B.TECH – ELECTRICAL & ELECTRONICS ENGINEERING

Course Structure R-20

SEMESTER VII

S. No.	Class	Course Code	Name of the Subject	L	T	P	Credits
1	**HS**	CHSM2	Fundamentals of Management	3	0	0	3
2	**PE**	C27PE1	Professional Elective-III	3	0	0	3
3	**PE**	C27PE2	Professional Elective-IV	3	0	0	3
4	**OE**	C27OE3	Open Elective-III	3	0	0	3
5	**PC**	C27PC4	Electrical & Electronics Design Lab	0	0	4	2
6	**PW**	C27PW5	Comprehensive Viva/Test	0	0	2	1
7	**PW**	C27PW6	Major Project Phase I	0	0	8	4
8	MC	MC007	Competitive Exams	0	0	0	**S**
			Total Credits				19

Major Project Phase I: Students can form a group of minimum of two or maximum of four under the allocated guide, students group should choose a project title, for the chosen project title carryout a detailed literature survey, problem formulation, planning higher level design. The project evaluation will be Continuous Internal Evaluation will be made by the PRC Committee. The PRC committee consists of Head, Project Coordinator, One Senior Professor, One Associate Professor, and guide.

Mandatory Course: Competitive Exams:

For completion of this course the student can submit the proof of appearing the competitive exams like, GATE, IELTES, GRE, TOEFL, CDAC, CDS, CAT, or any examination organized by NATIONAL TESTING AGENCY (NTA), or college in the level of NTA.

or

The student should request for the provision of conducting Technical Seminar by the department. The topic of seminar should be the current technology of respective Engineering Branch. The evaluation will be done by the Departmental Academic Committee (DAC) based on rubrics framed.

Professional Elective-III(Semester – VII)

1. Industrial Electrical Systems
   Electrical Systems
2. Hybrid Electrical Vehicles
3. Flexible AC Transmission Systems

Open Elective – III (Semester – VII)

1.Design Estimation and Costing of

2.Energy Storage Systems
3.Special Machines

Professional Elective-IV(Semester – VII)

1. HVDC Transmission Systems
2. Electrical Drives
3. Electromagnetic Waves

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

FUNDAMENTALS OF MANAGEMENT- CHSM2

B.Tech. VII Semester **L/T/P/C**

3/0/0/3

COURSE OBJECTIVES

1. To make the students to understand the management concepts
2. To analyze the managerial skills.
3. To know the applications of management concepts in practical aspects of business.
4. To interpret, understand and develop the management principles in organizations.
5. To learn the basic concepts of organization its principles and functions.

COURSE OUT COMES

1. To infer the basic knowledge of management functions , levels and evolution of Management.
2. To ensure the students in decision making problem solving for the issues in corporate in the organization.
3. To acquire the knowledge of entire organization design and structure.
4. To perceive the strategically decision in selection, requirement training and development.
5. To enact and impose the qualities of a leader, mentor and coach.

UNIT - I

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach.

UNIT – II

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans. Decision making and Problem solving - Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making.

UNIT – III

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization;

Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT - IV

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis.

Motivation - Types of Motivation; Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT - V

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls

TEXT BOOKS:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

REFERENCES:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
3. Harold Koontz and Heinz Weihrich, 2010, Essentials of Management, TMH

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

INDUSTRIAL ELECTRICAL SYSTEMS (Professional Elective-III)-C27PE1

B.Tech. VII Semester **L/T/P/C**
3/0/0/3

COURSE OBJECTIVES:

1. Illustrate different electrical system components
2. Explain illumination systems
3. To solve industrial electrical systems

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

1. Understand the electrical wiring systems for residential, commercial and industrial
2. Consumers, representing the systems with standard symbols and drawings, SLD.
3. Understand various components of industrial electrical systems.
4. Analyze and selectthe proper size of various electrical system components.

UNIT-I: Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT-II: Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT-III: Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT-IV: Industrial Electrical Systems I

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC,MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT-V: Industrial Electrical Systems II

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing theDG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Industrial Electrical System Automation

Study of basic PLC, Role of in automation, advantages of process automation, PLC basedcontrol system design, Panel Metering and Introduction to SCADA system for distributionautomation.

TEXT BOOKS

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.

REFERENCE BOOKS

1. S. Singh and R. D. Singh, “Electrical estimating and costing”, DhanpatRai and Co., 1997.. Web site for IS Standards.
2. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

HYBRID ELECTRICAL VEHICLES (PROFESSIONAL ELECTIVE-III)– C27PE1

B.Tech. VII Semester **L/T/P/C**
3/0/0/3

COURSE OBJECTIVES:

1. Classification of different electrical vehicles concepts
2. Apply drives for Electric Train system
3. Illustrate energy storage devices for vehicle application

COURSE OUTCOMES: At the end of this course, students will demonstrate the ability to

1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energy storage.
3. Understand the different strategies related to energy storage systems.

UNIT-I: Introduction Conventional Vehicles: Basics of vehicle performance, IC engines,parts,vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

UNIT -II: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.BEV.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT -III: Electric Trains

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor

drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT -IV: Energy Storage

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

UNIT V: Energy Management Strategies

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

TEXTBOOKS

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.

2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

REFERENCE BOOKS

1.M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.

2.T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

FLEXIBLE AC TRANSMISSION SYSTEMS (Professional Elective-III)- C27PE1

B.Tech. VII Semester **L/T/P/C**

3/0/0/3

PREREQUISITE: Power Electronics, Power System Analysis & Power System Operation and Control

COURSE OBJECTIVES:

1.To understand the fundamentals of FACTS Controllers,

2.To know the importance of controllable parameters and types of FACTS controllers &their benefits

3.To understand the objectives of Shunt and Series compensation

4.To Control STATCOM and SVC and their comparison and the regulation of STATCOM, Functioning and control of GCSC, TSSC and TCSC

COURSE OUTCOMES: After completion of this course, the students will be able to

1. Understand the basic concept of FACTs and FACTs controller
2. Understand the working of single phase and three phase voltage source inverter
3. Understand the concept of static shunt compensation.
4. Analyze SVC & STATCOM
5. Understand the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

UNIT - I

Facts Concepts: Need of FACTS devices,merits and demerits of FACTS devices. Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, and benefits from FACTS controllers.

Voltage Source Converters: Single phase, three phase full wave bridge converters transformer connections for 12 pulse operation.

UNIT - II

Static Shunt Compensation: Objectives of shunt compensation**,** midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable var generation, variable impedance type static var generators, switching converter type var generators and hybrid var generators.

UNIT - III

SVC and STATCOM: SVC: FC-TCR and TSC-TCR. STATCOM: The regulation and slope. Comparison between SVC and STATCOM

UNIT - IV

Static Series Compensators: Objectives of Series compensation, concept of series capacitive compensation, GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC TSSC and TCSC, Static synchronous series compensator (SSSC).

UNIT - V

UPFC and IPFC: Introduction to Unified Power Flow Controller (UPFC) and Interline power flow controller(IPFC), Mathematical modeling and performance evaluation of Unified Power Flow Controller(UPFC) and Interline power flow controller(IPFC).

Text Books:

1. "N.G. Hingorani and L. Guygi", Understanding FACTS Devices, IEEE Press Publications 2000.

Reference Books:

1. "Kalyan K. Sen and Meylingsen", Introduction to FACTS Controllers, John wiley& sons, Inc., Mohamed E.EI – Hawary Series editor, 2009.

2. "K. R Padiyar, Motilal",FACTS controllers in power transmission and distribution UK Books of India 2007.

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

HVDC TRANSMISSION SYSTEMS (Professional Elective-IV)-C27PE2

B.Tech. VII Semester **L/T/P/C**
3/0/0/3

PREREQUISITE: Power Systems & Power Electronics Course

COURSE OBJECTIVES:

1. To compare EHV AC and HVDC systems
2. To analyze Graetz circuit and also explain 6 and 12 pulse converters
3. To control HVDC systems with various methods and to perform power flow analysis in AC/DC systems.
4. To describe various protection methods for HVDC systems and Harmonics

COURSE OUTCOMES: After completion of this course, the students will be able to

1. Understand basic concepts of HVDC system.
2. Analyze various methods for the reactive power control of HVDC systems and converters used.
3. Analyze power flow analysis in AC/DC systems
4. Understand various faults and protection methods for HVDC systems.
5. Analyze the harmonics generation and design different types of filters

UNIT – I:

Basic Concepts: Necessity of HVDC systems, Economics and Terminal equipment of HVDC transmission systems, Types of HVDC Links, Apparatus required for HVDC Systems, Comparison of AC and DC Transmission, Application of DC Transmission System, Planning and Modern trends in D.C. Transmission. Analysis of HVDC Converters: Choice of Converter Configuration, Analysis of Graetz circuit, Characteristics of 6 Pulse and 12 Pulse converters, Cases of two 3 phase converters in Y/Y mode – their performance.

UNIT – II:

Converter and HVDC System Control: Principle of DC Link Control, Converters Control Characteristics, Firing angle control, Current and extinction angle control, Effect of source inductance on the system, Starting and stopping of DC link, Power Control.

Reactive Power Control In HVDC: Introduction, Reactive Power Requirements in steady state, sources of reactive power- Static VAR Compensators, Reactive power control during transients

UNIT – III:

Power Flow Analysis in AC/DC Systems: Modeling of DC Links, DC Network, DC Converter, Controller Equations, Solution of DC load flow, P.U. System for DC quantities, solution of AC-DC Power flow-Simultaneous method-Sequential method.

UNIT - IV :

Converter Faults and 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: Generation of Harmonics, Characteristics harmonics, calculation of AC Harmonics, Non- Characteristics harmonics, adverse effects of harmonics, Calculation of voltage and Current harmonics, Effect of Pulse number on harmonics Filters: Types of AC filters, Design of Single tuned filters –Design of High pass filters.

TEXT BOOKS

1. "K. R. Padiyar", HVDC Power Transmission Systems: Technology and system Interactions, New Age International (P) Limited, and Publishers, 1990.
2. "S K Kamakshaiah, V Kamaraju", HVDC Transmission , TMH Publishers, 2011

Reference Books:

1. "S. Rao", EHVAC and HVDC Transmission Engineering and Practice, Khanna publications, 3 rd Edition 1999.
2. "Jos Arrillaga", HVDC Transmission, The institution of electrical engineers, IEE power & energy series 29, 2nd edition 1998.
3. "E. W. Kimbark", Direct Current Transmission, John Wiley and Sons, volume 1, 1971.
4. "E. Uhlmann", Power Transmission by Direct Current, B. S. Publications, 2009

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

ELECTRICAL DRIVES (Professional Elective-IV)- C27PE2

B.Tech. VII Semester **L/T/P/C**
3/0/0/3

COURSE OBJECTIVES:

1. This course is an extension of Power Electronics applications to AC and DC drives.
2. Control of DC motor drives with single phase and three phase converters and choppers are given in detail.
3. The control of AC motor drives with variable frequency converters and variable voltage are presented.

COURSE OUTCOMES:

After Completion of this course, the students will be able to

1. Discuss control of DC Motors through Phase Controlled Rectifiers
2. Develop Four Quadrant Operation of DC Drives through Dual Converters
3. Explain Control of DC Motors by Choppers
4. Demonstrate different control techniques of induction motors
5. Demonstrate different control techniques of synchronous motors

UNIT – I:

Control of DC Motors through Phase Controlled Rectifiers

Introduction to Thyristor controlled Drives, Single Phase semi and fully controlled converters connected to DC separately excited and DC series motors – continuous current operation – output voltage and current waveform – Speed and Torque expressions – Speed – Torque Characteristics- Problems on Converter fed DC motors. Three phase semi and fully controlled converters connected to DC separately excited and DC series motors – output voltage and current waveform – Speed and Torque expressions – Speed – Torque characteristics – Problems.

UNIT – II:

Four Quadrant Operation of DC Drives through Dual Converters

Introduction to Four quadrant operation – Motoring operations. Electric Braking – Plugging, Dynamic and Regenerative Braking operations. Four quadrant operation of DC motors by dual converters – Closed loop operation of DC motor (Block Diagram Only).

UNIT-III:

Control of DC Motors by Choppers (1-, 2-, 4- Quadrant Operations)

Single quadrant, Two -quadrant and four quadrant chopper fed dc separately excited and series excited motors – Continuous current operation – Output voltage and current wave forms – Speed torque expressions – speed torque characteristics – Problems on Chopper fed DC Motors – Closed Loop operation (Block Diagram Only).

UNIT –IV:

Control of Induction Motors: Variable voltage characteristics:

Control of Induction Motor by Ac Voltage Controllers – Waveforms – speed torque characteristics.

Variable frequency characteristics:

Variable frequency control of induction motor by Voltage source and current source inverter and cyclo-converters- PWM control – Comparison of VSI and CSI operations – Speed torqu characteristics – numerical problems on induction motor

Static rotor resistance control:

Slip power recovery – Static Scherbius drive – Static Kramer Drive – their performance and speed torque characteristics – advantages applications – problems.

UNIT – V:

Control of Synchronous Motors:

Separate control &self control of synchronous motors – Operation of self controlled synchronous motors by VSI and CSI cyclo converters. Load commutated CSI fed Synchronous Motor – Operation – Waveforms – speed torque characteristics – Applications – Advantages and Numerical Problems – Closed Loop control operation of synchronous motor drives (Block Diagram Only).

TEXT BOOKS

1. Power Semiconductor Drives, PV Rao, BS Publications.
2. Fundamentals of Electric Drives, G K Dubey Narosa Publications

REFERENCE BOOKS

1. Power Semiconductor Drives, S. B. Dewan, G. R. Slemon , A. Straughen, Wiley Pvt Ltd.
2. Electric Drives N. K. De, P. K. Sen, PHI Learning Private Ltd.
3. Thyristor Control of Electric drives, VedamSubramanyam Tata McGraw Hill Publications.
4. Electrical machines and Drive Systems, John Hindmarsh, Alasdair Renfrew, Newnes.
5. Electric Motors and Drives, Fundamentals, Types and Applications Austin Hughes, Newnes.
6. Power Electronics and Variable Frequency Drives Technology and Applications, Bimal K. Bose, Wiley India Pvt. Ltd.
7. A First course on Electrical Drives, S K Pillai, New Age International (P) Ltd.
8. Modern Power Electronics and AC Drives, B.K.Bose, PHI.
9. Power Electronic Circuits, Devices and applications, M.H.Rashid, PHI.
10. Power Electronic Control of AC Motors, J. M. D. Murphy, F. G. Turnbull

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B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

ELECTROMAGNETIC WAVES (Professional Elective-IV)- C27PE2

B.Tech. VII Semester **L/T/P/C**
3/0/0/3

COURSE OBJECTIVES:

1. Define transmission lines
2. Apply Maxwell equations to field theory
3. Explain wave generation and applications

COURSE OUTCOMES: At the end of this course, students will demonstrate the ability to

1. Analyze transmission lines and estimate voltage and current at any point on Transmission line for different load conditions.
2. Provide solution to real life plane wave problems for various boundary conditions.
3. Analyze the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
4. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
5. Understand and analyse radiation by antennas.

UNIT-I:
Transmission Lines
Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

UNIT-II:
Maxwell's Equations
Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

UNIT-III:

Uniform Plane Wave

Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

UNIT-IV:

Plane Waves at Media Interface Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

UNIT-V:

Waveguides Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode,

Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Antennas

Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Text Books:

1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill, 2005.
2. D. K. Cheng, "Field and Wave Electromagnetics**"**, Addison-Wesley, 1989.

Reference Books

1. M. N.O. Sadiku, "Elements of Electromagnetics**"**, Oxford University Press, 2007.
2. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
3. C. A. Balanis, "Antenna Theory: Analysis and Design**"**, John Wiley & Sons, 2005.

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

Electrical & Electronics Design Lab – C27PC4

B.Tech. VII Semester **L/T/P/C**
0/0/4/2

PREREQUISITE: Basics of Electrical Engineering

COURSE OBJECTIVES:

1. To enhance practical knowledge related to different subjects
2. To develop hardware skills such as soldering, winding etc.
3. To develop debugging skills.
4. To increase ability for analysis and testing of circuits.
5. To give an exposure to market survey for available components
6. To develop an ability for proper documentation of experimentation.
7. To enhance employability of a student.
8. To prepare students for working on different hardware projects.

COURSE OUTCOMES: After completion of this course, the students will be able to

1. Get practical knowledge related to electrical
2. Fabricate basic electrical circuit elements/networks
3. Trouble shoot the electrical circuits
4. Design filter circuit for application
5. Get hardware skills such as soldering, winding etc.
6. Get debugging skills.

Group A:

1. Design and fabrication of reactor/ electromagnet for different inductance values.

2. Design and fabrication of single phase Induction/three phase motor stator.

3. Start delta starter wiring for automatic and manual operation.

4. Wiring of distribution box with MCB, ELCB, RCCB and MCCB.

5. Wiring of 40 W tube, T-5, LED, Metal Halide lamps and available latest luminaries.

6. Assembly of various types of contactors with wiring.

7. Assembly of DOL and 3 point starter with NVC connections and overload operation.

Group B: This group consists of electronic circuits which must be assembled and tested on general purpose PCB or bread boards.

1. Design and development of 5 V regulated power supply.

2. Design and development of precision rectifier.

3. Design and development of first order/ second order low pass/high pass filters with an application.

4. Microcontroller Interface circuit for temperature/level/speed/current/voltage measurement.

5. Peak detector using op-amplifiers.

6. Zero crossing detector using op-amplifiers

7. Power quality comparison of CFL, LED, and Incandescent and fluorescent lamps.

B.TECH – ELECTRICAL & ELECTRONICS ENGINEERING

Course Structure R-20

SEMESTERVIII

S. No.	Class	Course Code	Name of the Subject	Lecture	Tutorial	Practical	Credits
1	**OE**	C28OE1	Open Elective-IV	3	0	0	3
2	**PE**	C28PE2	Professional Elective-V	3	0	0	3
3	**PE**	C28PE3	Professional Elective-VI	3	0	0	3
4	**PW**	C28PW4	Major Project Phase II	0	0	20	10
		Total Credits					19

Major Project Phase II: The approved project in Major Project Phase I should be implemented, student should submit the progress of his implementation work in 2 phases, to the PRC (Project Review Committee). The PRC consists of Head, Project Coordinator, One Senior Professor, One Associate Professor, and guide. Upon approval in both the phases, the student is eligible to submit the final project report by completing proper documentation to the external viva voce.

Professional Elective-V(Semester – VIII)

1. Electrical Distribution Systems
2. Modern Control Theory
3. Computational Electromagnetics

Professional Elective-VI(Semester – VIII)

1. Utilization of Electrical Energy
2. High Voltage Engineering
3. Computer Aided Design of Electrical Machines

Open Elective –IV (Semester – VIII)

1.Power system Reforms
2. Programmable Logic Controllers & SCADA
3. Energy from Waste

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

ELECTRICAL DISTRIBUTION SYSTEMS (Professional Elective-V)-C28PE2

B.Tech. VIII Semester **L/T/P/C**
3/0/0/3

Prerequisites: Power Systems – I & Power Systems - II

COURSE OBJECTIVES:

1. To distinguish between transmission and distribution systems
2. To understand design considerations of feeders
3. To compute voltage drop and power loss in feeders
4. To understand protection of distribution systems
5. To examine the power factor improvement and voltage control

COURSE OUTCOMES: After completion of this course, the students will be able to

1. Understand the general concepts of distribution system and the design of feeders
2. Analyze the location and different parameters of substations.
3. Understand the distribution system protection and faults.
4. Apply different methods to improve the power factor.
5. Analyze the importance of voltage control and its methods.

UNIT – I

General Concepts: Introduction to distribution system, Distribution system planning, Factors effecting the Distribution system planning, Load modeling and characteristics. Coincidence factor - contribution factor - Loss factor - Relationship between the load factor and loss factor. Load growth, Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

Distribution Feeders: Design Considerations of Distribution Feeders: Radial, loop and network types of primary feeders, Factors effecting the feeder voltage level, basic design practice of the secondary distribution system, secondary banking,

UNIT – II

Substations: Location of Substations: Rating of distribution substation, service area with 'n' primary feeders. Benefits derived through optimal location of substations. Optimal location of Substations (Perpendicular bisector rule and X, Y co-ordinate method).

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, analysis of non-three phase systems, method to analyze the distribution feeder cost.

UNIT – III

Protection: Objectives of distribution system protection, types of common faults and procedure for fault calculations, over current Protective Devices: Principle of operation of Fuses, Auto-Circuit Recloser - and Auto-line sectionalizes, and circuit breakers.

COORDINATION: Coordination of Protective Devices: Objectives of protection co-ordination, general coordination procedure, Types of protection coordination: Fuse to Fuse, Auto-Recloser to Fuse, Circuit breaker to Fuse, Circuit breaker to Auto-Recloser.

UNIT – IV

Compensation For Power Factor Improvement: Capacitive compensation for power-factor control - Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), effect of series capacitors, difference between shunt and series capacitors, Calculation of Power factor correction, capacitor allocation - Economic justification of capacitors - Procedure to determine the best capacitor location.

UNIT – V

Voltage Control: Voltage Control: Importance of voltage control, methods of voltage control, Equipment for voltage control, effect of shunt capacitors, effect of series capacitors, effect of AVB/AVR on voltage control, line drop compensation, voltage fluctuations.

Text books:

1. TuranGonen, Electric Power Distribution system Engineering, CRC Press, 3rd Edition 2014.
2. V. Kamaraju, Electrical Power Distribution Systems, Tata Mc Graw HillPublishing Company, 2nd edition,2010.

Reference Books:

1. G. Ram Murthy, Electrical Power Distribution hand book, 2nd edition, University press2004.
2. A.S. Pabla, Electric Power Distribution, Tata McGraw Hill Publishing company, 6th edition,2013.
3. CL Wadhwa ,Electrical Power System by ,6th Edition

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

MODERN CONTROL THEORY (Professional Elective-V)- C28PE2

B.Tech. VIII Semester **L/T/P/C 3/0/0/3**

COURSE OBJECTIVES: The objective of the course is to

1. Understand state space representation of systems and study controllability and Observability tests for continuous time-invariant systems.
2. Understand the problem formulation of non linear systems and study the performance.
3. Understand different types of optimal control techniques and its applications

COURSE OUTCOMES: After completion of the course, the student acquires knowledge to

1. Represent a system in state space form and analyze controllability and Observability concepts.
2. Define the stability of a non linear system using lyapunov stability method.
3. linear and non linear systems in state model
4. stability analysis of linear and non linear systems through describing functions

UNIT–I:

Mathematical Preliminaries: Fields, Vectors and Vector Spaces – Linear combinations and Bases –Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous-Time State models.

UNIT-II:

State Variable Analysis: Linear Continuous time models for Physical systems– Non Linear Models- Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix

and its properties. General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model

UNIT-III:

Non Linear Systems: Introduction – Non Linear Systems - Types of Non-Linearities – Saturation –Dead- Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function– describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions.

UNIT-IV:

Phase-Plane Analysis: Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points phase-plane analysis of nonlinear control systems

UNIT-V:

Stability Analysis: Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method. State feedback controller design through Pole Assignment – State observers: Full order and Reduced order.

TEXT BOOKS:

1. Modern Control System Theory by M.Gopal – New Age International-1984
2. Modern Control Engineering by Ogata.K Prentice Hall – 1997 N.K.Sinha, control systems, New Age International, 3rd edition.

REFERENCES:

Optimal control by kircks

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

COMPUTATIONAL ELECTROMAGNETICS (Professional Elective-V)- C28PE2

B.Tech. VIII Semester **L/T/P/C**
3/0/0/3

COURSE OBJECTIVES:

1. To classify electromagnetic and electrostatics theory
2. To apply analytical methods to solve field equations
3. To discuss low frequency drives

COURSE OUTCOMES:
At the end of this course, students will demonstrate the ability to

1. Understand the basic concepts of electromagnetics.
2. Understand computational techniques for computing fields.
3. Apply the techniques to simple real-life problems.

UNIT-I:
Introduction
Conventional design methodology, Computer aided design aspects – Advantages. Review ofbasic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transientsand time-harmonic.

UNIT-II:
Analytical Methods
Analytical methods of solving field equations, method of separation of variables, Roth'smethod, integral methods- Green's function, method of images.

UNIT-III:
Finite Difference Method (FDM)
Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FDsolutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.
Finite Element Method (FEM)

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

UNIT-IV:
Special Topics
Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (Graphical method), hybrid methods, coupled circuit - field computations, electromagnetic - Thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's field

UNIT-V:
Applications
Low frequency electrical devices, static / time-harmonic / transient problems in transformers, Rotating machines, actuators. CAD packages.

Text/Reference Books
1. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

UTILIZATION OF ELECTRICAL ENERGY (Professional Elective-VI)-C28PE3

B.Tech. VIII Semester **L/T/P/C**
3/0/0/3

PREREQUISITE: Electrical Machines-I & Electrical Machines-II

COURSE OBJECTIVES:

1. To understand the fundamentals of illumination and good lighting practices
2. To understand the methods of electric heating and welding.
3. To understand the concepts of electric drives and their application to electrical traction systems.

COURSE OUTCOMES:

After completion of this course, the students will be able to

1. Understand the electric drives and types of loads.
2. Understands the concepts and methods of electric heating and welding.
3. Analyze the various illumination methods.
4. Apply the electric drives to electric traction applications.
5. Analyze various calculations involved in electric traction.

UNIT – I:

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

UNIT – II:

Electric Heating: Advantages and methods of electric heating, resistance heating induction heating and dielectric heating.

Electric Welding: Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT – III:

Illumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light.

Various Illumination Methods: Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of 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 rheostat 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 coefficient of adhesion.

TEXT BOOKS:

1. E. Openshaw Taylor, Utilisation of Electric Energy – by University press,1961.
2. Partab, H., 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Sons, New Delhi,1986.

REFERENCE BOOKS:

1. N. V. Suryanarayana, Utilization of Electrical Power including Electric drives and Electric traction, New Age International (P) Limited, Publishers,1996.
2. C. L. Wadhwa, Generation, Distribution and Utilization of electrical Energy,New Age International (P) Limited, Publishers,1997.
3. Tripathy, S.C., 'Electric Energy Utilisation and Conservation', Tata McGraw Hill Publishing Company Ltd. New Delhi,1991.
4. Soni, Gupta, Bhatnagar, “Principle of Electrical Engineering”, Dhanpatrai & Sons, 2008.

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

HIGH VOLTAGE ENGINEERING (Professional Elective-VI)- C28PE3

B.Tech. VIII Semester **L/T/P/C**
3/0/0/3

PREREQUISITE: Power Systems-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

COURSEOUTCOMES:

After completion of this course the students will be able to

1. Understand Various Dielectric Materials, Numerical methods for electric field computation and Applications.
2. Analyze break down occurs in Gaseous, Solid and liquid dielectrics.
3. Understand the generation and measurement of high voltages and currents.
4. Analyze the causes of over voltage and insulation coordination.
5. Analyze the High Voltage Testing of Electrical Apparatus and Non Destructive materials.

UNIT-I: INTRODUCTION TO HIGH VOLTAGE TECHNOLOGY ANDAPPLICATIONS

Electric Field Stresses, Gas / Vacuums 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: BREAKDOWN INGASEOUS, SOLID ANDLIQUID 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 MEASUREMENTSOFHIGH VOLTAGESAND 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 and trapping.

UNIT-IV: OVER VOLTAGEPHENOMENON ANDINSULATION CO-ORDINATION

Natural causes for over voltages–Lightning phenomenon, Over voltage 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 ANDHIGHVOLTAGE TESTINGOFMATERIAL 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.NaiduandV.Kamaraju–TMHPublications,3rdEdition, 2009.
2. High Voltage Engineering-C.L.Wadhwa, New Age Internationals (P)Limited, 1997.

REFERENCE BOOKS:

1. High Voltage Insulation Engineering – Ravindra Arora, Wolfgang Mosch, New Age International (P)Limited, 1995.
2. High Voltage Engineering: Fundamentals - E.Kuffel, W.S.Zaengl, J.Kuffel, Elsevier publications, 2ndEdition,2000.

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING –R20

COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES

(Professional Elective-VI)- C28PE3

B.Tech. VIII Semester **L/T/P/C**
3/0/0/3

PREREQUISITE: Elements of Electrical Engineering, DC Machines and Transformer, Elements of Electrical Design.

COURSE OBJECTIVES: The main objectives of the course are:

1. To introduce the basic concepts of CAD.
2. To teach the application of finite element method in design
3. To teach the CAD of electrical machines.

COURSE OUTCOMES: After completion of this course, the students will be able to:

1. Explain the concepts related to computer aided design of electrical equipments.
2. Formulate and solve the optimum design problems with computers.
3. Discuss application of finite element method in designing.
4. Develop computer aided design of electrical apparatus.
5. Explain the computer aided design of dc machines and transformers.

UNIT —I:

CONCEPT OF COMPUTER-AIDED DESIGN AND OPTIMIZATION

Introduction; Computer Aided Design; Explanation of details of flow chart; Input data to be fed into the program; Applicable constraints Max or Minimum permissible limits; Output data to be printed after execution of program; Various objective parameters for optimization in an electrical machine; Selection of optimal design; Explanation of lowest cost and significance of "Kg/KVA";Flowcharts.

UNIT –II:

BASIC CONCEPTS OF DESIGN:

Introduction; Specification; Output coefficient; Importance of specific loadings; Electrical Materials: Conducting Materials, Insulating Materials and Magnetic Materials; Magnetic circuit

calculations; General procedure for calculation of Amp-Turns; Heating and Cooling; Modes of heat dissipation; Standard ratings of Electrical machines; Ventilation schemes in static machines (Transformers) and in rotating machines; Quantity of cooling medium; Types of enclosures; General design procedure; Steps to get optimal design.

UNIT – III:

APPLICATION OF FINITE ELEMENT METHOD IN DESIGN

Introduction; Basics of Finite element, Shape functions, Single element computation. Assembly of elemental coefficient matrix, Global coefficient matrix, Application of FEM technique for design problems. Use of open source FEM software for 2D design. Computation of Capacitance of capacitor, cable, multi dielectric cable through FEM, Computation of electrostatic field for various geometry, skin and proximity effect in conductors.

UNIT – IV:

COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS

Introduction; Flowcharts and programs for computer aided design of Starters, field regulators, small transformers, choke coils. 2D FEM open source software based electrical apparatus design.

UNIT – V:

COMPUTER AIDED DESIGN OF DC MACHINES

Introduction; Flowcharts and programs for computer aided design of DC machines. 2D FEM open source software based DC machine part design.

COMPUTER AIDED DESIGN OF TRANSFORMERS

Introduction; Flowcharts and programs for computer aided design of transformers, 2D FEM open source software based transformer part design.

TEXT BOOKS

1. Computer aided design of electrical machines - K M Vishnu Murthy, B S Publications

2. Computer aided design of electrical machines – Maurya, Jallan, Shukla, Kataria publication

REFERENCE BOOKS

1.An Introduction to the Finite Element Method – J Reddy, TMH Publication

B.TECH – ELECTRICAL & ELECTRONICS ENGINEERING-R20

DESIGN ESTIMATION AND COSTING OF ELECTRICAL SYSTEMS- C27OE3
(OPEN ELECTIVE – III)

B. TECH VII SEMESTER **LTP C**
3 0 03

Prerequisite: Power systems - I & Power Systems - II

Course Objectives:
- To emphasize the estimation and costing aspects of all electrical equipment, installation and designs on the cost viability.
- To design and estimation of wiring
- To design overhead and underground distribution lines, substations and illumination

Course Outcomes: After Completion of this course, student will be able to
- Understand the design considerations of electrical installations.
- Design electrical installation for buildings and small industries.
- Identify and design the various types of light sources for different applications.

UNIT – I
Design Considerations of Electrical Installations: Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, Earthing, General requirements of electrical installations, testing of installations, Indian Electricity rules, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections , Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches, Location of Main Board and Distribution board, Guide lines for Installation of Fittings, Load Assessment, Permissible voltage drops and sizes of wires, estimating and costing of Electric installations.

UNIT – II
Electrical Installation for Different Types of Buildings and Small Industries: Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations for small industries.

UNIT – III
Overhead and Underground Transmission and Distribution Lines: Introduction, Supports for transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables.

UNIT – IV

Substations: Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substations – Floor mounted type.

UNIT – V

Design of Illumination Schemes: Introduction, Terminology in illumination, laws of illumination, various types of light sources, Practical lighting schemes LED, CFL and OCFL differences.

Text Books:

1. "K. B. Raina, S. K. Bhattacharya", "Electrical Design Estimating and Costing", New Age International Publisher, 2010.
2. "Er. V. K. Jain, Er. Amitabh Bajaj", "Design of Electrical Installations", University Science Press.

Reference Books:

1. Code of practice for Electrical wiring installations,(System voltage not exceeding 650 volts), Indian Standard Institution, IS:732-1983.
2. Guide for Electrical layout in residential buildings, Indian Standard Institution, IS: 4648-1968.
3. Electrical Installation buildings Indian Standard Institution, IS: 2032.
4. Code of Practice for selection, Installation of Maintenance of fuse (voltage not exceeding 650 V), Indian Standard Institution, IS: 3106-1966.
5. Code of Practice for earthling, Indian Standard Institution, IS: 3043-1966.
6. Code of Practice for Installation and Maintenance of induction motors, Indian Standard Institution, IS: 900-1965.
7. Code of Practice for electrical wiring, Installations (system voltage not exceeding 650 Volts), Indian Standard Institution, IS: 2274-1963.
8. "Gupta J. B., Katson, Ludhiana", "Electrical Installation, estimating and costing", S.K. Kataria and sons, 2013.

B.TECH – ELECTRICAL & ELECTRONICS ENGINEERING-R20

ENERGY STORAGE SYSTEMS- C27OE3
(OPEN ELECTIVE – III)

B. TECH VII **SEMESTER**

L	T	P	C
3	0	0	3

Prerequisite: Electro chemistry

Course Objective:

- To enable the student to understand the need for energy storage, devices and technologies available and their applications

Course Outcomes: After completion of this course, the student will be able to

- analyze the characteristics of energy from various sources and need for storage
- classify various types of energy storage and various devices used for the purpose
- Identify various real time applications.

UNIT - I

Electrical Energy Storage Technologies: Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

UNIT - II

Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT - III

Features of Energy Storage Systems: Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES),Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2),Synthetic natural gas (SNG).

UNIT - IV

Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC) ,Superconducting magnetic energy storage (SMES),Thermal storage systems ,Standards for EES, Technical comparison of EES technologies.

UNIT - V

Applications: Present status of applications, Utility use (conventional power generation, grid operation & service) , Consumer use (uninterruptable power supply for large consumers), New trends in applications ,Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA– aggregation of many dispersed batteries.

Text Books:

1. "James M. Eyer, Joseph J. Iannucci and Garth P. Corey ", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.

Reference Book:

1. "Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010

B.TECH – ELECTRICAL & ELECTRONICS ENGINEERING-R20

SPECIAL MACHINES - C27OE3

(OPEN ELECTIVE – III)

B. TECH VII SEMESTER	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Prerequisite: Electrical Machines - I & Electrical Machines - II

COURSE OBJECTIVES:

1. To understand the working and construction of special machines
2. To analyze the use of special machines in different feed-back systems
3. To understand the use of micro-processors for controlling different machines

COURSE OUTCOMES: After completion of this course, the students will be able to

1. Understand the special type of DC machines.
2. Understand the working of hybrid stepper motor and analyze its configurations.
3. Analyze the working and control of Variable Reluctance Stepping Motors and Switched Reluctance Motor.
4. Understand the working of permanent magnet and brushless dc motor..
5. Analyze the Linear induction motor.

UNIT – I

Special Types of DC Machines - I: Series booster-Shunt booster-Non-reversible boost-Reversible booster

Special Types of DC Machines – II: Armature excited machines—Rosenberg generator- The Amplidyne and metadyne— Rototrol and Regulex-third brush generator-three-wire generator-dynamometer.

UNIT – II

Stepper Motors: Introduction-synchronous inductor (or hybrid stepper motor), Hybrid stepping motor, construction, principles of operation, Energisation with two phase at a time- essential conditions for the satisfactory operation of a 2-phase hybrid step motor- very slow- speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors-an open-loop controller for a 2-phase stepping motor.

UNIT – III

Variable Reluctance Stepping Motors: Variable reluctance (VR) Stepper motors, single- stack VR step motors, Multiple stack VR motors-Open-loop control of 3-phase VR step motor-closed-Loop control of step motor, discriminator (or rotor position sensor) transilator, major loop-characteristics of step motor in open-loop drive – comparison between open-loop position control with step motor and a position control servo using a conventional (dc or ac)

servo motor- Suitability and areas of application of stepper motors-5- phase hybrid stepping motor-single phase-stepper motor, the construction, operating principle torque developed in the motor.

Switched Reluctance Motor: Introduction – improvements in the design of conventional reluctance motors- Some distinctive differences between SR and conventional reluctance motors-principle of operation of SRM- Some design aspects of stator and rotor pole arcs, design of stator and rotor and pole arcs in SR motor-determination of $L(\theta)$--- θ profile – power converter for SR motor-A numerical example –Rotor sensing mechanism and logic control, drive and power circuits, position sensing of rotor with Hall problems—derivation of torque expression, general linear case.

UNIT – IV

Permanent Magnet Materials And Motors: Introduction, Hysteresis loops and recoil line-stator frames (pole and yoke - part)of conventional PM dc Motors, Equivalent circuit of a PM-Development of Electronically commutated dc motor from conventional dc motor.

Brushless DC Motor: Types of construction – principle of operation of BLDM- sensing and switching logic scheme, sensing logic controller, lockout pulses –drive and power circuits, Base drive circuits, power converter circuit-Theoretical analysis and performance prediction, modeling and magnet circuit d-q analysis of BLDM -transient analysis formulation in terms of flux linkages as state variables-Approximate solution for current and torque under steady state –Theory of BLDM as variable speed synchronous motor (assuming sinusoidal flux distribution)- Methods or reducing Torque Pulsations, 180 degrees pole arc and 120 degree current sheet.

UNIT – V

Linear Induction Motor: Development of a double sided LIM from rotary type IM- A schematic of LIM drive for electric traction development of one sided LIM with back iron- field analysis of a DSLIM fundamental assumptions.

Text Books:

1. K. Venkataratnam, Special electrical machines, university press, 2009.
2. R. K. Rajput - Electrical machines, Laxmi Publications, 5th Edition 2016.

Reference Books:

1. “E. G. Janardanan”, Special electrical machines-PHI 2014.
2. V.V. Athani - Stepper motor: Fundamentals, Applications and Design, New age International publishers, 1997.

B.TECH ELECTRICAL & ELECTRONICS ENGINEERING- R20

POWER SYSTEM REFORMS- C28OE1

Open Elective – IV

B. TECH VIII SEMESTER

L	T	P	C
3	0	0	3

Course Objectives:

- To study fundamentals of power system deregulation and restructuring.
- To study available transfer capability.
- To study congestion management
- To study various electricity pricing.
- To study operation of power system in deregulated environment.
- To study importance of Ancillary services management.

Course Outcomes:

- Will understand importance of power system deregulation and restructuring.
- Able to compute ATC.
- Will understand transmission congestion management.
- Able to compute electricity pricing in deregulated environment.
- Will be able to understand power system operation in deregulated environment.
- Will understand importance of ancillary services.

UNIT–I : Over view of key issues in electric utilities : Introduction – Restructuring models – Independent system operator (ISO) – Power Exchange – Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT–II : **OASIS:** Open Access Same–Time Information System : Structure of OASIS – Processing of Information – Transfer capability on OASIS – Definitions Transfer Capability Issues – ATC – TTC – TRM – CBM calculations – Methodologies to calculate ATC.

UNIT–III : **Congestion Management** : Introduction to congestion management – Methods to relieve congestion.

UNIT–IV: **Electricity Pricing:** Introduction – Electricity price volatility electricity price indexes – Challenges to electricity pricing – Construction of forward price curves – Short–time price forecasting.

UNIT–V: **Power system operation in competitive environment:** Introduction – Operational planning activities of ISO – The ISO in pool markets – The ISO in bilateral markets – Operational planning activities of a Genco.
Ancillary Services Management: Introduction – Reactive power as an ancillary service – A review – Synchronous generators as ancillary service providers.

Text Books:

1. Kankar Bhattacharya, Math H.J. Boller, Jaap E.Daalder, 'Operation of Restructured Power System' Klum,er Academic Publisher – 2001
2. Mohammad Shahidehpour, and Muwaffaq alomoush, – "Restructured electrical Power systems" Marcel Dekker, Inc. 2001

Reference Books:

1. Loi Lei Lai; "Power system Restructuring and Deregulation", Jhon Wiley & Sons Ltd., England.
2. Electrical Power Distribution Case studies from Distribution reform, upgrades and Management (DRUM) Program, by USAID/India, TMH.

B.TECH ELECTRICAL & ELECTRONICS ENGINEERING-R20

Programmable Logic Controllers & SCADA- C28OE1

Open Elective – IV

B. TECH VIII SEMESTER

L	T	P	C
3	0	0	3

Course Outcomes: At the end of this course, students will be able to

1. Understand the concepts of PLC.
2. Illustrate the fundamentals of PLC for electrical devices
3. Analyze the operation of counters
4. Apply instructions in PLCs.
5. Investigate implementation of SCADA.

UNIT I:

Programmable Logic Controllers: Introduction, parts of PLC, principles of operation, modifying the operation, PLCs versus computers, PLC size and application.

PLC Hardware Components: The I/O section, discrete I/O modules, analog I/O modules, special I/O modules, I/O specifications, central processing unit (CPU), memory design, memory types, programming terminal devices, recording and retrieving data human machine interfaces (HMIs).

Basics of PLC programming: Processor memory organization, program scan, PLC programming languages, relay-type instructions, instruction addressing, branch instructions, internal relay instructions, programming examine if -closed and if-open instructions, entering the latter diagram.

UNIT II:

Developing fundamental PLC wiring diagrams and ladder logic programs: Electromagnetic control relays, contactors, motor starters, manually operated switches, mechanical operated switches, sensors, output control devices, seal-in circuits, latching relays, converting relay schematics into PLC ladder programs.

UNIT III:

Programming counters: Counter's instructions, up-counter, down-counter, cascading counters, incremental encoder-counter applications, combining counter and timer functions.

Program control instructions: Master control reset instruction, jump instruction, subroutine functions, immediate input and immediate output instructions, forcing external I/O addresses, safety circuitry, fault routine, temporary end instruction, suspend instruction.

UNIT IV:

Data manipulation instructions: Data manipulation, data transfer operation, data compare instructions, data manipulation programs, numerical data I/O interfaces, closed-loop control.

Math instructions: Match instructions, addition instruction, subtraction instruction, multiplication instruction, division instruction, file arithmetic operations.

UNIT V:

Sequencer and shift register instructions: Mechanical sequencers, sequencer instructions, sequencer programs, bit shift registers, word shift operations.

Process control network system and SCADA: Types of processes, structure of control systems, ON/OFF control PID control, Motion control, data communications, supervisory control and data acquisition (SCADA).

TEXT BOOKS:

1. Programmable Logic Controllers, W. Bolton, 5th edition, Newnes ELSEVIER, 2009
2. PLCs & SCADA: Theory and Practice, Rajesh Mehra, Laxmi Publications, 2012.

REFERENCE BOOKS:

1. Industrial applications of programmable logic controllers and SCADA, Kunal Chakraborty, Palash De, Indranil Roy, Anchor Academic Publishing, 2016
2. Ladder logic programming fundamentals, A.J. Wright, 2nd edition, AB Prominent publisher, 2020

B.TECH. ELECTRICAL & ELECTRONICS ENGINEERING-R20

ENERGY FROM WASTE- C28OE1
Open Elective – IV

B. TECH VIII SEMESTER

L	T	P	C
3	0	0	3

Course Objectives:

1. To enable students to understand of the concept of Waste to Energy.
2. To link legal, technical and management principles for production of energy form waste.
3. To learn about the best available technologies for waste to energy.
4. To analyze of case studies for understanding success and failures.
5. To facilitate the students in developing skills in the decision making process

Course Outcomes:

Upon completion of this course the student will be able to:

1. Apply the knowledge about the operations of Waste to Energy Plants.
2. Analyse the various aspects of Waste to Energy Management Systems.
3. Carry out Techno-economic feasibility for Waste to Energy Plants.
4. Apply the knowledge in planning and operations of Waste to Energy plants.

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods –Yieldsand application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidizedbed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and Their classification - Biomass conversion processes - Thermo chemical conversion – Direct combustion
-biomass gasification - pyrolysis and liquefaction - biochemical conversion -anaerobic digestion Types of biogas Plants – Applications - Alcohol production from biomass -Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

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1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. Were Ko-Brobby and E. B. Hagan, John Wiley & Sons, 1996.