B.TECH. ELECTRICAL & ELECTRONICS ENGINEERING (R22)

List of Open Electives

Open Elective-I (SEMESTER-V)

1. Charging Infrastructure for Electric Vehicles
2. Electrical Engineering Materials
3. Nano Technology

Open Elective-II (SEMESTER-VI)

1. Fundamentals of Electric Vehicles
2. Optimization Techniques
3. Renewable Energy Sources

Open Elective–III (SEMESTER-VII)

1. Design Estimation and Costing of Electrical Systems
2. Energy Storage Systems
3. Reliability Engineering

Open Elective–IV (SEMESTER-VIII)

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

B.TECH. ELECTRICAL & ELECTRONICS ENGINEERING (R22)

CHARGING INFRASTRUCTURE FOR ELECTRIC VEHICLES

(Open Elective-1) (D25OE1)

B. Tech. V-Sem

L	T	P	C
3	0	0	3

Prerequisite: None, Interest in Electric Vehicles.

Course Objectives:

1. Gain understanding of the various components involved in an electric vehicle charging system.
2. Comprehend the different types of electric vehicle chargers, along with the applicable standards governing their design and operation.
3. Interpret the diverse communication protocols utilized in electric vehicle charging systems andstay familiar with the latest trends in this evolving field.

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

1. Understand the various components of Electric vehicle charging system
2. Comprehend the different types of Electric vehicle chargers and their standards
3. Interpret the various communication protocols and recent trends in Electric vehicle charging

UNIT I

Introduction to EV charging:

Electric Vehicle Charging; Charging Modes; Electric Vehicle Supply Equipment (EVSE): Types,Components of EV Battery Chargers; Challenges in Electric Vehicle Charging.

UNIT II

Charger sizing and standards:

Charger Classification; Slow Charging and Fast Charging; DC Charging and AC Charging; Selection and Sizing of Chargers: Charger Connectors and Cables; Charging Standards: Connectors, Supply Equipment; EMI/EMC; Testing Methods for Chargers and EVSE

UNIT III

EV charger communications protocols:

Open Charge Point Protocol (OCPP); Open System Interconnection Layer Model (OSI); Adapted PWM Signal based Low-level Communication; PLC based High-level Communication; CAN Communication;Billing and Authentication

UNIT IV

Public charging infrastructure:

Location, Planning and Implementation of Public Charging Stations; Components; Selection and Sizing HT/LT Equipment & Cables; Protection; Safety Standards: Policy and Regulatory Aspects; EVCharging Station and their Business Models; Economic Aspects; Major Challenges

UNIT V

Future frontiers in EV charging:

Bulk Charging; Battery Swapping; Wireless Charging; EVs as Distributed Storage Resources: Grid to Vehicle (G2V) and Vehicle to Grid (V2G), V2X Concept, Integration of Charging Station with Renewable Sources and its Impact on the Grid

TEXT BOOKS:

1. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", 3rd Edition, CRC Press,2021
2. Code of Practice for Electric Vehicle Charging Equipment Installation, 4th Edition, IET, 2020.

REFERENCE BOOKS:

1. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid
2. Electric Vehicles", 1st Edition, Springer, 2013.
3. Tom Denton, "Automotive Electrical and Electronic Systems", 5th Edition, Routledge, 2018.
4. Wolfhard Lawrenz, "CAN System Engineering: From Theory to Practical Applications",Springer, 2nd Edition, 2013.

WEB LINK: **https://www.udemy.com/course/charging-infrastructure-for-electric-vehicles/**

B.TECH-ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

ELECTRICAL ENGINEERING MATERIALS-(D25OE1)
(Open Elective-1)

B.Tech. V Sem **L T P C**
3 0 0 3

Course Objective: To understand the importance of various materials used in electrical engineering and obtain a qualitative analysis of their behavior and applications.

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

1. Understand various types of dielectric materials, their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Acquire Knowledge on Materials used in electrical engineering and applications.

UNIT I

Dielectric Materials: Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectricmaterials

UNIT II

Magnetic Materials: Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis

UNIT III

Semiconductor Materials: Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI).

UNIT IV

Materials for Electrical Applications: Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V

Special Purpose Materials: Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI.

TEXT BOOKS:

1. "R K Rajput", " A course in Electrical Engineering Materials", Laxmi Publications, 2009
2. "T K Basak", " A course in Electrical Engineering Materials", New Age Science Publications2009

REFERENCE BOOKS:

1. TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education,2004.
2. "AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication,2006.

S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai & Sons,2011

WEB LINK: https://nptel.ac.in/courses/113104096

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)
NANO TECHNOLOGY (D25OE1)

(Open Elective-1)

B. Tech. V Semester **L T P C**
3 0 0 3

Course Objectives: Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

Course Outcomes:

1. Introduction to Nano Technology" will give insight into many aspects of Nano science, technology
2. Applications in the prospective of materials science.

UNIT I

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterial's, Nature: The Best of Nanotechnologist, Challenges, and Future Prospects.

UNIT II

Unique Properties of Nanomaterial's: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations,

Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.

Magnetic Properties: Soft magnetic Nano crystalline alloy, Permanent magnetic Nano crystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

UNIT III

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol- gel method ,Self-assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nano powders**: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

UNIT IV

Tools to Characterize nanomaterial's: X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope(STM),Field Ion Microscope (FEM), Three-dimensional Atom Probe(3DAP), Nano indentation.

UNIT V

Applications of Nanomaterial's: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

TEXT BOOKS:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, UniversityPress-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, WleyIndia Edition,2012.

REFERENCES BOOKS:

1. Nano: The Essentials by T. Pradeep, Mc Graw- HillEducation.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H.Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J.O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, CambridgeUniversity press.

WEB LINK: https://nptel.ac.in/courses/118102003

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

FUNDAMENTALS OF ELECTRIC VEHICLES (D26OE2)
(Open Elective – II)

B. Tech VI Sem

L	T	P	C
3	0	0	3

Pre-requisites: None; Interest in electric Vehicles

Course Objectives:

1. To understand the fundamentals of Electric Vehicles (EVs), especially in Indian Context.
2. To examine technology associated with each element of EV drive-train;
3. To get into the economics of EVs in India vis-à-vis petrol vehicles.

Course Outcomes: At the end of the course the student will be able to:

1. Understand the fundamentals of Electric Vehicles.
2. Design of batteries, EV motors and Power electronic controllers for EV systems.
3. Analyze the economics of EV market and EV data using Analytical tools.

UNIT I

Introduction

Overview of Electric Vehicles in India, India's EV program, Charging and Swapping Infrastructure, brief introduction of batteries, EV Subsystems, Loop travels.

UNIT II

Vehicle Dynamics: Forces acting when a vehicle move, Aerodynamic drag, Rolling Resistance and Uphill Resistance, Power and Torque to accelerate. **Drive Cycle:** Concept of Drive Cycle, Drive Cyclesand Energy used per km.

UNIT III

EV Powertrain: Design of EV Drive Train, Introduction to Battery Parameters, Why Lithium Ion Battery? Batteries in Future, Li-Ion Battery Cells, SoH and SoC estimation and Self Discharge, Battery Pack Development, Computation of Effective cost of battery, Charging Batteries.

Fundamentals of EV Battery Pack design: Mechanical, Thermal and Electrical Design, BMS Designof Electric Vehicle.

UNIT IV

EV Motors and Controllers: Fundamentals and Design, Understanding Flow of Electricity, Magnetism and Heat, Power and Efficiency, Torque Production, Speed and Back EMF, the d-q Equivalent circuit, Field-oriented Control, Understanding Three phase AC and DC to AC conversion systems, Understanding the thermal design of the motors, Engineering Considerations, Future Frontiers.

UNIT V

EV Charging: Introduction, Slow or Fast EV Chargers, Battery Swapping, Standardization and On board Chargers, Public Chargers, Bulk Chargers/Swap Stations, Economics of Public Chargers in context, Analytics and Tools for EV systems.

TEXT BOOKS:

1. Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuelcell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric andFuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

REFERENCE BOOKS:

1. James Larminie, John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2003
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, *Hybrid Electric Vehicles: Principles andApplications with Practical Perspectives*, John Wiley & Sons Ltd., 2011

WEB LINK: https://onlinecourses.nptel.ac.in/noc20_ee99/preview
https://archive.nptel.ac.in/courses/108/106/108106170

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING (R22)

OPTIMIZATION TECHNIQUES (D26OE2)
(Open Elective – II)

B. Tech VI Sem **L T P C**
3 0 0 3

Pre-requisites: None; Interest in electric Vehicles

Course Objectives:

1. To introduce various optimization techniques in classical, linear programming, transportation problem, simplex algorithm, dynamic programming
2. Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
3. To explain the concept of Dynamic programming and its applications to project implementation.

Course Outcomes: At the end of the course the student will be able to:

1. Explain the need of optimization of engineering systems
2. Understand optimization of electrical and electronics engineering problems
3. Apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
4. Apply unconstrained optimization and constrained non-linear programming and dynamic programming
5. Formulate optimization problems.

UNIT I

INTRODUCTION AND CLASSICALOPTIMIZATIONTECHNIQUES

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

CLASSICAL OPTIMIZATIONTECHNIQUES:

Single variable Optimization–multivariable 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

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.

TRANSPORTATIONPROBLEM: 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 NON LINEAR PROGRAMMING

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

UNCONSTRAINED OPTIMIZATION TECHNIQUES: Uni-variant method, Powell's method and steepest descent method.

UNIT IV

CONSTRAINEDNONLINEARPROGRAMMING

Characteristics of a constrained problem-classification-Basic approach of Penalty Function method- 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. SingiresuS.Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4thedition, 2009.
2. H.S. Kasene &K. D.Kumar, Introductory Operations Research, Springer (India),Pvt.Ltd.,2004

REFERENCE BOOKS:

1. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operationsresearch3rdedition,2003.
2. H.A.Taha, "Operations Research: An Introduction",8th Edition, Pearson/PrenticeHall,2007.
3. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt.Ltd, New Delhi, 2005

WEB LINK: https://nptel.ac.in/courses/111105039

B.TECH – ELECTRICAL & ELECTRONICS ENGINEERING (R22)

RENEWABLE ENERGY SOURCES (D26OE2)
(OPEN ELECTIVE – II)

B. Tech VI Sem

L	T	P	C
3	0	0	3

Pre-requisites: None

Course Objectives:

- To recognize the awareness of energy conservation in students
- To identify the use of renewable energy sources for electrical power generation
- To collect different energy storage methods
- To detect about environmental effects of energy conversion

Course Outcomes: At the end of the course the student will be able to:

- Understand the principles of wind power and solar photovoltaic power generation, fuel cells.
- Assess the cost of generation for conventional and renewable energy plants
- Design suitable power controller for wind and solar applications
- Analyze the issues involved in the integration of renewable energy sources to the grid

UNIT I

Introduction

Renewable Sources of Energy-Grid-Supplied Electricity-Distributed Generation-Renewable Energy. Economics- Calculation of Electricity Generation Costs –Demand side Management Options –Supply side Management Options-Modern Electronic Controls of Power Systems.

Wind Power Plants

Appropriate Location -Evaluation of Wind Intensity -Topography -Purpose of the Energy Generated -General Classification of Wind Turbines-Rotor Turbines-Multiple-Blade Turbines Drag Turbines –Lifting Turbines-Generators and Speed Control used in Wind Power Energy Analysis of Small Generating Systems.

UNIT II

Photovoltaic Power Plants

Solar Energy-Generation of Electricity by Photovoltaic Effect -Dependence of a PV Cell Characteristic on Temperature-Solar cell Output Characteristics-Equivalent Models and Parameters for Photovoltaic Panels-Photovoltaic Systems-Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy.

Fuel Cells: The Fuel Cell-Low and High Temperature Fuel Cells-Commercial and Manufacturing Issues Constructional Features of Proton Exchange-Membrane Fuel Cells –Reformers-Electro-lyzer Systems and Related Precautions-Advantages and Disadvantages of Fuel Cells-Fuel Cell Equivalent Circuit Practical Determination of the Equivalent Model Parameters -Aspects of Hydrogen as Fuel.

UNIT III

Induction Generators

Principles of Operation- Representation of Steady-State Operation-Power and Losses Generated-Self Excited Induction Generator-Magnetizing Curves and Self-Excitation Mathematical Description of the Self-Excitation Process- Interconnected and Stand-alone operation -Speed and Voltage Control - Economical Aspects.

UNIT IV

Storage Systems

Energy Storage Parameters-Lead–Acid Batteries-Ultra Capacitors-Flywheels –Superconducting Magnetic Storage System-Pumped Hydroelectric Energy Storage - Compressed Air Energy Storage - Storage Heat -Energy Storage as an Economic Resource.

UNIT V

Integration of Alternative Sources of Energy

Principles of Power Injection-Instantaneous Active and Reactive Power Control Approach Integration of Multiple Renewable Energy Sources-Islanding and Interconnection Control-DG Control and Power Injection.

Interconnection of Alternative Energy Sources with the Grid:

Interconnection Technologies –Standards and Codes for Interconnection – Interconnection Considerations - Interconnection Examples for Alternative Energy Sources.

TEXT BOOKS:

1. Felix A. Farret, M. Godoy Simoes, “Integration of Alternative Sources of Energy”, John Wiley& Sons, 2006.

2. Solanki: Renewable Energy Technologies: Practical Guide for Beginners, PHI Learning Pvt. Ltd., 2008.

REFERENCE BOOKS:

1. D. Mukherjee: Fundamentals of Renewable Energy Systems, New Age International publishers, 2007.

2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez: Grid Converters for Photovoltaic and Wind Power Systems, John Wiley & Sons, 2011.

3. Gilbert M. Masters: Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

WEB LINK: **https://nptel.ac.in/courses/103103206**

B.TECH. ELECTRICAL & ELECTRONICS ENGINEERING (R22)
DESIGN ESTIMATION AND COSTING OFELECTRICALSYSTEMS
(Open Elective–III) (D27OE3)

B. Tech VII Sem **L T P C**
3 0 0 3

Prerequisite: Power systems -I& PowerSystems-II

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

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

UNIT– I
Design Considerations of Electrical Installations: Electric Supply System,Threephase four wire distribution system, Protection of Electric Installation against overload, 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 under ground 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.

TEXTBOOKS:

1. "K. B. Raina, S. K. Bhattacharya","Electrical Design Estimating and Costing", NewAge International Publisher, 2010.
2. "Er. V. K. Jain, Er. AmitabhBajaj", "DesignofElectricalInstallations", UniversityScience Press.

REFERENCEBOOKS:

1. Code of practice for Electrical wiring installations,(System voltage not exceeding 650volts), Indian Standard Institution, IS:732-1983.
2. Guide for Electrical layout in residential buildings, Indian StandardInstitution,IS:4648-1968.
3 .Electrical Installation buildings Indian Standard Institution, I S:2032.
4 .Code of Practice for selection, Installation of Maintenance of fuse (voltage not exceeding650V), 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 650Volts), Indian Standard Institution, IS: 2274-1963.
8. Gupta J.B.,Katson, Ludhiana","Electrical Installation, estimating and costing",S.K.Kataria and sons, 2013.

WEB LINK:

http://nmdcdavpoly.in/7460E0C9-48DE-496B-BC04-585BC94A2FBA/CMS/Page/Estimation%20And%20Costing

B.TECH–ELECTRICAL&ELECTRONICSENGINEERING (R22)

ENERGY STORAGE SYSTEMS
(Open Elective–III)

B. Tech VII Sem **L T P C**
3 0 0 3

Prerequisite: Electrochemistry

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

1. analyzethecharacteristicsofenergyfromvarioussourcesandneedforstorage
2. classifyvarioustypesofenergystorageandvariousdevicesusedforthepurpose
3. Identify various real time applications.

UNIT - I

Electrical Energy Storage Technologies: Characteristics of electricity, Electricity andthe 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), Consumeruse(uninterruptablepowersupplyforlargeconsumers),Newtrendsinapplications ,Renewable energy generation, Smart Grid, Smart Microgrid, 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, JosephJ. Iannucci and Garth P.Corey", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories,2004.
2. The Electrical Energy Storage by IECMarket Strategy Board.

REFERENCEBOOK:

1."Jim Eyer, Garth Corey", Energy Storage fortheElectricityGrid:Benefits andMarketPotentialAssessmentGuide,Report,SandiaNationalLaboratories, Feb 2010

WEB LINK: https://nptel.ac.in/courses/113105102

B.TECH.ELECTRICAL&ELECTRONICS ENGINEERING (R22)

RELIABILITY ENGINEERING (D27OE3)
(Open Elective – III)

B. Tech. VII Sem **L T P C**
3 0 0 3

Prerequisite: Mathematics-III (Laplace Transforms, Numerical Methods and Complex variables)

Course Objectives:

- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems

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

1. Model various systems applying reliability networks and evaluation of the same
2. Estimate the limiting state probabilities of repairable systems
3. Apply various mathematical models for evaluating reliability of irreparable systems

UNIT-I:

Basic Probability Theory: Elements of probability, probability distributions, Random variables, Density and Distribution functions- Mathematical expected – variance and standard deviation – binomial distribution: Concepts, properties, engineering applications.

UNIT-II:

Network Modeling And Evaluation Of Simple Systems: Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems - Series-Parallel systems- Partially redundant systems- Examples.

Network Modeling And Evaluation Of Complex Systems: Conditional probability method- tie set, Cut-set approach- Event tree and reduced event tree methods- Relationships between tie and cut-setsExamples.

UNIT-III:

Probability Distributions In Reliability Evaluation: Distribution concepts, Terminology of distributions, General reliability functions, Evaluation of the reliability functions, shape of reliability functions –Poisson distribution – normal distribution, exponential distribution, Weibull distribution. **Network Reliability Evaluation Using Probability Distributions:** Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

UNIT-IV:

Discrete Markov Chains: Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Application. **Continuous Markov Processes**: Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems.

UNIT-V:

Frequency And Duration Techniques: Frequency and duration concepts, application to multi state problems, Frequency balance approach.

Approximate System Reliability Evaluation: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS:

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press.

2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited

REFERENCE BOOKS:

1. Reliability Engineering: Theory and Practice by Alessandro Birolini, Springer Publications.

2. An Introduction to Reliability and Maintainability Engineering by Charles Ebeling, TMH Publications.

3. Reliability Engineering by Elsayed A. Elsayed, Prentice Hall Publications.

B.TECH. ELECTRICAL&ELECTRONICS ENGINEERING (R22)

POWER SYSTEM REFORMS (D28OE4)
(Open Elective – IV)

B. Tech VIII Sem **L T P C**
3 0 0 3

Course Objectives:

1. To study fundamentals of power system deregulation and restructuring.
2. To study available transfer capability.
3. To study congestion management
4. To study various electricity pricing.
5. To study operation of power system in deregulated environment.
6. To study importance of Ancillary services management.

Course Outcomes:

1. Will understand importance of power system deregulation and restructuring.
2. Able to compute ATC.
3. Will understand transmission congestion management.
4. Able to compute electricity pricing in deregulated environment.
5. Will be able to understand power system operation in deregulated environment.
6. 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 electricitypricing – Construction offorward 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,MathH.J.Boller,JaapE.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, up grades and Management (DRUM) Program, by USAID/India, TMH.

WEB LINK: https://archive.nptel.ac.in/courses/108/101/108101005/

B.TECH. ELECTRICAL &ELECTRONICS ENGINEERING (R22)
Programmable Logic Controllers& SCADA (D28OE4)
(Open Elective – IV)

B. Tech. VIII Sem **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.

UNITI:
Programmable Logic Controllers: Introduction, parts of PLC, principles of operation, modifying the operation, PLC s 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.

UNITII:
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.

UNITIII:
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.

UNITIV:

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

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

UNITV:

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).

TEXTBOOKS:

1. ProgrammableLogicControllers,W.Bolton,5thedition,NewnesELSEVIER, 2009
2. PLCs &SCADA: Theory and Practice, Rajesh Mehra, Laxmi Publications, 2012.

REFERENCEBOOKS:

1. Industrial applications of programmable logic controllers and SCADA, Kunal Chakraborty, Palash De, IndranilRoy, AnchorAcademicPublishing,2016
2. Ladderlogicprogrammingfundamentals,A.J.Wright,2nd edition, AB Prominent publisher, 2020

WEB LINK: https://nptel.ac.in/courses/108105088

B.TECH. ELECTRICAL&ELECTRONICS ENGINEERING (R22)

ENERGY FROM WASTE (D28OE4)
(Open Elective – IV)

B. Tech VIII Sem **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 linklegal, 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. Analyze the various aspects of Waste to Energy Management Systems.
3. Carryout 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 wastes fuel–Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT II

Biomass Pyrolysis: Pyrolysis–Types, slowfast–Manufactureofcharcoal–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 bedcombustors,Types,inclinedgratecombustors,Fluidizedbedcombustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V

Biogas: Propertiesofbiogas(Calorificvalueandcomposition)-Biogasplanttechnology 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.

TEXTBOOKS:

1. Non-Conventional Energy, Desai, AshokV.,Wiley EasternLtd.,1990.

2. Biogas Technology- A Practical HandBook- Khandelwal,K. C.andMahdi, S.S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

REFERENCEBOOKS:

1. Food, Feed and Fuel from Biomass, Challal,D. S.,IBHPublishingCo. Pvt.Ltd., 1991.

2. Biomass Conversion and Technology, C.Y.Were Ko-Brobby and E.B.Hagan, John Wiley & Sons, 1996.

Web Link: https://onlinecourses.nptel.ac.in/noc20_ch16/preview