**Sequential Circuit ICs:** Commonly Available 74XX & CMOS 40XX Series ICs - RS, JK.JK Master-Slave. D and T Type Flip-Flops & their Conversions, Synchronous and asynchronous counters. Decade counters. Shift Registers & applications.

**TEXT BOOKS:**
1. Linear Integrated Circuits -D. Roy Chowdhury, New Age International (p)Ltd, 3" Ed., 2008.
2. Digital Fundamentals - Floyd and Jain, Pearson Education,8th Edition, 2005.
3. Op-Amps and Linear Integrated Circuits - Concepts and Applications by James M.Fiore, Cengage/ Jaicc, 2/e, 2009.

**REFERENCE BOOKS:**
1. Modern Digital Electronics - RP Jain - 4/e - TMH, 2010.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI, 1987

**Course Outcomes :**

After going through this course the student will be able to

* Design various applications of Op-Amps.
* Design the circuits using special ICs like 555 timer, 723 voltage regulator and 565 PLL.
* Design A/D and D/A Converters using ICs.
* Design digital circuits using digital ICs.
* Understanding of the different families of digital integrated circuits and their characteristics.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year I-Semester L T C**

**3 1 3**

**MANAGEMENT SCIENCE**

**Course Objectives:**

* To provide students a wonderful opportunity of learning the basics and concepts of management functions like Marketing, HRM, Operations Management and an Organization environment.
* To apply major quantitative techniques in order to improve managerial decisions
* To develop analytical, critical thinking, and problem-solving skills in a business context

**Unit-I**

**Introduction to Management: Entrepreneurship and organization:** Nature and importance of Management, Functions of Management, Taylor’s scientific Management Theory, Fayol’s principles of management, Maslow’s theory of Human Needs, Douglas Mc Gregor’s Theory X and Theory Y, Herzberg’s Two factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social Responsibilities of Management. Types of organization structures.

**Unit-II**

**A) Operations Management:** Principles and Types of Plant Layout-Methods of production(Job, batch and Mass production), Work Study – Basic procedure involved in Method Study and Work measurement-Statistical Quality Control: X chart, R chart, C chart, P chart, (simple problems), Acceptance Sampling, Deming’s contribution to quality.

**B) Materials Management:** Objectives, Need for Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records – Supply Chain Management.

**Unit –III**

**A) Human Resources Management (HRM):**  Evolution of HRM, Concepts of HRM, Basic functions of HR Manager: Manpower Planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating.

**B) Marketing:** Functions of Marketing, Marketing Mix, Marketing strategies based on Product Life cycle, Channels of distribution.

**Unit –IV**

**Project Management(PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method(CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing.(simple Problem)

**Unit –V**

**Strategic &** **Contemporary Management Practices:** Mission, Goals, objectives, policy, strategy, Programmes, Elements of Corporate Planning process, Environmental Scanning, SWOT analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Basic concepts of Just-In-Time(JIT) system, Total Quality Management(TQM), Six Sigma and Capability Maturity Model(CMM) levels, Value chain Analysis, Enterprise Resource Planning(ERP), Performance Management, Business Process Outsourcing(BPO), Business process Re-engineering 5S Model, Deming’s PDCA, Kaizen, Poka-Yoke, Muda, Benchmarking, Balanced Score Card.

**Text books:**

1. Management Science, Aryasri, TMH, New Delhi, 2009

**References:**

1. Management, Stoner, Pearson, 2009.
2. Marketing Management, Kotler Philip & Keller Kevin Lane: PH, 2009.
3. Principles of Management, Koontz, Weihrich & Aryasri: TMH, 2009.
4. Management-Principles and Guidelines, Thomas N. Duening & John M. Ivancevich, Cengage, 2009.
5. Production and Operations Management, Kanishka Bedi, Oxford University Press, 2009.
6. Personnel Management, Memoria & S.V.Ganker, Himalaya, 2009.
7. Management, Schermerhorn, Wiley, 2009
8. Parnell: Strategic Management, Biztantra, 2009.
9. PERT/CPM, L.S. Srinath, Affiliated East-West Press, 2009.
10. Introduction to Management Science, William J. Stevenson & Ceyhun Ozgur: TMH, 2007

**Course Outcomes:**

1. There are varieties of sources in helping you to understand the foundation of decision making.
2. Provide the students with a basic understanding of contract models.
3. be able to prepare contract plans and specifications.
4. be able to prepare quantity take-offs, productivity analyses, cost estimates and schedules for given projects.
5. understand elements of procurement and bidding strategies.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year I-Semester L T C**

**3 1 3**

**POWER ELECTRONICS**

**Course Objectives:**

1. To understand and acquire knowledge about various power semiconductor devices
2. To analyze and design various power converter circuits
3. To know their applicability as per the specific requirement
4. Introduce hardware and software used in power electronic switching circuits

**UNIT-I**

**Power Semi Conductor Devices and Commutation Circuits**

Thyristors – Silicon Controlled Rectifiers (SCRs) – BJT – Power MOSFET – Power IGBT and their characteristics and other thyristors .Basic theory of operation of SCR – Static characteristics – Turn on and turn off methods- Dynamic characteristics of SCR - Turn on and Turn off times -Salient points.

Two transistor analogy of SCR - UJT firing circuit - Series and parallel connections of SCRs Snubber circuit details – Specifications and Ratings of SCRs, BJT, IGBT - Numerical problems – Line Commutation and Forced Commutation circuits.

**UNIT-II**

**Single Phase Half Controlled Converters and Fully Controlled Converters**

Phase control technique - Single phase Line commutated converters Midpoint and Bridge connections – Half controlled converters with Resistive, RL loads and RLE load with continuous current mode of operation –Derivation of average load voltage and current -Active and Reactive power inputs to the converters without and with Free wheeling Diode.

Fully controlled converters, Midpoint and Bridge connections with Resistive, RL loads and RLE load for continuous current mode of operation. Derivation of average load voltage and current – Line commutated inverters. Active and Reactive power inputs to the converters without and with Freewheeling Diode. Effect of source inductance – Derivation of load voltage and current – Numerical problems.

**UNIT-III**

**Three Phase Line Commutated Converters**

Three phase converters – Three pulse and six pulse converters – Midpoint and bridge connections average load voltage With R and RL loads.

Effect of Source inductance–Dual converters (both single phase and three phase) - Waveforms –Numerical Problems.

**UNIT-IV**

**AC Voltage Controllers & Cyclo Converters**

AC voltage controllers – Single phase two SCRs in anti parallel – With R and RL loads – modes of operation of Triac with R and RL loads – Derivation of RMS load voltage, current and power factor wave forms. Firing circuits -Numerical problems.

Cyclo converters – Single phase midpoint Cyclo converters with Resistive and inductive loads (Principle of operation only) – Bridge configuration of single phase Cyclo converter (Principle of operation only) – Waveforms

### UNIT-V

### Choppers and Inverters

Choppers – Time ratio control and Current limit control strategies – Step down choppers Derivation of load voltage and currents with R, RL and RLE loads for continuous and discontinuous current modes.

Step up Chopper – load voltage expression

Morgan’s chopper – Jones chopper (Principle of operation only) -Waveforms - AC Chopper – Problems.

Inverters – Single phase inverter – Basic series inverter – Basic parallel Capacitor inverter- Bridge inverters -120o and 180o modes of operation – Waveforms – Simple forced commutation circuits for bridge inverters. Voltage control techniques for inverters-Pulse width modulation techniques – Numerical problems.

**TEXT BOOKS:**

 1. Power electronics-P.S. Bimbhra- Khanna Publishers, 4th Edition

2. Power electronics – M.D. Singh & K.B. Kanchandhani, Tata Mc Graw – Hill Publishing Company, 2nd edition.

3. Power Electronics: Circuits Devices and Applications – M.H. Rashid, Prentice Hall of India, 3rd edition.

**REFERENCE BOOKS:**

1. Power Electronics – Vedam Subramanyam, New Age International (p) Limited, Publishers.
2. Power Electronics – P.C. Sen, Tata Mc Graw-Hill Publishing.
3. Thyristorised power Controllers – G.K. Dubey, S.R Doradra, A. Joshi and R.M.K. Sinha, New Age international Pvt Ltd. Publishers.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. Characteristics of various Power Electronics devices such as SCR, TRIAC, DIAC, IGBT, GTO etc.
2. To apply fundamental concepts of Power Electronics devices in Choppers, Inverters and Converters etc.
3. To identify basic requirements for power electronics based design application.
4. To understand the use of power electronics in commercial and industrial applications.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year I-Semester L T C**

**4 1 4**

**POWER SYSTEMS-II**

**Course Objectives:**

1. To learn the concept Power factor and Voltage Control, Dependency of Voltage on Reactive Power Flow
2. To describe Traveling wave theory and derive expressions for reflection and refraction coefficients with various terminations of the lines
3. To perform sag-tension calculations and also describe various types of Insulators
4. To illustrate different types of cable and also describe grading of cables

**Unit-I**

**Power factor and Voltage Control, Dependency of Voltage on Reactive Power Flow**

Causes of low p.f - Methods of improving p.f -Phase advancing and generation of reactive KVAR using static Capacitors-Most economical p.f. for constant KW load and constant KVA type loads, Numerical Problems.

Methods of Voltage Control: Shunt Capacitors, Series Capacitors, Synchronous Capacitors, Tap changing and Booster Transformers

**Unit-II**

**Performance of Short and Medium Length Transmission Lines and Performance of Long Transmission Lines**

Classification of Transmission Lines - Short, medium and long line and their model representations - Nominal-T, Nominal-π and A, B, C, D Constants for symmetrical & Asymmetrical Networks, Numerical Problems, Mathematical Solutions to estimate regulation and efficiency of all types of lines - Numerical Problems.

Long Transmission Line-Rigorous Solution, evaluation of A,B,C,D Constants, Interpretation of the Long Line Equations, Incident, Reflected and Refracted Waves , Surge Impedance and SIL of Long Lines, Wave Length and Velocity of Propagation of Waves - Representation of Long Lines - Equivalent-T and Equivalent π network models (numerical problems).

**Unit-III**

**Power System Transients**

Types of System Transients - Travelling or Propagation of Surges - Attenuation, Distortion, Reflection and Refraction Coefficients - Termination of lines with different types of conditions, Open Circuited Line, Short Circuited Line,T-Junction, Lumped Reactive Junctions (Numerical Problems). Bewley’s Lattice Diagrams (for all the cases mentioned with numerical examples).

**Unit-IV**

**Various Factors Governing the Performance of Transmission line and Overhead Line Insulators**

Skin and Proximity effects - Description and effect on Resistance of Solid Conductors -

Ferranti effect - Charging Current - Effect on Regulation of the Transmission Line, Shunt Compensation.

Corona - Description of the phenomenon, factors affecting corona, critical voltages and power loss, Radio Interference.

Types of Insulators, String efficiency and Methods for improvement, Numerical Problems voltage distribution, calculation of string efficiency, Capacitance grading and Static Shielding.

**Unit-V**

**Sag and Tension Calculations and Underground Cables**

Sag and Tension Calculations with equal and unequal heights of towers Effect of Wind and Ice on weight of Conductor, Numerical Problems - Stringing chart and sag template and its applications

Types of Cables, Construction, Types of Insulating materials, Calculations of Insulation resistance and stress in insulation, Numerical Problems.

Capacitance of Single and 3-Core belted cables, Numerical Problems.

Grading of Cables - Capacitance grading, Numerical Problems, Description of Inter-sheath grading.

**TEXT BOOKS:**

1. A Text Book on Power System Engineering- M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarthy, Dhanpat Rai & Co Pvt. Ltd.
2. Electrical power systems - C.L.Wadhwa, New Age International (P) Limited, Publishers,1998.

**REFERENCE BOOKS:**

1. Power system Analysis- John J Grainger William D Stevenson, TMC Companies, 4th edition
2. Power System Analysis and Design- B.R.Gupta, Wheeler Publishing.
3. Power System Analysis - Hadi Saadat – TMH Edition.
4. Modern Power System Analysis- I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 2nd Edition.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. To learn the concept Power factor and Voltage Control, Dependency of Voltage on Reactive Power Flow
2. To understand the various problems arise in transmission like such as corona, Sag, Ferranti effect.
3. The investigate power factor improvement, capacitor bank installation in distribution system.
4. Design prototype model of small, medium and long transmission lines and calculate line parameters.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year I-Semester L T C**

**4 1 4**

**ELECTRICAL MACHINES- III**

**Course objectives :**

1. Able to know theory and performance of Synchronous Generators.
2. To Understand the parallel operation of AC Generators.
3. To know the importance of Synchronous Motor in power Generation and Industry.
4. To have a brief idea about various special machines.

**Unit-I**

 **Synchronous Generator: Construction-Principle of Operation & Characteristics**

Constructional Features of round rotor and salient pole machines – Armature windings – Integral slot and fractional slot windings; Distributed and concentrated windings – distribution, pitch and winding factors – E.M.F Equation. Harmonics in generated e.m.f. – suppression of harmonics – armature reaction - leakage reactance – synchronous reactance and impedance – experimental determination - phasor diagram – load characteristics.

**Unit-II**

**Voltage Regulation of Synchronous Generators**

Regulation by synchronous impedance method, M.M.F. method, Z.P.F. method and A.S.A. methods – Salient pole alternators – two reaction theory – experimental determination of Xd and Xq (Slip test) Phasor diagrams – Regulation of salient pole alternators.

**Unit-III**

 **Parallel Operation of Synchronous Generator**

Synchronizing alternators with infinite bus bars – Synchronizing power and synchronizing torque – parallel operation and load sharing - Effect of change of excitation and mechanical power input. Analysis of short circuit current wave form – determination of sub-transient, transient and steady state reactances.

**Unit-IV**

**Synchronous Motors**

Principle of operation-methods of starting-phasor diagram-Variation of current and power factor with excitation-synchronous condenser-Mathematical analysis for power developed-circle diagrams of synchronous machines-hunting and its suppression-damper windings.

**Unit-V**

**Special Motors**

 Basic Principle of operation and application of AC series motor-Universal motor-Stepper motor –shaded pole motor-Reluctance motor-BLDC motor (Elementary treatment only)

**TEXT BOOKS:**

1. Electrical Machinery – P.S. Bimbra, Khanna Publishers, 7th Edition.
2. Theory and Performance of Electrical machines - J.B Gupta, S.K. Kataria & Sons, 14th Edition.

**REFERENCE BOOKS:**

 1. Electric Machines – I.J.Nagrath & D.P.Kothari, Tata Mc Graw-Hill Publishers, 3rd Edition

 2006.

2. Electrical Machines- Milukutla S Sarma, Mukesh K Pathak, Cengage Learning, 2009

1. Electric Machinery – A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw-Hill Companies, 5th edition, 1990.
2. Electromachanics-III (Synchronous and single phase machines),S.Kamakashiah, Right Publishers

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. Learned the theory, operation and characteristics of Synchronous Generators.
2. Understood conditions to be fulfilled for parallel operation of AC Generators
3. Analyzed the improvement of power factor using Synchronous Motor.
4. Gained knowledge about special Motors used for various applications.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year I-Semester L T C**

**4 1 4**

**SWITCHING THEORY AND LOGIC DESIGN**

**Course Objectives:**
The main objectives are:

1. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
2. To understand common forms of number representation in digital electronic circuits and to be able to convert between different representations.
3. To implement simple logical operations using combinational logic circuits.
4. To design combinational logic circuits, sequential logic circuits.
5. To impart to student the concepts of sequential circuits, enabling them to analyze sequential systems in terms of state machines.
6. To implement synchronous state machines using flip-flops.

**UNIT-1: Number Systems And Codes:**

Review of number systems binary arithmetic, binary weighted and non-weighted codes. Error detecting and error correcting codes.

**Boolean Algebra:**

Postulates and theorems: representation of switching functions, SOP and POS forms Karnaugh Map representations, minimization using K Maps.

 **UNIT- II:**

**Design Of Combinational Circuits:**

Tabular minimization – design of single output and multi output functions design using conventional AND, OR, NOT, NAND, NOR & EX-OR gates. Design using MSI & LSI devices, digital multiplexer/selector, decode demultiplexer, design of 4 bit adder, carry look-ahead adder, magnitude comparator, BCD converter. Logic implementations using ROM, PAL & PLA.

**Unit-III:**

**Introduction To Sequential Circuits:**

Combinational versus sequential circuits, asynchronous versus synchronous circuits, state table and state diagram, state assignment, memory elements and their excitation functions, T flip flop, RS flip flop, JK flip flop and their excitation requirements. Design of synchronous sequential circuits like sequence detectors and binary counters.

**UNIT-IV:**

**Capabilities And Minization Of Sequential Machines:**

Melay and Moore machines, capabilities and limitations of finite state machine, state equivalence and machine minimization.

**UNIT-V:**

**Algorithimic State Machines:**

ASM chart, timing considerations, control implementation, design with multiplexers and PLA control. Introduction to unate functions and threshold logic.

**Text Books:**

1. Switching And Finite Automata Theory – Zvi Kohavi, TMH Edition.
2. Digital Logic Computer Design – M. Morris Mano, PHI.
3. Digital Logic Design Principles – Norman Balbamian and Breadly, John Wiley

**References:**

1. Introduction to Switching Theory and Logic Design- By F. J. Hill and Peterson, John Wiley Publications.
2. Digital Logic – Applications & Design – By- John M. Yarbroough, Vikas Publications, 1997.
3. Digital System Design – By R. P. Jain TMH.
4. Digital Systems Principles, Applications– By Ronald J. Tocci, Pearson Education/Phil

**Course Outcomes:**

Upon completion of the course, students should possess the following skills:

1. Be able to manipulate numeric information in different forms, e.g. different bases, signed integers, various codes such as ASCII, Gray, and BCD.
2. Be able to manipulate simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.
3. Be able to design and analyze small combinational circuits and to use standard combinational functions/building blocks to build larger more complex circuits.
4. Be able to design and analyze small sequential circuits and devices and to use standard sequential functions/building blocks to build larger more complex circuits.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year I-Semester L P C**

**- 3 2**

**CONTROL SYSTEMS LAB**

Any Ten Experiments from the following list.

1. Time response of Second Order System
2. Effect of P, PI, PID controller on a second order system
3. Characteristics of Synchros
4. Lead and Lag Compensation –Magnitude and phase plot
5. Characteristics of AC Servomotor
6. Effect of feedback on DC Servomotor
7. Transfer function of a DC motor
8. P-spice simulation of OP-AMP based Integrator and Differentiator
9. Root Locus Plot, Bode Plot, Nyquist Plot and Polar Plot of Transfer Function using Matlab
10. State space model for a given classical transfer function using Matlab
11. Programmable Logic Controller

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year I-Semester L P C**

**- 3 2**

 **ELECTRICAL MACHINES-II LAB**

All experiments from part A and Two experiments from part B.

 **Part A**

1. O.C. & S.C. Tests on single phase transformer.

2. Sumpner's test on a pair of single phase transformers.

3. Brake test on three phase squirrel cage induction motor.

4. No-load & blocked rotor tests on three phase Slip ring Induction motor.

**5.** Regulation of a three phase alternator by synchronous impedance (EMF & MMF) method.

6. V and inverted V curves of a three - phase Synchronous motor.

7. Equivalent circuit of a single phase induction motor.

**8.** Determination of Xd and Xq of a salient pole synchronous machine.

 **Part B**

1. Parallel Operation of Single Phase Transformers.

2. Separation of core losses of a single phase transformer.

3. Scott connection of Transformers.

4. Regulation of a three phase alternator by ZPF & ASA method.

5. Efficiency of a three phase alternator.

6. Heat run test on a bank of 3 Nos. of single phase delta connected transformers.

7. Measurement of sequence Impedance of a 3phase alternator..

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L T C**

**4 1 4**

**SWITCH GEAR AND PROTECTION**

**Course Objectives:**

1. To introduce students to power system protection and switchgear
2. To teach students theory and applications of the main components used in power system protection for electric machines, transformers, bus bars overhead and underground feeders
3. To teach students the theory, construction, applications of main types Circuit breakers, Relays for protection of generators, transformers and protection o f feeders from over- voltages and other hazards. It emphasis on neutral grounding for overall protection
4. To develop an ability and skill to design the feasible protection systems needed for each main part of a power system in students

**Unit - I**

**Circuit Breakers**

Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages.- Restriking Phenomenon, Average and Max. RRRV, Numerical Problems - Current Chopping and Resistance Switching - CB ratings and Specifications: Types and Numerical Problems. – Auto reclosures.

Description and Operation of following types of circuit breakers: Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers.

**Unit-II**

 **Electromagnetic and Static Relays**

Principle of Operation and Construction of Attracted armature, Balanced Beam, Induction Disc and Induction Cup relays.

Relays Classification: Instantaneous, DMT and IDMT types.

Applications of relays: Over current/ under voltage relays, Direction relays, Differential Relays and Percentage Differential Relays.

Universal torque equation, Distance relays: Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison.

Static Relays:

Introduction to static Relays- phase comparators- Amplitude comparators- Static Relays versus Electromagnetic Relays.

**Unit-III**

**Generator and Transformer Protection**

Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on (%) Winding Unprotected.

Protection of transformers: Percentage Differential Protection, Numerical Problems on Design of CTs Ratio in differential protection, Buchholtz relay Protection.

**Unit-IV**

**Feeder and Bus-Bar Protection**

Protection of Lines: Over Current, Carrier Current and Three-zone distance relay protection using Impedance relays. Translay Relay.

Protection of Bus bars – Differential protection.

**Unit-V**

**Neutral Grounding and Protection against over voltages**

Grounded and Ungrounded Neutral Systems.- Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance - Arcing Grounds and Grounding Practices.

Generation of Over Voltages in Power Systems.-Protection against Lightning Over Voltages - Valve type and Zinc-Oxide Lighting Arresters - Insulation Coordination -BIL, Impulse Ratio, Standard Impulse Test Wave, Volt-Time Characteristics.

**TEXT BOOKS:**

1. Switchgear and Protection – Sunil S Rao, Khanna Publishers

2. Power System Protection and Switchgear - Badri Ram, D.N Viswakarma, TMH Publications

**REFERENCE BOOKS:**

1. Transmission network Protection -Y.G. Paithankar, Taylor and Francis, 2009.
2. Power System Protection and Switch Gear - Bhuvanesh Oza, TMH 2010.
3. Electrical Power systems – C.L. Wadhwa, New Age International (P) Limited, Publishers, 6th Edition.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. Compare and contrast electromagnetic, static and microprocessor based relays
2. Select relay settings of over current and distance relays.
3. Analyze quenching mechanisms used in air, oil and vacuum circuit breakers
4. Apply technology to protect power system components.

**Anurag Group of Institutions**

**(Autonomous)**

**B.Tech EEE III Year II-Semester L T C**

**4 1 4**

**POWER SYSTEM OPERATION AND CONTROL**

**Course Objectives:**

1. To provide the knowledge of optimization techniques used in the power system and Load Frequency Control (LFC).
2. To provide a solid foundation in mathematical models and engineering fundamentals required to control the governing system in Turbine models, hence the power system control.
3. To provide the knowledge of load scheduling of power plants.
4. To provide the knowledge of reactive power control and compensation

**UNIT - I : Economic Operation of Power Systems**

Optimal operation of Generators in Thermal Power Stations, - Heat rate Curve – Cost Curve –Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected.

Optimum generation allocation including the effect of transmission line losses – Loss coefficients, General transmission line loss formula.

**Unit - II : Hydro Thermal Scheduling**

Optimal scheduling of Hydrothermal System: Hydroelectric power plant models, scheduling problems-Short term hydrothermal scheduling problem.

**UNIT- III : Modelling of Turbine, Generator and Automatic Controllers**

Modelling of Governor: Mathematical Modelling of Speed Governing System – Derivation of small signal transfer function.

Modelling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models.

Modelling of Generator (Steady State and Transient Models): Description of Simplified Network

Model of a Synchronous Machine (Classical Model), Description of Swing Equation (No Derivation) and State-Space 2nd-Order Mathematical Model of Synchronous Machine -Generator – Load Model.

Modelling of Excitation System: Fundamental Characteristics of an Excitation system, Transfer function, Block Diagram Representation of IEEE Type-1 Model

**UNIT- IV : Load Frequency Control**

Necessity of keeping frequency constant. Definitions of Control area – Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response –Controlled and Uncontrolled cases.

Load frequency control of 2-area system – uncontrolled case and controlled case, tie-line bias Control

Proportional plus Integral control of single area and its block diagram representation, steady state response – Load Frequency Control and Economic dispatch control.

**UNIT-V: Reactive Power Control**

Overview of Reactive Power control – Reactive Power compensation in transmission systems –advantages and disadvantages of different types of compensating equipment for transmission systems; load compensation – Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation.

**TEXT BOOKS:**

1 .‘Modern Power system Analysis’- D P Kothari and I J Nagrath - Tata McGraw-Hill -

 4th Edition.

2.‘Modelling of Power Systems’ – P S R Murthy– BS Publications.

3. ‘Power System Operation and Control’- S. Sivanagaraju *-* Pearson Education India, 1st

 Edition.

**REFERENCE BOOKS:**

1.‘Operation and Control In Power Systems’ - P S R Murthy.

2. ‘Power generation, Operation and Control’ – Allen J Wood.

3. ‘Power System Analysis’ – C.L. Wadhwa, Newage International – 6th Edition.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. Get a knowledge on performance curves of power plants, importance of economic operation and LFC of interconnecting power system.
2. Be conversant with the concept and principle of optimal operation of interconnected and isolated of power plants and compensation of reactive power flow.
3. Apply the right methodologies to solve the issues in complex power system and analyze the systems based on their performance .
4. Analyze the steady state and dynamic behavior of the power system for voltage and frequency fluctuations also different compensating devices for reactive power flow control

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L T C**

**3 1 3**

**ELECTRICAL MEASUREMENTS**

**Course Objectives:**

1. Introduction to common measuring instruments, and their application to electrical measurements.
2. Identify and classify error sources, and explain how their effects can be minimized
3. To understand the basic design techniques of measuring devices.
4. To know the industrial and laboratory applications.

**Unit-I**

**Measuring Instruments**

Classification – deflecting, control and damping torques – Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations, extension of range using shunts and series resistance. Electrostatic Voltmeters-electrometer type and attracted disc type – Extension of range of Electrostatic Voltmeters.

**Unit-II**

**Instrument Transformers**

CT and PT – Ratio and phase angle errors – design considerations- Type of P.F. Meters – dynamometer and moving iron type – 1-ph and 3-ph meters – Frequency meters – Resonance type and Weston type – Synchroscopes.

**Unit-III**

**Measurement of Power and Energy**

Single phase dynamometer wattmeter, LPF and UPF, Double element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems

Single phase induction type energy meter – driving and braking torques – errors and compensations – testing. Three phase energy meter – trivector meter, maximum demand meters.

## Unit IV:

## Potentiometers and Magnetic Measurements

## Principle and operation of D.C. Crompton’s potentiometer – standardization – Measurement of unknown resistance, current, voltage.

## A.C. Potentiometers: polar and coordinate types– applications.

**Magnetic Measurements**: Ballistic galvanometer, flux meter.

**Unit-V:**

**Measurement of R, L & C**

 Method of measuring low, medium and high resistance – sensitivity of Wheatstone’s bridge – Kelvin’s double bridge for measuring low resistance, measurement of high resistance – loss of charge method.

## Measurement of inductance, Quality Factor - Maxwell’s bridge, Hay’s bridge, Anderson’s bridge, Owen’s bridge. Measurement of capacitance and loss angle - Desauty bridge.Wien’s bridge – Schering Bridge.

**TEXT BOOKS:**

1. Electrical & Electronic Measurement & Instruments - A.K.Sawhney Dhanpat Rai & Co. Publications, 3rd Edition
2. Electrical Measurements and measuring Instruments – E.W. Golding and F.C. Widdis, 5th Edition, Wheeler Publications.

**REFERENCE BOOKS:**

1. Electrical Measurements – Buckingham and Price, PHI

2. Electrical Measurements - Harris.

3. Electrical Measurements: Fundamentals, Concepts, Applications – Reissland, M.U, New Age International (P) Limited, Publishers.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability

1. To understand working of various types of meters and their construction
2. To analyze the mathematical concepts of measuring instruments.
3. To service and maintain such meters in case of damage or misuse,
4. To design and create novel measuring instruments and solutions for real life problems.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L T C**

**4 1 4**

**MICROPROCESSORS AND MICROCONTROLLERS**

**Course Objectives:**

The student will be able to

1. Understand the memory system
2. learn concepts of microprocessor, different addressing modes and programming of
3. understand interfacing of 8086, with memory and other peripherals.
4. learn concept of DMA, USART RS-232 and PIC controller.
5. study the features of 8051 Microcontroller, its instruction set and also other controllers

**Unit – I: 8086 Microprocessor**

**Architecture:** An Overview of 8085, Architecture of 8086 & functional diagram, register organization, memory segmentation, programming model, memory Addresses, physical memory organization, signal descriptions of 8086, common function signals, minimum and maximum mode signals, timing diagrams, interrupts of 8086.

**Instruction set and Assembly Language programming:** Instruction formats, Addressing modes, Instruction set, assembler directives, Macros and procedures, simple programs involving logical, Branch& call instructions, Sorting and evolution of arithmetic expression, String manipulations.

**Unit – II: 8086 interfacing**

 **I/O Interface:** 8255-PPI, various modes of operation and interfacing to 8086, Interfacing Keyboard, Display, stepper motor Interfacing, A/D & D/A converter interfacing.

**Interfacing with advanced devices:** memory interfacing to 8086,Interrupt structure of 8086, Vector interrupt table, Interrupt service routine, Introduction to DOS,BIOS Interrupt,8259 PIC architecture, Interfacing Interrupt Controller 8259,8257 DMA controller to 8086.

**Unit – III: Communication interface**

serial communication standards, Serial data transfer schemes, 8251 USART architectures and interfacing.

RS-232C, IEEE-488, prototyping and trouble shooting

**Unit – IV: Microcontrollers**

**Introduction:** Overview of 8051 Microcontroller, Architecture, I/OPorts, MemoryOrganisation, Addressing Modes and Instruction set of 8051,Simple Programs.

Interrupts, Timer/Counter and serial communication. Programming timer interrupts, programming external hardware interrupts, and programming the serial communication interrupts, programming 8051 timers and counters.

**Unit – V: AVR RISC microcontroller**

Introduction, AVR family architecture, register file, the ALU, memory access and instruction execution, I/O memory, EEPROM,I/O ports, timers, UART, Interrupt structure.

**TEXT BOOKS:**

1. Advanced Microprocessors and peripherals – A.K. Ray & Bhuchani, TMH publications.
2. The 8051 Micro controllers Programming – Kenneth J Ayala –3rd Edition- Penram International publications
3. Microprocessor and interfacing –Douglas V Hall – 2nd Edition, TMH publication

**REFERENCE BOOKS:**

1. Microcomputer systems – 8086/8088 family architecture –Liu and GA Gibson-2nd Edition- PHI

1. Micro controllers and application-Ajay V Deshmukh-TMGH-2006

**Course Outcomes:**

After going through this course the student will be able to

1. Develop programs for different addressing modes.
2. Perform 8086 interfacing with different peripherals and implement programs.
3. Describe the key features of serial and parallel communication.
4. Design a microcontroller for simple applications.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L T C**

**3 1 3**

**DIGITAL SIGNAL PROCESSING**

**Course Objectives :**

The student will be able to

1. Define and use Discrete Fourier Transforms (DFTs)
2. Use Z - transforms and discrete time Fourier transforms to analyze adigital system.
3. Understand simple finite impulse response filters
4. Learn the design procedures used for filter bank
5. Learn to program a DSP processor to filter signals

**UNIT –I:**

**Introduction:** Introduction to Digital Signal processing: Discrete time signals&sequences,linear shift invariant systems,stability,and causality. Linear constant coefficient difference equations, Frequency domain representation of discrete time signals and systems

**UNIT II**

**Discrete Fourier Series:** properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: properties of DFT, linear convolution of sequences using DFT, computation of DFT, Relation between Z-transform and DFS

**Fast Fourier Transforms:** Fast Fourier transform (FFT)-Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT, and FFT for composite N

**UNIT III**

**Realization Of Digital Filters:** Review of Z-transform, Application of Z-transforms, solution of difference equations of digital filters, Block diagram representation of linear constant coefficient difference equations, Basic structures of IIR systems, Transposed forms, Basic structures of FIR systems, system function

**UNIT IV**

**Iir Digital Filters:** Analog filter approximations-Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples: Analog-Digital transformations

**Fir Digital Filters:** Characteristics of FIR Digital Filters, frequency response. Design of FIR digital filters using Window techniques, frequency sampling technique, comparison of IIR&FIR filters

**Multirate Digital Signal Processing:** Decimation, interpolation, sampling rate conversion, Implementation of sampling rate conversion

**UNIT V**

**Introduction To DSP Processors:** Introduction to programmable DSPs:Multiplier and Multiplier Accumulator(MAC),Modified Bus Structures and Memory Access schemes in DSPs multiple access memory, multiport memory,VLSI Architecture,pipelining,Special addressing Architecture of TMS 320C5X-Introduction,Bus structure, Central Arithmetic Logic unit, Auxiliary registrar, Index Registrar, Auxiliary Register Compare Register, Block Move Address Register parallel Logic Unit, Memory mapped registers, program controller, Some flags in the status registers, On-chip registers, On-chip peripherals

**TEXT BOOKS:**

1. Digital Signal Processing,principles,Algorithms,and Applications:John G.Proakis,Dimitris G.Manolakis,Pearson Education/PHI,2007
2. Discrete Time signal processing-A.V Oppenheim and R.W.Schaffer,PHI
3. Digital Signal Processing-Architecture, Programming and Applications,B.venkataramani,M.Bhaskar,TATA McGraw Hill,2002

**REFERENCE BOOKS:**

1. Digital Signal Processing:Andreas Antoniou,TATA McGraw Hill,2006
2. Digital Signal Processing:MH Hayes,schaum’s Outlines,TATA Mc-Graw Hill,2007
3. DSP Primer-C.Britton Rorabaugh,Tata McGraw Hill,2005
4. Fundamentals DSP using Matlab-Robert J.Schilling,Sandra L.Harris,Thomson,2007
5. Digital Signal Processing-Alan V.Oppenheim,Ronald W.Schafer,PHI Ed.

**Course Outcomes :**

After going through this course the student will be able to

1. Estimate the spectra of signals that are to be processed by a discrete time filter, and to verify the performance of a variety of modern and classical spectrum estimation techniques.
2. Design and simulate a digital filter
3. Design new digital signal processing systems.
4. Design and realize FIR, IIR filters
5. Program a DSP processor to filter signals

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L T C**

**3 1 3**

**OBJECT ORIENTED PROGRAMMING THROUGH JAVA**

 **(OPEN ELECTIVE)**

**Course Objectives:**

1. Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
2. Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
3. Have the ability to write a computer program to solve specified problems.
4. Be able to use the Java SDK environment to create, debug and run simple Java programs.

**UNIT -I :**

Object oriented thinking – need for oop paradigm- Agents, responsibility, messages, methods, classes and instances, class hierarchies (Inheritance), method binding, overriding and exceptions, coping with complexity, abstraction mechanisms. Java Basic History of Java Java buzzwords, data types, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and casting, simple java program, concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, parameter passing, recursion, nested and inner classes, exploring string class.

**UNIT -II :**

Inheritance – Hierarchical abstractions, Base class object, subclass, subtype, substitutability, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance. Member access rules, super uses, using final with inheritance, polymorphism- method overriding, abstract classes, the Object class. Packages and Interfaces : Defining, Creating and Accessing a Package, Understanding CLASSPATH importing packages, differences between classes and interfaces, defining an interface, implementing interface applying interfaces, variables in interface and extending interfaces.

Exploring java.io.

**UNIT -III:**

Exception handing – Concepts of exception handling, benefits of exception handling, Termination or resumptive models, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes.

String handling, Exploring java.util

Multithreading- Difference between multi threading and multitasking, thread life cycle, creating threads, thread priorities, synchronizing threads, inter thread communication, thread groups, daemon threads.

Enumerations, autoboxing, annotations, generics.

**UNIT- IV:**

Event Handling : Event, Event sources, Event classes, Event Listeners, Delegation event model, hand ling mouse and keyboard events, adapter classes.

The AWT class hierarchy, user interface components- labels, buttion, canvas, scrollbars, text components, check box, check box groups, choices, lists panels – scrollpane, dialogs, menubar, graphics, layout manager – layout manager types – border, grid, flow, card and grid bag.

**UNIT -V :**

Applets – Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets, passing parameters to applets.

Swing – Introduction, limitations of AWT, MVC architecture, components, containers, exploring swing- JApplet, JFrame and JComponent, Icons and Labels, text fields, buttons – The JButton class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables.

**TEXT BOOKS :**

1. Java; the complete reference, 7th edition, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, pearson eduction.

**REFERENCES :**

1. An Introduction to programming and OO design using Java, J.Nino and F.A. Hosch. John wiley & sons.
2. An Introduction to OOP, third edition, T.Budd pearson education. Introduction to Java programming, Y. Daniel Liang, pearson education

**Course Outcomes:**

1. Understand the model of object oriented programming
2. Analyze the fundamental features of an object oriented language.
3. Apply statement of a business problem and determine suitable logic for solving the problem

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L T C**

**3 1 3**

**INTELLECTUAL PROPERTY RIGHTS**

**(OPEN ELECTIVE)**

**Course Objectives:**

1. To acquire specialized knowledge of law and practice relating to Insurance and trademarks.
2. To apply the appropriate ownership rules to intellectual property you have been involved
3. To get the international overview of intellectual property.
4. Analyse an innovative or creative output in terms of intellectual property rights generated

**UNIT –I**

**Introduction to Intellectual Property**: Introduction, types of Intellectual Property, International organization, agencies and treaties, importance of intellectual property rights.

**UNIT II**

**Trademarks**: Purpose and function of Trademarks, Acquisition of Trademarks Rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

**UNIT III**

**Law of Copy Rights & Patents**: fundamental of copy rights law, originality of material, rights of reproduction, rights to perform the work publicly, copy right owner ship issues, copy right registration, notice of copy right, international copy right law. Foundation of patent law, patent searching process, owner ship rights & transfer.

**UNIT IV**

**Trade Secrets & Unfair Competition**: Trade secret law, determination of trade secrete status, liability for misappropriation right of trade secrets, protection for submission, trade secrete litigation. Misappropriation right of publicity, false advertising.

**UNIT V**

**New Development & International overview on Intellectual Property**: New developments in trade mark law, copy right law, patent law, and intellectual property audits. International trade mark law, copy right law, international patent law, international development in trade secrets law.

**REFERENCES AND TEXT BOOKS:**

1. Itellectual property rights, Deborah. E. bouchoux , Cengage learning

2. Intellectual Property Rights Nleashmy the knowledge economy, Prabuddha gangulli, Tate Mc Graw Hill Publishing Company Ltd.

**Course Outcomes:** After completing this course the student must demonstrate the knowledge and ability to

1. Get a holistic understanding of the complexities involved in the process of attributing intellectual property rights to people.
2. Learn the legalities of intellectual property to avoid plagiarism and other IPR problems.
3. Understand the relevance and impact of IP Law on academic/scientific works/studies.
4. Demonstrate appreciation and critical awareness of pertinent IP issues in the academic and professional lives.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L T C**

**3 1 3**

**NANO TECHNOLOGY**

 **(OPEN ELECTIVE)**

**Course Objectives:**

1. To get a knowledge on nano science and nano technology
2. Apply key concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology.
3. To get an idea over the fabrication of nanomaterials
4. Identify current nanotechnology solutions in design, engineering and manufacturing

**UNIT – I**

**INTRODUCTION TO NANOTECHNOLOGY:** Importance of nano scale, Nanostructure types, electronic, magnetic, optical Properties of Nano materials, top-down and bottom – up approach to nanostructures.

**QUANTUM MECHANICAL PHENOMENON IN NANO STRUCTURES:** Quantum confinement of electrons in semiconductor Nano structures, one dimensional confinement ( Quantum wires), two dimensional confinements ( Quantum Wells), three dimensional confinements ( Quantum dots).

**UNIT – II**

**CARBON NANO STRUCTURES:** Carbon Nano tubes ( CNT’s), Fullerenes, C60, C80 and C240 Nanostructures, Properties ( mechanical, optical and electrical) and applications.

**FABRICATION OF NANO MATERIALS:** Physical methods; inert gas condensation, Arc discharge, RF PLASMA, Plasma arc technique, ion sputtering, Laser ablation, Laser pyrolysis, Molecular beam epitaxy, Chemical vapour deposition method.

**UNIT – III**

**NANO SCALE CHARACTERIZATION TECHNIQUES**: Scanning probe techniques ( AFM, MFM, STM, SEM, TEM), XRD

**NANODEVICES AND NANOMEDICINE:** Lab on chip for bioanalysis, Core / shell Nanoparticles in drug delivery systems ( site specific and targeted drug delivery), cancer treatment, and bone tissue treatment.

**UNIT- IV**

**NANO AND MOLECULAR ELECTRONICS:** Resonant – tunneling structures, single electron tunneling, Single Electron transistors, coulomb blockade, giant magneto resistance, tunneling magneto resistance.

**UNIT – V**

**NANOLITHOGRAPHY AND NANOMANIPULATION**: e – beam lithography and SEM based nanolithography and nanomanipulation, ion beam lithography, oxidation and metallization. Mask and its application. Deep UV lithography, X-ray based lithography.

**TEXT BOOKS:**

1. Charles.p.pode, introduction to nanotechnology, springer publications.
2. Springer Handbook of Nanotechnology – Bharat Bhusan
3. Phani Kumar, Principles of nanotechnology, scitech publications.

**REFERENCE BOOKS:**

1. David Ferry “ Transport in Nano structures” Cambridge University press 2000
2. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.
3. Nanofabrication towards biomedical application, Techniques, tools, Application and impact – Ed. Challa S.S.R.Kumar, J.H.Carola.
4. Encyclopedia of Nanotechnology – Hari Singh Nalwa
5. Carbon Nanotubes; Properties and Applications – Micheal J.O’ Connell
6. S.Dutta “ Electon Transport in Mesoscopic systems” Cambridge University press.
7. H.Grabert and M. Devoret “ Single charge Tunneling” Plenum press 1992.

**Course Outcomes:**

1. Get an idea and importance of nano science and nano technology
2. Apply key concepts in materials science, chemistry, physics, biology and engineering to the field of nanotechnology.
3. Get an idea over the fabrication of nanomaterials
4. Identifies current nanotechnology solutions in design, engineering and manufacturing

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L P C**

**- 3 2**

**POWER ELECTRONICS LAB**

 Any 8 experiments from part - A. Any 2 experiments from part - B.

**PART – A**

1. Study of Volt - Ampere characteristics of SCR,MOSFET & IGBT.

2. Gate firing circuits for SCR.

3. Single phase ac voltage controller with R and RL loads.

4. Single phase half controlled bridge rectifier with R and RL loads with and without freewheeling Diode.

5. Single phase fully controlled bridge rectifier with R and RL loads.

6. Forced commutation circuits (Class A, Class B, Class C, Class D & Class E).

7. DC Jones chopper with R and RL loads.

8. Single phase parallel inverter with R and RL loads.

9. Single phase series inverter with R and RL loads.

10. Single phase cycloconverter with R and RL loads.

**PART –B**

1. Simulation of single phase full converter using RLE load.
2. Single phase AC voltage controller using RLE load.
3. Simulation of single phase inverter with PWM control.
4. Simulation of resonant pulse commutation circuit and buck chopper.

**REFERENCE BOOKS**

1. Simulation of Electric and Electronic circuits using PSPICE-by M.H.Rashid,M/s PHI publications.
2. PSPICE A/D users manual- Microsim, USA.
3. PSPICE Reference guide- Microsim, USA.
4. MATLAB and its Tool Boxes, user manual and Mathworks,USA.
5. PSPICE for power electronics and electric power by Rashid,CRC Press

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE III Year II-Semester L P C**

**- 3 2**

 **ADVANCED ENGLISH COMMUNICATION SKILLS LAB**

**1. Introduction**

The introduction of the English Language Lab is considered essential at 3rd year level. At this stage the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be an integrated theory and lab course to enable students to use good English and perform the following:

* Gather ideas and information, to organize ideas relevantly and coherently.
* Engage in debates.
* Participate in group discussions.
* Face interviews.
* Write project/research reports/technical reports.
* Make oral presentations.
* Write formal letters.
* Transfer information from non-verbal to verbal texts and vice versa.
* To take part in social and professional communication.

**2. Objectives:**

This Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

 To improve the students‘ fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.

 Further, they would be required to communicate their ideas relevantly and coherently in writing.

**3. Syllabus**:

The following course content is prescribed for the Advanced Communication Skills Lab:

1. **Vocabulary Building** – synonyms and antonyms, Word Roots, One-Word Substitutes, Prefixes and Suffixes, Study of Word Origin, Analogy, Idioms and Phrases.
2. **Reading Comprehension –** Reading for Facts, Guessing meanings from context, Scanning, Skimming, Inferring Meaning, and Critical Reading.
3. **Writing Skills** –Structure and presentation of different types of writing - Resume Writing /E-Correspondence/Statement of Purpose.
4. **Technical Writing**- Technical Report Writing, Research Abilities/Data Collection/Organizing Data/Tools/Analysis.
5. **Group Discussion** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Coherence.
6. **Presentation Skills** – Oral presentations (individual and group) through JAM sessions/Seminars, Written Presentations through Projects/ PPTs/e-mails etc.
7. **Interview Skills** – Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Interview through Telephone and Video-Conferencing.

 **4. Minimum Requirement**: The English Language Lab shall have two parts:

 i) The Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.

 ii) The Communication Skills Lab with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo –audio & video system and camcorder etc.

**System Requirement (Hardware component):** Computer network with Lan with minimum 60 multimedia systems with the following specifications:

 i) P – IV Processor

 a) Speed – 2.8 GHZ

 b) RAM – 512 MB Minimum

 c) Hard Disk – 80 GB

 ii) Headphones of High quality

 **5. Suggested Software:**

 The software consisting of the prescribed topics elaborated above should be procured and used.

 **Suggested Software**:

* Clarity Pronunciation Power – part II 
* Oxford Advanced Learner‘s Compass, 7th Edition 
* DELTA‘s key to the Next Generation TOEFL Test: Advanced Skill Practice.
* Lingua TOEFL CBT Insider, by Dreamtech.
* TOEFL & GRE( KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS) 
* The following software from ‗train2success.com‘ 
1. Preparing for being Interviewed,
2. Positive Thinking,
3. Interviewing Skills,
4. Telephone Skills,
5. Time Management
6. Team Building,
7. Decision making
* English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge 

6. **Books Recommended:**

1. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
2. Advanced Communication Skills Laboratory Manual by Sudha Rani, D, Pearson Education 2011.
3. English Language Communication : A Reader cum Lab Manual Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.
4. English Vocabulary in Use series, Cambridge University Press 2008.
5. Management Shapers Series by Universities Press(India)Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
7. Handbook for Technical Writing by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. Master Public Speaking by Anne Nicholls, JAICO Publishing House, 2006.
10. English for Technical Communication for Engineering Students, Aysha Vish hwamohan, Tata Mc Graw-Hil 2009.
11. Books on TOEFL/GRE/GMAT/CAT/ IELTS by Barron‘s/DELTA/Cambridge University Press.
12. International English for Call Centres by Barry Tomalin and Suhashini Thomas, Macmillan Publishers, 2009.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**4 1 4**

**UTILIZATION OF ELECTRICAL ENERGY**

**Course Objectives:**

1. To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading conditions.
2. To acquaint with the different types of heating and welding techniques.
3. To study the basic principles of illumination and its measurement and to understand different types of lightning system including design.
4. To understand the basic principle of electric traction including speed–time curves of different traction services.

**UNIT – I**

**Electric Drives**

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, types of industrial loads, continuous, intermittent and variable loads, load equalization, applications of electric drives.

## UNIT – II

## Electric Heating & Welding

Advantages and methods of electric heating, Resistance heating ,Induction heating and Dielectric heating.

Electric welding, Resistance and Arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

**UNIT – III**

**Illumination Fundamentals & Various Illumination Methods**

Introduction, terms used in illumination, laws of illumination, polar curves, Discharge lamps, MV , SV and LED lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of interior lighting and flood lighting.

## UNIT – IV

## Electric Traction – I

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking, plugging, rheostatic braking and regenerative braking.

Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.

**UNIT – V**

 **Electric Traction-II**

Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation, adhesive weight and coefficient of adhesion.

**TEXT BOOKS:**

1. Utilization of Electric Energy – E. Openshaw Taylor, Orient Longman Private Limited, 1971.
2. Art & Science of Utilization of electrical Energy – Partab, Dhanpat Rai & Sons, 2nd edition, 1975.

**REFERENCE BOOKS:**

1. Generation, Distribution and Utilization of electrical Energy – C.L.Wadhwa, New Age International (P) Limited, Publishers, 1997.
2. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. After completion of the course, the student will be able to choose a right drive for a particular application and able to design suitable schemes for welding, heating, drives, illumination and traction.
2. Learn the mathematical aspects involved in various fields like illumination and able to design Illumination systems for various applications.
3. Identifying and troubleshooting the various applications of electrical equipments and Maintain various domestic electrical appliances.
4. Able to determine the speed/time characteristics of different types of traction motors and estimate energy consumption levels at various modes of operation.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**3 1 3**

**INSTRUMENTATION**

**Course Objectives:**

1. To introduce students to monitor, analyze and control any physical system.
2. To understand students how different types of meters work and their construction
3. To provide a student a knowledge to design and create novel products and solutions for real problems.
4. To introduce students a knowledge to use modern tools necessary for electrical projects.

## UNIT-I

## Characteristics of Signals

Measuring Systems, Performance Characteristics, - Static characteristics, Dynamic Characteristics; Errors in Measurement – Gross Errors, Systematic Errors, Random Errors.

**Signals and their representation**

Signal and their representation: Standard Test, periodic, aperiodic, modulated signal, sampled data, pulse modulation and pulse code modulation

## UNIT-II

## Oscilloscope

Cathode ray oscilloscope-Cathode ray tube-time base generator-horizantal and vertical amplifiers-CRO probes-applications of CRO-Measurement of phase and frequency-lissajous patterns-Sampling oscilloscope-analog and digital type

## UNIT-III

## Digital Voltmeters

Digital voltmeters- Successive approximation, ramp, dual-Slope integration continuos balance type-Micro processor based ramp type DVM digital frequency meter-digital phase angle meter

**Signal Analyzers**

Wave Analyzers- Frequency selective analyzers, Heterodyne, Application of Wave analyzers- Harmonic Analyzers, Total Harmonic distortion, spectrum analyzers, Basic spectrum analyzers, spectral displays, vector impedance meter, Q meter. Peak reading and RMS voltmeters

## UNIT-IV

## Transducers

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of resistor, inductor, LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Synchros, Piezo electric transducers, photovoltaic, photo conductive cells, photo diodes.

## UNIT-V

## Measurement of Non-Electrical Quantities

Measurement of strain, Gauge Sensitivity, Displacement, Velocity, Angular Velocity, Acceleration, Force, Torque, Temperature, Pressure, Vacuum, Flow and Liquid level.

**TEXT BOOKS:**

1. Transducers and Instrumentation - D.V.S Murthy, Prentice-Hall Of India Pvt. Limited, 2nd edition, 2004.
2. A course in Electrical and Electronic Measurements and Instrumentation- A.K. Sawhney, Dhanpat Rai and Sons, New Delhi, 1999

**REFERENCE BOOKS:**

1. Measurement Systems, Applications and Design – Ernest O. Doebelin,International Student Edition, IV Edition, McGraw Hill Book Company, 1998.
2. Principles of Measurement and Instrumentation – A.S Morris, 2nd Edition, Prentice Hall of India, 2003.
3. Electronic Instrumentation- H.S. Kalsi, Tata MC-Graw Hill Edition, 1995.
4. Modern Electronic Instrumentation and Measurement techniques – A.D Helfrick and W.D.Cooper, Pearson/Prentice Hall of India, 2007.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. To learn instrumentation systems having conversion from Non-electrical quantities
2. To understand instrumentation systems concerned with pressure, force, temp & flow etc
3. Evaluate electronic instrumentation line Analog storage CROs and digital storage CROs etc
4. To design temperature related instrumentation of linear nature

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**4 1 4**

**COMPUTER METHODS IN POWER SYSTEMS**

**Course Objectives:**

1. To gives idea for the formation of Z-bus , Y-bus by different methods.
2. To provide comprehensive coverage of the power flow solution of an interconnected system using Gauss-Seidal method during normal operation
3. To introduce Iterative techniques like NR and Fast Decoupled method for solving Non linear power flow equations
4. To study fault analysis and steady state ,transient stability analysis

**UNIT-I**

Power System Network Matrices

Graph theory: Definitions, Bus incidence Matrix, Ybus formation by direct and singular transformation methods, Numerical Problems.

Formation of Zbus: Partial network, algorithm for the modification of Zbus for addition element for the following cases: addition of element from a new bus to reference, addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses. Modification of Zbus for the changes in network (problems).

Unit –II

Power Flow Studies

Necessity of power flow studies- data for power flow studies- derivation of static load flow equations- load flow solution using Gauss seidel Method: Acceleration Factor, load flow solution with and without P-V buses, Algorithm and Flowchart, Numerical load flow Solution for Simple Power systems (Max 3- buses): Determination of Bus Voltages, Injected Active and Reactive Powers (Sample one iteration only) and finding line flows and losses for the given Bus Voltages.

Newton Raphson Method in Rectangular and Polar Co-Ordinates form: Load flow solution with or without PV busses- Derivation of Jacobian Elements, Algorithm and Flowchart.

Decoupled and Fast Decoupled Methods.- Comparison of Different Methods

Unit-III

Short Circuit Analysis

Per unit system representation. Per unit equivalent reactance network of three phase Power System, Numerical Problems.

Symmetrical fault Analysis: short circuit current and MVA Calculations, Numerical Problems.

Symmetrical Component Theory: Symmetrical Component Transformation, Positive, Negative and Zero sequence components: Voltages, Currents and Impedances.

Sequence Networks: Positive, Negative and Zero sequence Networks, Numerical Problems.

Unsymmetrical Fault Analysis: LG, LL, LLG faults with and without fault impedances, Numerical Problems.

Unit-IV

Power System Steady State Stability Analysis

Elementary concepts of Steady State, Dynamic and Transient Stabilities.

Description of Steady State Stability Power limit, Transfer Reactance, Synchronizing Power Coefficient, Power angle curve and determination of steady state stability and methods to improve steady state stability.

Unit-V

Power System Transient State Stability Analysis

Derivation of Swing Equation, Determination of Transient Stability by Equal Area Criterion. Application of EAC, Critical Clearing Angle calculation. Solution of swing equation. Point by point method. Methods to improve stability.

TEXT BOOKS:

1. Computer Techniques in Power System Analysis - M.A.Pai, TMH Publications, 2nd edition, 2006.

2. Modern Power System Analysis- I.J.Nagrath and D.P.Kothari, Tata McGraw-Hill Publishing Company, 2nd edition, 2003.

REFERENCE BOOKS:

1. Computer Methods in Power System Analysis - G.W. Stagg & A.H. El-Abiad, International

 Student Edition, 1968.

2. Power System Analysis - Grainger and Stevenson, Tata McGraw-Hill Publishing

 Company,1st Edition , 2003.

 3. Power System Analysis - Hadi Saadat, Tata McGraw-Hill Publishing Company, 2nd Edition,

 2002.

4. Power System Analysis & Design - B.R. Gupta, Wheeler Publications, 3rd Edition, 2003.

5. Electrical Power Systems - C.L. Wadwa - New Age International (P) Ltd, 6th

 edition,2006.

Course Outcomes:

After completing this course the student must demonstrate the knowledge and ability

1. An ability to form different network matrices.
2. Provides opportunity to understand different load flow study methods.
3. An understanding of different faults and their study.
4. Ability to conduct analysis of power system for Transient stability and steady state stability.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**4 1 4**

**POWER SEMICONDUCTOR DRIVES**

**Course Objectives:**

1. Able to learn DC Drives control by phase controlled converters and choppers.
2. To understand four quadrant operation of DC drives using phase controlled convertors and choppers.
3. To know control of Induction Motors from stator side and rotor side.
4. To gain knowledge about control of Synchronous Motor drive using various Inverters.

**UNIT – I: Control of DC motors by Single phase Converters**

Introduction to Thyristor controlled Drives, Single Phase semi and fully controlled converters connected to separately excited d.c motors – continuous current operation, output voltage and current waveforms, Speed and Torque expressions and speed - torque Characteristics- numerical Problems.

## UNIT – II : Control of DC motors by Three phase Converters

Three phase semi and fully controlled converters connected to separately excited d.c motors – output voltage and current waveforms, Speed and Torque expressions, Speed - Torque characteristics – numerical Problems.

**UNIT – III : Four Quadrant operation of DC Drives & Control of DC motors by Choppers**

Introduction to phase controlled four quadrant operations – Four quadrant operation of D.C motors by dual converters – Closed loop operation of DC motor in motoring mode (Block Diagram Only).

Single quadrant, two quadrant and four quadrant chopper fed separately excited dc motors – Continuous current operation, Output voltage and current wave forms, Speed and torque expressions, speed - torque characteristics – numerical Problems.

## UNIT – IV: Control of Induction motors

## From stator side:

Variable voltage Control of Induction Motor by Ac Voltage Controllers, Waveforms, speed - torque characteristics – V/f control of Induction motors by Voltage source inverter, current source inverter, Speed - torque characteristics and their comparison – PWM control technique used for various converters –numerical problems.

**From rotor side:** Rotor resistance control – Slip power recovery control – Static Scherbius drive performance, speed - torque characteristics – Static Kramer Drive performance, speed vs torque characteristics, advantages and applications – numerical problems.

**UNIT – V: Control of synchronous motors**

Separate control & self control of synchronous motors, Operation of self controlled synchronous motors by voltage source inverter and current source inverter – Load commutated CSI fed Synchronous Motor Operation, Waveforms, speed - torque characteristics, Applications and Advantages – Numerical Problems.

**TEXT BOOKS:**

1. Fundamentals of electric Drives – G K Dubey, Narosa publications, 2nd edition, 2002.
2. Power Electronics – MD Singh and K B Khanchandani, Tata – McGraw-Hill Publishing company,1998
3. Principles of electrical machines & power electronics - PC Sen, John Wiley & Sons, 2nd edition, 1997.

**REFERENCE BOOKS:**

1. Power Electronics Circuits, Devices and applications - M.H.Rashid, Pearson Education - Third Edition – First Indian reprint 2004.
2. Modern Power Electronic and AC Drives - B.K.Bose, Pearson Publications - 1st edition
3. Thyristor Control of Electric drives – Vedam Subramanyam, Tata McGraw Hill Publilcations, 1987.
4. A First course on Electrical Drives – S K Pillai New Age International (P) Ltd. 2nd Editon, 2009.

**Course Outcomes:**

After the completion of this course students will be to

1. Understood about phase controlled DC drives and chopper DC drives.
2. Known the operation of DC drives in all four quadrants using phase and chopper controls.
3. Understood the speed control of Induction Motor from stator and rotor side.
4. Gained the knowledge to control Synchronous Motor drive using VSI and CSI etc.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**3 1 3**

**HIGH VOLTAGE ENGINEERING**

 **(Elective-I)**

**Course Objectives:**

1. To get the knowledge of dielectric materials.
2. Deals with Various Dielectric Materials, Numerical methods for electric field computation and Applications.
3. To learn the over voltage phenomena and insulation co-ordination
4. Deals with high voltage testing of materials and electrical apparatus

**UNIT I: Introduction to High Voltage Technology and Applications**

Electric Field Stresses, Gas / Vaccum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.

**UNIT II : Break Down in Gaseous, Solid and Liquid Dielectrics**

Gases as insulating media, collision process, Ionization process, Townsend’s criteria of breakdown in gases, Paschen’s law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids.

Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

**UNIT III : Generation and Measurements of High Voltages And Currents**

Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators.

Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.

**UNIT IV: Over Voltage Phenomenon and Insulation Co-Ordination**

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

**UNIT V : Non-Destructive and High Voltage Testing Of Material And Electrical Apparatus**

Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements.

Testing of Insulators and bushings, Testing of Isolators and circuit breakers, Testing of cables, Testing of Transformers, Testing of Surge Arresters, Radio Interference measurements.

**TEXT BOOKS:**

1. High Voltage Engineering - M.S.Naidu and V. Kamaraju – TMH Publications, 3rd Edition, 2009.
2. High Voltage Engineering: Fundamentals - E.Kuffel, W.S.Zaengl, J.Kuffel, Elsevier publications, 2nd Edition, 2000.

**REFERENCE BOOKS:**

1. High Voltage Engineering - C.L.Wadhwa, New Age Internationals (P) Limited, 1997.
2. High Voltage Insulation Engineering - Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

|  |
| --- |
| 1. To understand Various Dielectric Materials , Numerical methods for electric field computation and Applications.
2. The knowledge gained in this subject helps in High Voltage Testing of Electrical Apparatus and Non Destructive materials.
3. Student can apply knowledge in Measurement of High voltages and currents.
4. To generate AC , DC and Impulse high voltages, currents In real time applications .
 |

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**3 1 3**

**VLSI DESIGN**

**(Elective-I)**

**Course objectives:**

1. Give exposure to different steps involved in the fabrication of ICs using MOS transistor,CMOS/BICMOS transistors and passive components
2. Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters designed with various loads.
3. Give exposure to the design rules to be followed to draw the layout of any logic circuit.
4. Provide concept to design different types of logic gates using CMOS inverter and analyze their transfer characteristics.
5. Provide design concepts to design building blocks of data path of any system using gates.
6. Understand basic programmable logic devices and testing of CMOS circuits.

**UNIT I**

**Introduction:** Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS

Technologies- Oxidation, Lithography, Diffusion, Ion implantation, Metallization, Encapsulation, Probe testing, Integrated Resistors and Capacitors, CMOS Nanotechnology.

**Basic Electrical Properties :** Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit ωo; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, BiCMOS Inverters.

**UNIT II**

**VlSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 μm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

**UNIT III**

**Gate Level Design :** Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out, Choice of layers.

**Data Path Subsystems:** Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters.

**UNIT IV**

**Array Subsystems:** SRAM, DRAM, ROM, Serial Access Memory, Content addressable memory

**Semiconductor Integrated Circuit Design:** PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Design Approach, Parameters influencing low power design.

**UNIT V**

**CMOS Testing :** CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

**TEXT BOOKS:**

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian

 Dougles and A.Pucknell, PHI, 2005 Edition

2. VLSI Design – K.Lal Kishore,V.S.V.Prabhakar,I.K Imternational,2009.

3. CMOS VLSI Design – A circuits and systems perspective,Neil H.E Weste,David Harris,Ayan Banerjee,pearson,2009.

**REFERENCE BOOKS:**

1. CMOS logic circuit Design- John P.Uyemura, Springer, 2007.

2. Modern VLSI Design – Wayne Wolf, Pearson Education, 3rd Edition, 1997.

3. VLSI Design-A. Albert Raj, Latha, PHI, 2008.

4. Introduction to VLSI-Mead & Convey, BS Publications, 2010.

5. VLSI Design-M.Micheal Vai, CRC Press, 2009.

**Course Outcomes:**

Upon successfully completing the course, the student should be able to:

1. Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors.
2. Choose an appropriate inverter depending on specifications required for a circuit.
3. Draw the layout of any logic circuit which helps to understand and estimate parasitic of any logic circuit.
4. Design different types of logic gates using CMOS inverter and analyze their transfer characteristics.
5. Provide design concepts required to design building blocks of data path using gates.
6. Design simple memories using MOS transistors and can understand design of large memories.
7. Design simple logic circuit using PLA, PAL, FPGA and CPLD.
8. Understand different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**3 1 3**

**NEURAL NETWORKS AND FUZZY LOGIC**

**(Elective-I)**

**Course Objectives:**

1. This course introduces the basics of Neural Networks
2. Essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks.
3. It deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components.
4. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented.

**Unit – I**

**Introduction to Neural Networks & Essentials of Artificial Neural Networks**

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, , ANN Architectures, Types of neuron models: Integrate-and-Fire Neuron Model, Spiking Neuron Model, McCulloch-Pitts Model, Characteristics and Operation of ANN, Historical Developments and Potential Applications of ANN.

#### Types of Neuron Activation Function, Classification Taxonomy of ANN ­– Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Applications

## Unit–II

##  Single Layer and Multilayer Feed Forward Neural Networks

Single layer: Introduction, Perceptron Models- Discrete, Continuous, Training Algorithms- Discrete and Continuous Perceptron Networks,

Multi layer: Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Learning Difficulties and Improvements.

**Unit- III**

 **Associative Memories**

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm

Architecture of Hopfield Network: Discrete and Continuous versions

**Unit – IV**

**Classical & Fuzzy Sets**

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

## Fuzzy Logic System Components

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

**UNIT- V**

**Applications**

**Neural network applications:** Process identification, control, fault diagnosis and load forecasting.

**Fuzzy logic applications:** Fuzzy logic control and Fuzzy classification.

## TEXT BOOKS:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications - Rajasekharan and Rai – PHI Publication, 2009.
2. Introduction to Artificial Neural Systems – Jacek M Zurada, Jaico publishing house 1997

## REFERENCE BOOKS:

1. Neural and fuzzy systems : Foundations, Architectures and applications – N Yadaiah and S.BapiRaju, Pearson Education
2. Neural Networks – James A Freeman and Davis Skapura, Pearson Education, 2002.
3. Neural Networks – Simon Hakins , Pearson Education, 2 nd edition, 2008.
4. Neural Engineering - C.Eliasmith and CH.Anderson, PHI, 2003.
5. Neural Networks and Fuzzy Logic System - Bart Kosko, PHI Publications,2003.

**Course Outcomes:**

Upon completion of the course, the student will be able to

1. Comprehend the concepts of feed forward neural networks
2. Analyze the various feedback networks.
3. Understand the concept of fuzziness involved in various systems and fuzzy set theory.
4. Comprehend the fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.
5. Analyze the application of neural networks and fuzzy logic control to real time systems.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**3 1 3**

**OPTIMIZATION TECHNIQUES**

**(Elective-II)**

**Course Objectives**:

1. To learn different Optimization Techniques.
2. To learn and solve the problems using linear, non linear programming and transportation problems
3. To solve problems using constrained and un constrained programming methods
4. To learn the dynamic programming method

**UNIT – I**

**Introduction and Classical Optimization Techniques:**

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.

Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – II**

**Linear Programming and Transportation Problem**

**Linear Programming:**

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

**Transportation Problem:**

Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s approximation method – testing for optimality of balanced transportation problems.

**UNIT – III**

**Unconstrained Nonlinear Programming and Optimization Techniques**

**Unconstrained Nonlinear Programming:**

One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method

**Unconstrained Optimization Techniques**

Univariate method, Powell’s method and steepest descent method.

**UNIT – IV Constrained Nonlinear Programming:**

Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

**UNIT – V Dynamic Programming:**

 Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

**TEXT BOOKS:**

1. Engineering optimization: Theory and practice- S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.

2. Operations Research – Dr. S.D.Sharma, Kedar Nath Ram Nath and Co. ,Meerut, 10th edition, 1992

3. Optimization Methods in Operations Research and systems Analysis” – K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.

**REFERENCE BOOKS:**

1. Introductory Operations Research - H.S. Kasene & K.D. Kumar, Springer(India), Pvt. Ltd.

2. Operations Research : An Introduction – H.A. Taha, PHI Pvt. Ltd., 6th edition, 2012.

3. Linear Programming – G. Hadley, Addison-Wesley. Publishing Co, 1963.

**Course Outcomes:**

After the completion of this course students will be able to

1. Know the concepts of optimization techniques
2. Understands the problem solving methods in different conditions
3. Solve different real time problems under different constraints by applying suitable methodologies
4. Analyze the problems for better output

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**3 1 3**

**ELECTRICAL DISTRIBUTION SYSTEM**

**(Elective-II)**

**Course Objectives:**

1. Explain the principles of design and operation of electric distribution feeders.
2. Apply analytic techniques pertaining to primary distribution systems.
3. Use basic design principles for distribution substations and facilities.
4. To learn power factor improvement and to learn voltage control methods

## UNIT – I

## General Concepts:

Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, contribution factor, loss factor - Relationship between the load factor and loss factor. Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

**Distribution Feeders:**

Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.

**UNIT – II**

**Substations:**

Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

**System Analysis:**

Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

**UNIT – III**

**Protection:**

Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures, line sectionalizes, and circuit breakers.

**Coordination:**

Coordination of Protective Devices: General coordination procedure.

**UNIT – IV**

**Compensation for Power Factor Improvement:**

Capacitive compensation for power-factor control. Different types of power capacitors, shunt andseries

capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction,

capacitor allocation - Economic justification - Procedure to Determine the best capacitor location.

**UNIT – V**

**Voltage Control:**

Voltage Control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR,

 line drop Compensation.

**TEXT BOOKS:**

1. Electric Power Distribution system, Engineering – Turan Gonen, Mc Graw-hill Book Company, 1986.
2. Electric Power Distribution – A.S. Pabla, Tata Mc Graw-hill Publishing company, 4th edition, 1997.

**REFERENCE BOOKS:**

1. Electrical Power Distribution and Automation - S.Sivanagaraju, V.Sankar, Dhanpat Rai & Co, 2006
2. Electrical Power Distribution Systems - V.Kamaraju, Tata McGraw-Hill Education, 2009.

**Course Outcomes:**

This course will enable the students

1. To understand the objectives of Distribution system protection and Coordination of protective devices
2. Able to analyze substations and benefits derived through optimal location of substations.
3. Able to calculate Voltage drop and power – loss and manual methods of solution for radial networks
4. Able to apply the knowledge on distribution systems, Load Modelling and Characteristics.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L T C**

**3 1 3**

**LINEAR SYSTEM ANALYSIS**

**(Elective-II)**

**Course Objectives:**

1. To find the Fourier transforms of some common signals using Laplace Transform and Parsevals theorem.
2. To test the polynomials using Sturms theorem and reliability of elements.
3. To evaluate linear system programming for different approaches like foster and cauer methods and theorems.
4. To Design Network Synthesis using foster and Cauer methods for RL and RC networks

**UNIT-I:**

**State Variable Analysis**

Choice of state variables in Electrical networks-Formulation of state equations for Electrical networks-Equivalent source method. Network topological method - Solution of state equations-Analysis of simple networks with state variable approach.

**UNIT–II**

**Fourier series And Fourier Transform Representation And Applications**

Introduction, Trigonometric form of Fourier series, Exponential form of Fourier series, Wave symmetry, Fourier integrals and transforms, Fourier transform of a periodic function , Properties of Fourier Transform , Parseval’s theorem , Fourier transform of some common signals, Fourier transform relationship with Laplace Transform.

Introduction, Effective value and average values of non sinusoidal periodic waves, currents, Power Factor, Effects of harmonics, Application in Circuit Analysis, Circuit Analysis using Fourier Series.

**UNIT – III**

**Laplace Transform Applications**

Application of Laplace transform Methods of Analysis – Response of RL, RC, RLC Networks to Step, Ramp, and impulse functions, Shifting Theorem – Convolution Integral – Applications

**Testing of Polynomials & Network Synthesis**

Elements of reliability-Hurwitz polynomials-positive real functions-Properties-Testing-Sturm’s Test, examples.

Synthesis of one port LC networks-Foster and Cauer methods-Synthesis of RL and RC one port networks-Foster and Causer methods

**UNIT-IV**

**Sampling**

Sampling theorem – Graphical and Analytical proof for Band Limited Signal impulse sampling, natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, introduction to Band Pass sampling, Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Power density spectrum, Relation between auto correlation function and Energy / Power spectral density function.

**UNIT-V**

**Z-Transforms**

Fundamental difference between continuous and discrete time signals, discrete time complex, exponential and sinusoidal signals, periodicity of discrete time complex exponential, concept of Z-Transform of a discrete sequence. Distinction between Laplace, Fourier and Z-Transforms. Region of convergence in Z-Transforms, constraints on ROC for various classes of signals, Inverse Z-Transform properties of Z-Transforms.

**TEXT BOOKS:**

1. Signals, Systems and Communications - B.P. Lathi, BS Publications 2003.
2. Network Analysis and Synthesis – Umesh Sinha- Satya Prakashan Publications.

**REFERENCE BOOKS:**

1. Linear System Analysis – A N Tripathi, New Age International, 2007.
2. Network and Systems – D Roy Chowdhary, New Age International, 2nd edition, 2005.
3. Engineering Network Analysis and Filter Desgin- Gopal G. Bhise, Prem R. Chadha, Durgesh C. Kulshreshtha - Umesh Publications, 2009.
4. Linear system anlysis - A.Cheng, Oxford publishers.

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. Ability to find the Fourier transforms using Laplace Transform and Perseval’s theorem.
2. To test the polynomials using Sturms theorem and reliability of elements.
3. Know and be able to apply properties of linear time-invariant systems
4. Evaluate the convolution of an input waveform with an impulse response

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L P C**

**0 3 2**

**MICRO PROCESSORS & MICRO CONTROLLERS LAB**

**Note:** Minimum of 12 experiments to be conducted.

**List of Experiments:**

The Following programs/experiments are to be written for assembler and execute the same with 8086 and 8051 kits.

1. Programs for 16 bits arithmetic operations for 8086 (using Various Addressing Modes).
2. Program for sorting an array for 8086.
3. Program for searching for a number or character in a string for 8086.
4. Programs for string manipulations for 8086.
5. Program for digital clock design using 8086.
6. Interfacing ADC and DAC to 8086.
7. Parallel communication between two microprocessors using 8255.
8. Serial communication between two microprocessor kits using 8251.
9. Interfacing to 8086 and programming to control stepper motor using 8255.
10. Programming using arithmetic, logic and bit manipulation instructions of 8051/AVR.
11. Program and verify Timer / Counter in 8051.
12. Program and verify Interrupt handling in 8051.
13. UART Operation in 8051.
14. Communication between 8051 kit and PC.
15. Interfacing LCD to 8051.
16. Interfacing Matrix / Keyboard to 8051.
17. Data Transfer from Peripheral to Memory through DMA controller 8237/ 8257.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year I-Semester L P C**

**0 3 2**

**ELECTRICAL MEASUREMENTS LAB**

**The following experiments are required to be conducted as compulsory experiments:**

1. Calibration and Testing of single phase energy Meter
2. Calibration of dynamometer power factor meter
3. Crompton D.C. Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter
4. Kelvin’s double Bridge .
5. Measurement of % ratio error and phase angle of given C.T. by comparison.
6. Schering bridge & Anderson bridge.
7. Measurement of 3 phase reactive power with single-phase wattmeter.
8. Measurement of parameters of a choke coil using 3 voltmeter and 3 ammeter methods.

**In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted:**

1. Calibration LPF wattmeter – by Phantom loading.
2. Measurement of 3 phase power with single watt meter and 2 No’s of C.T.
3. Dielectric oil testing using H.T. testing Kit
4. LVDT and capacitance pickup – characteristics and Calibration
5. Solid Insulation testing using Megger.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year II-Semester L T C**

**3 1 3**

**HVDC TRANSMISSION**

**Course Objectives:**

1. To learn the importance of HVDC transmission and to analyze HVDC converters
2. To know the reactive power control in HVDC transmission system.
3. To know the faults and protections required in HVDC system
4. To get idea of harmonics and Filters

## UNIT – I

## Basic Concepts

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C Transmission.

## UNIT – II

## Analysis of HVDC Converters, Converter Control

##  Choice of Converter configuration – Analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters – Cases of two 3 phase converters in star –star mode – their performance.

Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control

**UNIT-III**

**Reactive Power Control In HVDC, Power Flow Analysis**

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies-sources of reactive power-AC Filters – shunt capacitors-synchronous condensers. Modeling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow

**UNIT-IV**

**Converter Fault & Protection**

Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

## UNIT –V

## Harmonics & Filters

Generation of Harmonics – Characteristics harmonics, calculation of AC Harmonics, Non- Characteristics harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics

Types of AC filters ,Design of Single tuned filters –Design of High pass filters.

**TEXT BOOKS:**

1. HVDC Power Transmission Systems: Technology and system Interactions – K.R.Padiyar, New Age International (P) Limited, 1990.
2. EHVAC and HVDC Transmission Engineering and Practice – S.Rao, Khanna Publishers, 1990.

**REFERENCE BOOKS:**

 1. HVDC Transmission – J.Arrillaga, IEE, 2nd Edition, 1998.

 2. Direct Current Transmission – E.W.Kimbark, Volume I, John Wiley & Sons, 1971.

 3. Power Transmission by Direct Current – E.Uhlmann, B.S.Publications

**Course Outcomes**:

After completing this course the student must demonstrate the knowledge and ability to

1. Describe the advantages of HVDC system
2. Analyze the characteristics of converters and inverters used in HVDC transmission.
3. Apply the knowledge of reactive power control and power factor improvement in real time problems.
4. Design filters such as AC filers, single tuned filters and High pass filters

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year II-Semester L T C**

**3 1 3**

**RENEWABLE ENERGY SOURCES**

**(Elective-III)**

**Course Objectives:**

1. Ability to understand about wind turbines, Geothermal energy sources, ocean energy and Bio conversion process.
2. Ability to learn Renewable energy sources, generating systems, its performance characteristics and potential in India
3. Ability to apply the knowledge to solve the present issues in power world.
4. Ability to design solar panels such as flat plate collectors, dish collectors, fuel cells and etc.,

## UNIT – I

## Principles of Solar Radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

**Solar Energy Collection**: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**UNIT-II**

**Solar Energy Storage And Applications**: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

**UNIT-III**

**Wind Energy**: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

**Bio-Mass**: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

**UNIT-IV**

**Geothermal Energy**: Resources, types of wells, methods of harnessing the energy, potential in India.

**Ocean Energy**: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles.

**Tidal and Wave energy:** Potential and conversion techniques, mini-hydel power plants, and their economics.

**UNIT-V**

**Direct Energy Conversion**: Need for DEC, Carnot cycle, limitations, principles of DEC. Seebeck effect, MHD generators,

**TEXT BOOKS:**

1. Non-Conventional Energy Sources - G.D. Rai, Khanna Publishing House, 2011.
2. Renewable Energy Technologies - Ramesh & Kumar , Narosa Publishing House.

**REFERENCE BOOKS:**

1. Renewable energy resources- Tiwari and Ghosal, Narosa Publishing House, 2007.

2. Non-Conventional Energy - Ashok V Desai,Wiley Eastern Ltd, New Delhi, 2003.

3. Non-Conventional Energy Systems - K Mittal, Wheeler Publishing Co.

 4. Solar Energy – Sukhame, Tata McGraw-Hill Education, 3rd edition, 2008.

**Course Outcomes**

After completing this course the student must demonstrate the knowledge and ability to

1. To gain knowledge on setting of solar power generating system, wind turbines, geo thermal energy generating system, ocean thermal energy generating system and etc.,
2. Understanding the Non conventional energy sources and types of energy generating systems, construction, principle, operation and applications
3. Ability to learn Renewable energy sources, generating systems, its performance characteristics and potential in India
4. Ability to design solar panels such as flat plate collectors, dish collectors, fuel cells and etc.,

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year II-Semester L T C**

**3 1 3**

**DIGITAL CONTROL SYSTEMS**

**(Elective-III)**

**Course Objectives**:

1. To equip the students with the basic knowledge of A/D and D/A conversion
2. To understand the basics of Z- Transform
3. To study the stability analysis of digital control system
4. To equip the basic knowledge of digital process control design

## UNIT – I

##  Sampling & Reconstruction

Introduction, Examples of Data control systems – Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

**The Z – Transforms**

Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms

**UNIT-II**

 **Z-Plane Analysis of Discrete-Time Control System**

 Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane.

**State Space Analysis**

State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it’s Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations

**UNIT –III**

**Controllability & Observability**

Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function

## Stability Analysis

Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci, Constant damping ratio loci, Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.

## UNIT – IV

## Design of Discrete Time Control System by Conventional Methods

Transient and steady – State response Analysis – Design based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.

**UNIT-V**

**State Feedback Controllers and Observers**

Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman’s formula.

State Observers – Full order and Reduced order observers.

**TEXT BOOKS:**

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition, 2003.

**REFERENCE BOOKS:**

1. Digital Control Systems- Kuo, Oxford University Press, 2nd Edition, 2003.

 2. Digital Control and State Variable Methods - M.Gopal, TMH , 4th Edition, 2008.

**Course Outcomes:**

**After completing this course the students will be able to**

1. Have the basic knowledge of A/D and D/A conversion, Z- Transform, stability and state variable techniques
2. Have knowledge of digital process control design
3. Analyze the signals in both time domain and z- domain
4. Design the required compensators for variable applications

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year II-Semester L T C**

**3 1 3**

**POWER SYSTEM RELIABILITY**

**(Elective-III)**

**Course Objectives:**

1. Understand the concept of probability theory, distribution, network modeling and reliability analysis.
2. Describe the reliability functions with their relationships and Markov modeling.
3. Evaluate reliability models using frequency and duration techniques and generate various reliability models.
4. Explicate the reliability of composite systems and distribution systems

**UNIT – I**

## Basics of Probability theory & Distribution

Basic probability theory – rules for combining probabilities of events – Bernoulli’s trials – probabilities density and distribution functions – binomial distribution – expected value and standard deviation of binomial distribution.

## UNIT – II

## Network Modeling and Reliability Analysis

Analysis of Series, Parallel, Series-Parallel networks – complex networks – decomposition method.

**Reliability functions**

Reliability functions f(t), F(t), R(t), h(t) and their relationships – exponential distribution – Expected value and standard deviation of exponential distribution – Bath tub curve – reliability analysis of series parallel networks using exponential distribution – reliability measures MTTF, MTTR, MTBF.

**UNIT – III Markov Modeling**

### Markov chains – concept of stochastic transitional probability Matrix, Evaluation of limiting state Probabilities. – Markov processes one component repairable system – time dependent probability evaluation using Laplace transform approach – evaluation of limiting state probabilities using STPM – two component repairable models.

## UNIT – IV

## Frequency & Duration Techniques

### Frequency and duration concept – Evaluation of frequency of encountering state, mean cycle-time, for one , two component repairable models – evaluation of cumulative probability and cumulative frequency of encountering of merged states.

**Generation System Reliability Analysis**

Reliability model of a generation system– recursive relation for unit addition and removal – load modeling - Merging of generation load model – evaluation of transition rates for merged state model – cumulative Probability, cumulative frequency of failure evaluation – LOLP, LOLE.

## UNIT – V

## Composite Systems Reliability Analysis

Decompositions method – Reliability Indices – Weather Effects on Transmission Lines.

**Distribution System and Reliability Analysis**

Basic Concepts – Evaluation of Basic and performance reliability indices of radial networks.

**TEXT BOOKS:**

1. Reliability Evaluation of Engg. System – R. Billinton, R.N.Allan, Plenum Press, New York, reprinted in India by B.S.Publications, 2007.
2. Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York, reprinted in India - B.S.Publications, 2007.

**Course Outcomes:**

After completion of this course students will be able to

1. The student shall have a thorough understanding of the main principles in power system reliability analysis as well as knowledge of different methods and tools for reliability analysis.
2. The student shall be able to model and analyze electric power systems with respect to reliability of supply.
3. Understand the application of basic probability theory and distribution to power systems.
4. Apply techniques for reliability evaluation of individual systems and of composite systems.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year II-Semester L T C**

**3 1 3**

**ADVANCED CONTROL SYSTEMS**

**(Elective-IV)**

**COURSE OBJECTIVES**:

1. To learn about State Space Representation and find solution of State Equation, State Transition Matrix.
2. To apply Controllability and Observability for controlling the systems.
3. To analyze Describing functions, Phase Plane and Stability Analysis.

**Unit – I**

**State Space Analysis , Controllability And Observability**

State Space Representation, Solution of State Equation, State Transition Matrix, Canonical Forms – Controllable Canonical Form, Observable canonical Form, Jordan Canonical Form.

Test for controllability and Observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and Observability from Jordan canonical form and other canonical forms.

**Unit – II**

**Stability Analysis**

Stability: Stability in the sense of Lyapunov. Lyapunov’s stability and Lyapunov’s instability theorems, Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.

**Unit – III**

**Phase-Plane Analysis**

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

**Describing Function Analysis**

Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems.

**Unit – IV**

**Modal Control**

Modal Control: Effect of state feedback on controllability and observability. Pole placement by state feedback, Full order observer and reduced order observer.

**Calculus Of Variations**

Calculus of variations approach: minimization of functionals of single function, constrained minimization, minimum principle, control variable inequality constraints. Control and state variable inequality constraints. Euler Lagrangie Equation.

**Unit – V**

**Optimal Control**

Optimal Control: Formulation of optimal control problem, Minimum time, Minimum energy, minimum fuel problems, State regulator problem, Output regulator problem, Tracking problem, Continuous-Time Linear Regulators.

**Text Books**

1. Modern control system theory – M.Gopal, New Age international publishers, 2nd edition, 1996.
2. Distributed computer control systems – S.S.Lamba and V.P.Singh.

**Reference Books**

1. Modern control engineering – K.Ogata, Prentice-Hall of India, 3rd edition, 1998
2. Digital control and state variable methods – M.Gopal, Tata Mc.Grawhill companies, 1997]
3. Computational aids in control systems using MATLAB – HadiSaadat, Mc.GrawHill companies, 1993.

**COURSE OUTCOMES:**

After going through this course the student gets a thorough knowledge on

* 1. State space analysis, controllability and Observability.
	2. Lyapunov’s stability.
	3. Phase plane and describing function analysis of non linear control system.
	4. Model control and calculus of variations approach.
	5. Optimal control problem.

With which he/ she can able to apply the above conceptual things in controlling of electrical and electronics engineering applications.

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year II-Semester L T C**

**3 1 3**

**EHVAC TRANSMISSION**

**(Elective-IV)**

**Course Objectives:**

1. To identify the different aspects of Extra High Voltage A.C and D.C Transmission design and Analysis
2. To get the knowledge of operating conditions of EHV lines.
3. To understand the importance of modern developments of E.H.V and U.H.V transmission systems.
4. To demonstrate EHV ac transmission system components, protection and insulation level for over voltages.

**Unit – I:**

**Preliminaries:**

Necessity of EHV AC transmission – advantages and problems–power handling capacity and line losses- mechanical considerations –– bundle conductor systems.

Line inductance and capacitances – sequence inductances and capacitances – modes of propagation.

**Unit – II:**

**Voltage gradients of conductors**:

Electrostatics – field of sphere gap – field of line changes and properties – charge – potential relations for multi-conductors – surface voltage gradient on conductors – distribution of voltage gradient on sub-conductors of bundle – Examples.

**Unit – III:**

**Corona Effects :**

Corona in E.H.V. lines – Corona loss formulae- attention of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – frequency spectrum of RI fields –Measurements of RI and RIV.

**Unit – IV:**

**Electro Static Field**:

Electrostatic field: calculation of electrostatic field of EHV/AC lines – effect on humans, animals and plants – electrostatic induction in unenergised circuit of double-circuit line – electromagnetic interference-Examples. Traveling wave expression and solution- source of excitation- terminal conditions- open circuited and short-circuited end- reflection and refraction coefficients-Lumped parameters of distributed lines-generalized constants-No load voltage conditions and charging current.

**Unit –V:**

**Voltage control:**

Power circle diagram and its use – voltage control using synchronous condensers – cascade connection of shunt and series compensation – sub synchronous resonance in series capacitor – compensated lines – static VAR compensating system.

**TEXT BOOKS:**

1. EHVAC Transmission Engineering - R. D. Begamudre, New Age International (p) Ltd, 3rd Edition, 2006.
2. HVAC and DC Transmission - S. Rao.

**REFERENCE BOOKS :**

1. Extra High Voltage AC Transmission Engineering - Rokosh Das Begamudre, Wiley

Eastern LTD., New Delhi, 1987.

1. EHV Transmission line - Electric Institution -Edison (GEC 1968).

**Course Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to

1. Understand AC and DC transmission system with all aspects
2. Evaluate the latest trends in modern transmission systems.
3. perform in depth converter analysis, faults, protections, harmonic considerations, grounding system
4. work and analyze modern and classical EHVAC systems

**ANURAG GROUP OF INSTITUTIONS**

(Autonomous)

**B.Tech EEE IV Year II-Semester L T C**

**3 1 3**

**COMPUTER ORGANIZATION**

**(Elective-IV)**

**Course Objectives:**

1. Understand instruction format, life cycle and CPU Architecture and Organization
2. Understand different types of I/O interfaces .
3. Familiar with the concepts of pipelining techniques.

**UNIT-I:**

**Basic Structure Of Computers:** Computer Types, Functional unit, Basic OPERATIONAL concepts, Bus structures, Software, Performance, multiprocessors and multi computers. Data Representation. Fixed Point Representation. Floating – Point Representation. Error Detection codes.

**UNIT-II:**

**Register Transfer Language And Micro-Operations:** Register Transfer language. Register Transfer Bus and memory transfers, Arithmetic Micro-operations, logic micro operations, shift micro operations, Arithmetic logic shift unit. Instruction codes. Computer Registers Computer instructions – Instruction cycle.

**UNIT – III:**

**Memory** – Reference Instructions. Input – Output and Interrupt. STACK organization. Instruction formats. Addressing modes. DATA Transfer and manipulation. Program control. Reduced Instruction set computer

**Micro Programmed Control**: Control memory, Address sequencing, micro-program example, design of control unit Hard wired control. Micro-programmed control

**UNIT-IV:**

**The Memory System:** Basic concepts semiconductor RAM memories. Read-only memories Cache memories performance considerations, Virtual memories secondary storage.

**Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer, Priority Interrupt Direct memory Access.

**UNIT-V:**

**Pipeline And Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors.

**Multi Processors:** Characteristics or Multiprocessors, Interconnection Structures, Inter-processor Arbitration. Inter Processor Communication and Synchronization Cache Coherence. Shared Memory Multiprocessors.

**TEXT BOOKS:**

1. Computer Systems Architecture – M.Moris Mano, PHI/Pearson, 3rd Edition, 1993.
2. Computer Organization and Architecture - V.Rajaraman and T.Radhakrishnan, PHI Publications, 2007.

**REFERENCE BOOKS:**

1. Computer Organization and Architecture – William Stallings, 8th Edition, PHI/Pearson 2010.
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI/Pearson, 1996.
3. Fundamentals or Computer Organization and Design, - Sivaraama Dandamudi, Springer Science & Business Media, 2003 .
4. Computer Organization – Car Hamacher, Zvonks Vranesic, SafeaZaky, 5th Edition, McGraw

 Hill, 1996.

**Course Outcomes:** Students will be able to

1. Understand the basic organization of computer and different instruction formats and

 addressing modes.

2. Analyze the concept of pipelining.

3. Understand and analyze various issues related to memory hierarchy.

4. Evaluate various modes of data transfer between CPU and I/O devices.