JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH – POWER ENGINEERING AND ENERGY SYSTEMS
(Applicable for the Batch admitted from the Academic Year 2025-26 onwards)

(R25) COURSE STRUCTURE AND SYLLABUS

I YEAR I SEMESTER

			L	T	P	Credits
S.No	**Core/Elective**	**Course Name**				
1.	Program Core-I	Renewable Energy Technologies	3	0	0	3
2.	Program Core-II	Power Converters Analysis	3	0	0	3
3.	Program Elective-I	1. Optimization of Energy Systems 2. Smart Grid Technologies 3. Modern Control Theory 4. Distributed Generation	3	0	0	3
4.	Program Elective-II	1. Reactive Power Compensation and Management 2. Electric Vehicle Technologies 3. Sustainable Energy Solutions 4. High Frequency Magnetic Design	3	0	0	3
5.		Research Methodology & IPR	2	0	0	2
6.	Lab-I	Power Converters Analysis Lab	0	0	4	2
7.	Lab-II	Renewable Energy Lab	2	0	4	2
8.	Audit-I	Audit Course-I	2	0	0	0
		Total Credits	**18**	**0**	**8**	**18**

I YEAR II SEMESTER

			L	T	P	Credits
Sr. No	**Core/Elective**	**Course Name**				
1.	Program Core-III	Digital Protection of Power System	3	0	0	3
2.	Program Core-IV	Energy Storage Systems	3	0	0	3
3.	Program Elective-III	1. Restructured Power Systems 2. Energy Conversion Process 3. Power Quality Improvement Techniques 4. Electric Vehicle Charging Techniques	3	0	0	3
4.	Program Elective-IV	1. Data Science Applications in Power Engineering 2. Wind Energy Conversion Systems 3. Energy Auditing and Management 4. Digital Control Systems	3	0	0	3
5.		Mini Project with Seminar	0	0	4	2
6.	Lab-III	Energy Systems Lab	0	0	4	2
7.	Lab-IV	Power System Protection Lab	0	0	4	2
8.	Audit-II	Audit Course-II	2	0	0	0
		Total Credits	**14**	**0**	**12**	**18**

II YEAR I SEMESTER

			L	T	P	Credits
Sr.No	**Core/Elective**	**Course Name**				
1.	Program Elective-V	1. Fuel Cell Technologies 2. FACTS and Custom Power Devices 3. Gas Insulated Systems 4. SCADA System and Applications	3	0	0	3
2.	Open Elective	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Photovoltaic Systems	3	0	0	3
3.	Dissertation	Dissertation Work Review -II	0	0	12	6
		Total Credits	**6**	**0**	**12**	**12**

II YEAR II SEMESTER

			L	T	P	Credits
Sr.No	**Core/Elective**	**Course Name**				
1.	Dissertation	Dissertation Work Review – III	0	0	12	6
2.	Dissertation	Dissertation Viva-Voce	0	0	28	14
		Total Credits	**0**	**0**	**40**	**20**

***For Dissertation Work Review - I, please refer R25 Academic Regulations.**

Open Elective:

1. Business Analytics (Offered by **CSE** Department)
2. Industrial Safety (Offered by **Chemical Engineering** Department)
3. Operations Research (Offered by **Mechanical Engineering** Department)
4. Cost Management of Engineering Projects (Offered by **Civil Engineering** Department)
5. Composite Materials (Offered by **Metallurgical Engineering** Department)
6. Photovoltaic Systems (Offered by **EEE** Department)

Audit Course I & II:

1. English for Research Paper Writing.
2. Disaster Management.
3. Sanskrit for Technical Knowledge.
4. Value Education.
5. Constitution of India.
6. Pedagogy Studies.
7. Stress Management by Yoga.
8. Personality Development through Life Enlightenment Skills.

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M. Tech – I Semester

L	T	P	C
3	0	0	3

RENEWABLE ENERGY TECHNOLOGIES

(Program Core-I)

Prerequisite: Power Systems and Electrical Machines

Course Objectives:

- To learn various renewable energy sources
- To gain understanding of integrated operation of renewable energy sources
- To understand Power Electronics Interface with the Grid.

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

- Gain knowledge about renewable energy
- Understand the working of distributed generation system in autonomous/grid connected modes

UNIT-I:

SOLAR ENERGY SYSTEMS:

Introduction to solar radiation, Solar thermal energy conversion, Flat plate collector, Concentric collectors, Solar Pond, Central receiver system, Solar pumping, Solar photovoltaic systems, Characteristics of PV cell, Photo voltaic modules, Types of Photo voltaic systems.

UNIT-II:

WIND ENERGY AND BIO-GAS:

Basics of wind energy, Classification of turbines, Wind characteristics, Energy extraction, Betz limit, Modes of wind power generation.

Bio-Mass energy conversion, Anaerobic Digestion, Aerobic Digestion, Gasification, Bio-Gas Plants.

UNIT-III:

OCEAN ENERGY CONVERSION:

Tidal Energy generation, Characteristics of Tides, Power generation schemes, Components in Tidal power Plant.

Wave Energy: Principle of wave energy plant, Wave energy conversion machines.

Ocean Thermal Energy conversion: Principle, Cycles of operation, Types of OTEC plants, Applications.

UNIT-IV:

GEO-THERMAL ENERGY AND FUEL CELLS:

HYBRID ENERGY SYSTEMS:

Geothermal Energy: Structure of Earth's interior, geothermal fields, Gradient, Resources, Geothermal power generation.

Fuel cells: Introduction, Principle of operation, Types of Fuel cells, State of art fuel cells, Energy output of a fuel cell, Operating characteristics of fuel cells, Thermal efficiency, Need for Hybrid systems, Types of Hybrid systems.

UNIT-V:

ENERGY SYSTEMS AND GRIDS

Introduction, Energy systems, Distribution technologies, Energy storage for grid electricity, Social and environmental aspects of energy supply and storage.

Electricity grids (networks), DC grids, Special challenges and opportunities for renewable electricity,

Power Electronic Interface with the Grid.

TEXTBOOKS:

1. D.P.Kothari, K.C.Singal, R.Ranjan, "Renewable Energy Resources and emerging technologies", PHI 2nd Edition, 2011.
2. John Twidell and Tony Weir,"Renewable Energy Resources", 2nd Edition, CRC Press.
3. Rakosh Das Begamudre, "Energy conversion systems", New Age International Publishers, New Delhi, 2000.
4. Rakosh das Begamudre, "Energy conversion systems", New Age International publishers, New Delhi, 2000.
5. John Twidell and Tony Weir, "Renewable Energy Resources", 2nd Edition, Fspon & Co.

REFERENCES:

1. Volker Quaschning, “Understanding Renewable Energy Systems”, 2005, UK.
2. Faner Lin Luo Honer Ye, “Renewable Energy Systems Advanced Conversion Technologies & Applications”, CRC press, Taylor & Francis group

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L	T	P	C
3	0	0	3

POWER CONVERTER ANALYSIS

(Program Core-II**)**

Prerequisite: Power Electronics

Course Objectives:

- To understand various advanced power electronic devices.
- To comprehend the design of rectifiers and inverters.
- To understand the operation of multi-level inverters with switching strategies for high power applications.

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

- Develop and analyze various converter topologies.
- Use power electronic simulation packages for analyzing and designing power converters.

UNIT-I:

MODERN POWER SEMICONDUCTOR DEVICES

Modern power semiconductor devices: Symbol, Structure and equivalent circuit of Insulated Gate Bipolar Transistor (IGBT), MOSFET, MOS Turn off Thyristor (MTO), Emitter Turn off Thyristor (ETO), Integrated Gate-Commutated Thyristor (IGCTs), MOS-controlled thyristors (MCTs), Power Integrated Circuits (PICs). Comparison of their features.

UNIT-II:

SINGLE PHASE & THREE-PHASE CONVERTERS

Single phase converters: Half controlled and Fully-controlled converters, Evaluation of input power factor and harmonic factor, continuous and Discontinuous load current, Single phase dual converters, Power factor Improvements Techniques, Extinction angle control, Symmetrical angle control, Single phase sinusoidal PWM, Single phase series converters, Overlap analysis, Applications & Problems.

Three phase converters: Half controlled and fully controlled converters, Evaluation of input power factor and harmonic factor, Continuous and Discontinuous load current, Three-phase dual converters, Power factor Improvements Techniques, Three-phase PWM, Twelve-pulse converters, Applications & Problems.

UNIT-III:

PULSE WIDTH MODULATED INVERTERS

Principle of operation, Performance parameters, Single phase bridge inverter, Evaluation of output voltage and current with resistive, inductive and capacitive loads, Voltage control of single-phase inverters, Single PWM, Multiple PWM, Sinusoidal PWM, Modified PWM, Phase displacement Control, Advanced modulation techniques for improved performance, Trapezoidal, Staircase, Stepped, Harmonic injection and Delta modulation, Advantages, Applications & Problems.

UNIT-IV:

THREE PHASE INVERTERS

Introduction to Three phase inverter, Analysis of 180-degree conduction for output voltage And current with resistive, inductive loads, Analysis of 120-degree Conduction, Voltage control of three phase inverters, Sinusoidal PWM, Third Harmonic PWM, 60-degree PWM, Space vector modulation, Comparison of PWM techniques, Harmonic reductions, Problems.

UNIT-V:

MULTILEVEL INVERTERS

Multilevel concept, Classification of multilevel inverters, Principle of operation, main features and comparison of Diode clamped, Improved diode Clamped, Flying-capacitors, Cascaded-multilevel inverters, Multilevel inverter applications, Reactive power compensation, Back to back intertie system, Adjustable drives, Switching device currents, and DC link capacitor voltage balancing.

TEXTBOOKS:

1. Mohammed H. Rashid, “Power Electronics”, Pearson Education, 3rd Edition, 1st Indian reprint2004.
2. Ned Mohan Tore M. Undeland and William P. Robbins, “Power Electronics”, John Wiley & Sons, 2nd Edition.

REFERENCES:

1. Milliman Shepherd and Lizang, “Power converters circuits”, Chapter 14 (Matrix converter) PP-415-444,
2. M.H.Rashid, “Power Electronics handbook”.
3. Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition, “Control in Power electronics”, Published by Academic Press, 2002.

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M. Tech – I Semester

L	T	P	C
3	0	0	3

OPTIMIZATION OF ENERGY SYSTEMS

(Program Elective-I)

Prerequisite:

Course Objectives:

- Know about optimization of design parameters.
- Know about different design methodologies and simulation processes.

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

- Perform Numerical calculations
- Understand Role of design parameters
- Run simulation models like genetic algorithms

UNIT-I:

Thermal Systems – Characteristics- formulation of design problem - Steps in the design process - Modeling of thermal systems – importance - Types of models - Mathematical Modeling

UNIT-II:

Linear programming models – Formulation - Simplex method – Artificial variable technique – Big M method - Concept of Sensitive analysis.

UNIT-III:

Unconstrained Optimization: Single variable optimization – Fibonacci & Golden section method - Multi variable optimization – Gradient methods – Gradient of the function - Steepest descent – Flecher-Reeves method -Variable metric method - Constrained Non-linear Optimization Methods - Lagrangian multiplier – Application to thermal and electrical systems.

UNIT-IV:

Geometric programming – Polynomial – Arithmetic and Geometric inequalities – Unconstrained GP - Constrained GP with constraints of type less than or equal- Application to thermal and electrical systems- Dynamic Programming- Bellman's principle of optimality- shortest route problems

UNIT-V:

Simulation - Definition- Types of Simulation models - Steps involved in simulation models - Application of simulation - Advantages and disadvantages – Introduction to Genetic algorithm – Applications in Genetic Algorithm - Similarities and dissimilarities with traditional methods - Genetic operators.

TEXTBOOKS:

1. Design and Optimization of Thermal Systems, Yogesh Jaluria, McGraw Hill.
2. Optimization theory and applications, S.S.Rao, New Age Publication.

REFERENCES:

1. Design of Thermal System, W.F.Stoecker, McGraw Hill.
2. Operation Research, Panner Selvam, Prentice Hall.
3. Optimization Research, M.C.Joshi.
4. Simulation Modeling & Analysis, Law & Kelto.
5. Operation Research, S Prinsc Valle Kasur.
6. NPTEL online course, Introduction to Optimisation, https://www.youtube.com/playlist?list=PLA8E4E0900B672792

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3	0	0	3

SMART GRID TECHNOLOGIES

(Program Elective-I**)**

Prerequisite: Power Systems

Course Objectives:

- To understand concept of smart grid and its advantages over conventional grid
- To know smart metering techniques
- To learn wide area measurement techniques
- To understand the problems associated with integration of distributed generation & its solution through smart grid.

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

- Appreciate the difference between smart grid & conventional grid
- Apply smart metering concepts to industrial and commercial installations
- Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
- Come up with smart grid solutions using modern communication technologies

UNIT-I:

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self-Healing Grid Present development & International policies in Smart Grid

UNIT-II:

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

UNIT-III:

Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT-IV:

Concept of micro-grid, Need& applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, Fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

UNIT-V:

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit. Advanced Metering Infrastructure (AMI) and Various Communication means and IP based Protocols.

TEXTBOOKS:

1. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE, 2011.
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press, 2009.

REFERENCES:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, “Smart Grid: Technology and Applications”,Wiley, 2012.
2. Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions”, CRC Press.
3. A.G.Phadke, “Synchronized Phasor Measurement and their Applications”, Springer.

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M. Tech – I Semester

L	T	P	C
3	0	0	3

MODERN CONTROL THEORY

(Program Elective-I**)**

Prerequisite: Control Systems

Course Objectives:

- To explain the concepts of basics and modern control system for the real time analysis and design of control systems.
- To explain the concepts of state variables analysis.
- To study and analyze nonlinear systems.
- To analyze the concept of stability for nonlinear systems and their categorization.

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

- Know various terms of basic and modern control system for the real time analysis and design of control systems.
- Perform state variables analysis for any real time system.
- Examine a system for its stability, controllability and observability.
- Implement basic principles and techniques in designing linear control systems.
- Apply knowledge of control theory for practical implementations in engineering and network analysis.

UNIT I:

MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS

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 systems, The concept of state, State space model of Dynamic systems, Time invariance and Linearity, Non uniqueness of state model, State diagrams for Continuous-Time State models, Existence and Uniqueness of Solutions to Continuous-Time State Equations, Solutions of Linear Time Invariant Continuous-Time State Equations, State transition matrix and it's properties.

Complete solution of state space model due to zero input and due to zero state.

UNIT II:

CONTROLLABILITY AND OBSERVABILITY

General concept of controllability, Controllability tests, Different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems, General concept of Observability, Observability tests for Continuous-Time Invariant Systems, Observability of different State transformation forms.

UNIT III:

STATE FEEDBACK CONTROLLERS AND OBSERVERS

State feedback controller design through Pole Assignment, using Ackkermans formula.

State observers: Full order and Reduced order observers.

UNIT IV:

NON-LINEAR SYSTEMS

Introduction to Non-Linear Systems, Types of Non-Linearities, Saturation, Dead-Zone, Backlash, Jump Phenomenon etc., Linearization of nonlinear systems, Singular Points and its types, describing function, describing function of different types of nonlinear elements, Stability analysis of Non-Linear systems through describing functions.

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

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.

TEXTBOOKS:

1. M.Gopal, "Modern Control System Theory", New Age International, 1984.
2. Ogata. K, "Modern Control Engineering", Prentice Hall, 1997.

REFERENCES:

1. N K Sinha, "Control Systems", New Age International, 3rd Edition.
2. Donald E.Kirk, "Optimal Control Theory an Introduction", Prentice Hall Network series,1stEdition

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M. Tech – I Semester

L	T	P	C
3	0	0	3

DISTRIBUTED GENERATION

(Program Elective-I)

Prerequisite: Power Systems, Power Electronics

Course Objectives:

- To understand renewable energy sources.
- To explore the working of off-grid and grid-connected renewable energy generation schemes.

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

- Understand the planning and operational issues related to Distributed Generation.
- Acquire knowledge about Distributed Generation Learn Micro-Grids

UNIT-I:

Need for Distributed generation, Renewable sources in distributed generation and current scenario in Distributed Generation.

UNIT-II:

Planning of DGs, Sitting and sizing of DGs optimal placement of DG sources in distribution systems, Grid integration of DG's, Different types of interfaces, Inverter based DG's and rotating machine- b a s e d interfaces, Aggregation of multiple DG units.

UNIT-III:

Technical impacts of DG' on Transmission systems and Distribution Systems, De-regulation, Impact of DGs upon protective relaying, Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis.

UNIT-IV:

Economic and control aspects of DG's Market facts, Issues and challenges, Limitations of DG's, Voltage control techniques, Reactive power control, Harmonics, Power quality issues, Reliability of DG based systems.

UNIT-V:

Introduction to micro-grids, Types of micro-grids, Autonomous and non-autonomous grids, Sizing of micro-grids, Modeling & analysis of Micro-grids with multiple DG's, Micro-grids with power electronic interfacing units, Transients in micro-grids, Protection of micro-grids, Case studies, Advanced topics.

TEXT BOOKS:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation-Planning and Evaluation", MarcelDecker Press.
2. M.Godoy Simoes, Felix A.Farret, "Renewable Energy Systems-Design and Analysis with Induction Generators", CRC press.

REFERENCES:

1. Stuart Borlase, "Smart Grid: Infrastructure Technology Solutions", CRC Press.

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M. Tech – I Semester

L	T	P	C
3	0	0	3

REACTIVE POWER COMPENSATION AND MANAGEMENT

(Program Elective-II**)**

Prerequisite: Power Systems

Course Objectives:

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To illustrate reactive power coordination system
- To characterize distribution side and utility side reactive power management.

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

- Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads
- Work out on various compensation methods in transmission lines
- Construct models for reactive power coordination
- Distinguish demand side reactive power management & user side reactive power management

UNIT-I:

LOAD COMPENSATION

Objectives and specifications, Reactive power characteristics, Inductive and capacitive approximate biasing, Load compensator as a voltage regulator, Phase balancing and power factor correction of unsymmetrical loads, Examples.

UNIT-II:

STEADY–STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS

Uncompensated line, Types of compensation, Passive shunt and series and dynamic shunt compensation, Examples.

TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS

Characteristic time periods, Passive shunt compensation, Static compensation, Series capacitor compensation, Compensation using synchronous condenser, Examples.

UNIT-III:

REACTIVE POWER COORDINATION

Objective, Mathematical modeling, Operation planning, Transmission benefits, Basic concepts of quality of power supply, Disturbances, Steady–state variations, Effect of under-voltages, Frequency, Harmonics, Radio frequency and electromagnetic interference.

UNIT-IV:

DEMAND SIDE MANAGEMENT

Load patterns, Basic methods load shaping, Power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT

System losses, Loss reduction methods, Examples, Reactive power planning, Objectives, Economics Planning capacitor placement, Retrofitting of capacitor banks.

UNIT-V:

USER SIDE REACTIVE POWER MANAGEMENT

KVAR requirements for domestic appliances, Purpose of using capacitors, Selection of capacitors, Deciding factors, Types of available capacitor, Characteristics and Limitations.

REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES

Typical layout of traction systems, Reactive power control requirements, Distribution transformers, Electric arc furnaces, Basic operation, Furnaces transformer, Filter requirements, Remedial measures, Power factor of an arc furnace.

TEXTBOOKS:

1. T.J.E.Miller, “Reactive power control in Electric power systems”, John Wiley and sons, 1982.
2. D.M. Tagare,” Reactive power Management”, Tata McGraw Hill, 2004.

REFERENCES:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, “Reactive Power Compensation: A Practical Guide”, Wiley Publication, April2012.

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L	T	P	C
3	0	0	3

ELECTRIC VEHICLE TECHNOLOGIES

(Program Elective-II**)**

Prerequisite: Power Semiconductor Drives, Electrical Drives and Control, Utilization of Electric Energy

Course Objectives:

- To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To know the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used energy storage devices, etc.

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

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

UNIT-I:

INTRODUCTION

Conventional Vehicles: Basics of vehicle performance, 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.

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.

REFERENCES:

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

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M. Tech – I Semester

L	T	P	C
3	0	0	3

SUSTAINABLE ENERGY SOLUTIONS
(Program Elective-II)

COURSE OBJECTIVES:
- To inculcate sustainable choices in wake of present global scenario
- To raise awareness on the importance and opportunities available in the field of sustainable energy
- To raise entrepreneurs with understanding of technical and economic aspects of sustainable energy solutions

COURSE OUTCOMES: After completion of the course, the student should be able to
- Enrich their understanding of present energy scenario to realize the importance of sustainability
- Understand different ways of generating and utilizing energy in a sustainable manner
- Appreciate the role of EV as a sustainable energy solution
- Understand the various underlying economic aspects

UNIT-I:
Global Energy Scenario: Concept of Sustainability (Social, Economic and Environmental impacts). Sustainable and non-sustainable energy sources. Present global and Indian scenario. Bureau of energy efficiency. Initiatives and incentives for promoting sustainability. UN 2030 goals for clean and affordable energy.

UNIT-II:
Sources of Sustainable Energy: Working principles of: Solar Thermal Power Generation, Solar Photovoltaic Power Generation, Wind Power Generation, Hydro Power Generation, Biomass Power Generation, Hydrogen energy and fuel cells and Wave and Tidal Energy.

UNIT-III:
Sustainable Utilization of Energy: Smart grid technologies - overview, penetration of renewable energy sources. Energy storage technologies. Renewable energy to Hydrogen. Waste to energy: waste to value added materials, capture, storage and utilization of CO2 from various sources to ensure cyclic carbon economy.

UNIT-IV:
Sustainability Through e-mobility: Electric vehicles. Advantages and environmental impact. Regenerative braking. Hybrid electric vehicles, modes of operation. Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) Technologies-fundamentals.

UNIT-V:
Energy Economics and Management: Cost analysis, interest, accounting rate of return, Payback, Discounted cash flow, Net present value, Internal rate of return, Inflation and life cycle analysis of energy systems.
Energy Management: Definition, objectives, resource conservation, climate protection and cost savings

TEXT BOOKS:
1. Energy, the Environment, and the Sustainability, 1st Edition, Efstathios E. Michaelides, CRC Press, 2018
2. Modern Electric, Hybrid Electric and Fuel cell vehicles, Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, 3rd Edition, CRC Press, 2018
3. Energy Economics Concepts, Issues, Markets and Governance, 2nd Edition, S. C. Bhattacharyya, Springer, 2019

REFERENCE:
1. Renewable Energy: Power for a Sustainable Future, G. Boyle (Editor), 3rd Edition, Oxford University Press, 2012

ONLINE RESOURCES:
1. https://nptel.ac.in/courses/112106318
2. https://nptel.ac.in/courses/127103236

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M. Tech – I Semester

L	T	P	C
3	0	0	3

HIGH FREQUENCY MAGNETIC DESIGN

(Program Elective-II)

- To have a knowledge on magnetic circuits
- To know the skin effect and proximity effect

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

- Design of magnetic components (i.e., inductor and transformer) in a converter.
- Perform steady-state analysis of switched mode power supply.
- Understand core loss in an electromagnetic device, recognize& describe its effect.
- Describe the engineering uses of electromagnetic waves, by frequency band, and the respective hazards associated with them.

UNIT-I:

FUNDAMENTALS OF MAGNETIC DEVICES

Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Volt-Second Balance, Inductance, Inductance Factor, Magnetic Energy, Self-Resonant Frequency, Classification of Power Losses in Magnetic Components, Non-inductive Coils.

MAGNETIC CORES

Introduction, Properties of Core Materials, Magnetic Dipoles, Magnetic Domains, Curie Temperature, Magnetization, Magnetic Materials, Hysteresis, Core Permeability, Core Geometries, Iron Alloy Cores, Amorphous Alloy Cores, Nickel–Iron and Cobalt–Iron Cores, Ferrite Cores, Powder Cores, Nano-crystalline Cores, Superconductors, Hysteresis Core Loss, Eddy-Current Core Loss, Total Core Loss, Complex Permeability.

UNIT-II:

SKIN EFFECT & PROXIMITY EFFECT

Introduction, Magnet Wire, Wire Insulation, Skin Depth, Ratio of AC-to-DC Winding Resistance, Skin Effect in Long Single Round Conductor, Current Density in Single Round Conductor, Impedance of Round Conductor, Magnetic Field Intensity for Round Wire, Other Methods of Determining the Round Wire Inductance, Power Density in Round Conductor, Skin Effect on Single Rectangular Plate. Proximity and Skin Effects in Two Parallel Plates, Anti-proximity and Skin Effects in Two Parallel Plates, Proximity Effect in Multiple-Layer Inductor, Appendix: Derivation of Proximity Power Loss.

WINDING RESISTANCE AT HIGH FREQUENCIES

Introduction, Winding Resistance, Square and Round Conductors, Winding Resistance of Rectangular Conductor, Winding Resistance of Square Wire, Winding Resistance of Round Wire, Leakage Inductance, Solution for Round Conductor Winding in Cylindrical Coordinates, Litz Wire, Winding Power Loss for Inductor Current with Harmonics, Effective Winding Resistance for Non-sinusoidal Inductor Current, Thermal Model of Inductors.

UNIT-III:

TRANSFORMERS

Introduction, Neumann's Formula for Mutual Inductance, Mutual Inductance, Energy Stored in Coupled Inductors, Magnetizing Inductance, Leakage Inductance, Measurement of Transformer Inductances, Stray Capacitance, High-Frequency Transformer Model, Non-interleaved Windings, Interleaved Windings, AC Current Transformers, Winding Power Losses with Harmonics, Thermal Model of Transformers.

DESIGN OF TRANSFORMERS

Introduction, Area Product Method, Optimum Flux Density, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM.

UNIT-IV:

INTEGRATED INDUCTORS

Introduction, Resistance of Rectangular Trace, Inductance of Straight Rectangular Trace, Construction of Integrated Inductors, Meander Inductors, Inductance of Straight Round Conductor, Inductance of Circular Round Wire Loop, Inductance of Two-Parallel Wire Loop, Inductance of Rectangle of Round Wire, Inductance of Polygon Round Wire Loop, Bond-wire Inductors, Single-Turn Planar Inductor, Inductance of Planar Square Loop, Planar Spiral Inductors, Multi-metal Spiral Inductors, Planar Transformers, MEMS Inductors, Inductance of Coaxial Cable, Inductance of Two-Wire Transmission Line, Eddy Currents in Integrated Inductors, Model of RF Integrated Inductors, PCB Inductors.

DESIGN OF INDUCTORS

Introduction, Restrictions on Inductors, Window Utilization Factor, Temperature Rise of Inductors, Mean Turn Length of Inductors, Area Product Method, AC Inductor Design, Inductor Design for Buck Converter in CCM, Inductor Design for Buck Converter in DCM method.

UNIT-V:

SELF-CAPACITANCE

Introduction, High-Frequency Inductor Model, Self-Capacitance Components, Capacitance of Parallel-Plate Capacitor, Self-Capacitance of Foil Winding Inductors, Capacitance of Two Parallel Round Conductors, Capacitance of Round Conductor and Conducting Plane, Self-Capacitance of Single-Layer Inductors, Self-Capacitance of Multi-layer Inductors, Capacitance of Coaxial Cable.

TEXTBOOKS:

1. Umanand L, Bhat, S.R, “Design of Magnetic Components for Switched Mode Power Converters”, ISBN: 978-81-224-0339-8, Wiley Eastern Publication, 1992.
2. Marian K. Kazimierczuk, “High-Frequency Magnetic Components”, ISBN: 978-0-470-71453-9, John Wiley& Sons, Inc.

REFERENCES:

1. G.C. Chryssis, “High frequency switching power supplies”, McGraw Hill, 1989 (2nd Edition.)
2. Eric Lowdon, “Practical Transformer Design Handbook”, Howard W. Sams & Co., Inc., 1980
3. Thompson, “Electrodynamic Magnetic Suspension.pdf”
4. Witulski, “Introduction to modeling of transformers and coupled inductors”
5. Beattie, “Inductance 101.pdf”
6. P. L. Dowell, “Effects of eddy currents in transformer windings.pdf”
7. Dixon, “Eddy current losses in transformer windings.pdf”
8. J J Ding, J S Buckkeridge, “Design Considerations for A Sustainable Hybrid Energy System” IPENZ Transactions, 2000, Vol. 27, No. 1/EMCh.
9. Texas Instruments, “Windings.pdf”
10. Texas Instruments, “Magnetic core characteristics.pdf”.
11. Ferroxcube, “3f3 ferrite datasheet.pdf”.
12. Ferroxcube, “Ferrite selection guide.pdf”, Magnetics, Inc., Ferrite Cores (www.mag-inc.com)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Semester

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2	0	0	2

RESEARCH METHODOLOGY & IPR

Prerequisite: None

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know about the patent rights

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept and creativity.
- Understanding that when IPR would take such important place in growth of individuals &nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products and in turn brings about economic growth and social benefits.

UNIT-I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, Data collection, Analysis, Interpretation, Necessary instrumentations.

UNIT-II:

Effective literature studies approaches, Analysis, Plagiarism, Research ethics.

UNIT-III:

Effective technical writing, How to write a report, paper in developing a research proposal, Format of research proposal, A presentation and assessment by a review committee.

UNIT-IV:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright.
Process of Patenting and Development: Technological research, Innovation, Patenting, Development.
International Scenario: International cooperation on Intellectual Property, Procedure for grant of patents, Patenting under PCT.

UNIT-V:

Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.
New Developments in IPR: Administration of Patent System, New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies, IPR and IITs.

TEXTBOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: An Introduction for science & engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".

REFERENCES:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step-by-Step Guide for beginners”.
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
3. Mayall , “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New TechnologicalAge”, 2016.
7. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I Semester

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POWER CONVERTERS ANALYSIS LAB

Prerequisite: None

Course Objectives:

- To know the Speed control techniques of DC and AC drives
- To understand Gate drive circuit configurations for converter circuits
- To analyze Advanced converter topologies
- To study Open loop and closed loop speed control analysis of AC and DC drives

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

- Know the speed control strategies of AC and DC drives
- Design speed, current controllers for AC and DC drives
- Get the knowledge on multi-level inverter/converter topologies
- Perform the open loop and closed loop speed control analysis of AC and DC drives
- Design the gate driver circuits for converter topologies
- Know the complete study of advanced converter technologies

PART-A

1. Single phase diode clamped Multilevel inverter.
2. Single phase flying capacitor Multilevel inverter
3. Single phase cascaded Multilevel inverter
4. Push pull converter
5. Fly back converter
6. Forward converter
7. Series resonant converter
8. Parallel resonant converter
9. ZVS
10. ZCS

PART-B:

1. Single phase diode clamped Multilevel inverter.
2. Single phase flying capacitor Multilevel inverter
3. Single phase cascaded Multilevel inverter
4. Push pull converter
5. Fly back converter
6. Forward converter
7. Series resonant converter
8. Parallel resonant converter
9. ZVS
10. ZCS

Note: Conduct any 5 experiments from PART -A using Hardware and PART-B using any simulation tool

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RENEWABLE ENERGY LAB

Prerequisite: None

Course Objectives:

- To expose simulation of renewable energy systems
- To solve problems in renewable energy conversion technologies

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

- Apply simulation of models of renewable sources in real time applications
- Expertise in developing programs in various applications.

List of Experiments: Any ten experiments from PART-A and PART-B should be done

SIMULATION EXPERIMENTS: (PART-A)

1. Simulation of Solar PV energy System
2. Effect of Temperature Variation and irradiation on Photovoltaic Array
3. Design of solar PV boost converter using P&O MPPT technique.
4. Simulation study of Fuel Cell
5. Simulation study on Wind energy generator
6. Simulation study on Hybrid (solar-wind) power system

HARDWARE EXPERIMENTS: (PART-B)

1. Observation of current waveform for linear loads & calculations
2. Impact of transmission line inductance on voltage quality at PCC.
3. Power factor correction using capacitor bank and its impact on power quality at PCC
4. Grid synchronization of solar PV inverter and its performance analysis.
5. Evaluation of active and reactive power & apparent energy flow between grid tied inverter, grid & load & net metering concept.
6. Observation of current waveform for non-linear loads & calculations

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – II Semester

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DIGITAL PROTECTION OF POWER SYSTEM

(Program Core-III**)**

Prerequisite: Power System Protection

Course Objectives:

- To study numerical relays.
- To develop mathematical approach towards protection.
- To study algorithms for numerical protection.

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

- Learn the importance of Digital Relays.
- Apply Mathematical approach towards protection.
- Develop various Protection algorithms.

UNIT-I:

MATHEMATICAL BACKGROUND TO DIGITAL PROTECTION

Overview of static relays, Transmission line protection, Transformer protection, Need for Digital protection. Performance and operational characteristics of Digital protection, Basic structure of Digital relays, Finite difference techniques, Interpolation formulas, Numerical differentiation, Curve fitting and smoothing, Fourier analysis, Walsh function analysis, Relationship between Fourier and Walsh coefficients.

UNIT-II:

BASIC ELEMENTS OF DIGITAL PROTECTION

Basic components of a digital relay, Signal conditioning subsystems, Conversion subsystem, Digital relay subsystem, The digital relay as a unit.

UNIT-III:

DIGITAL RELAYING ALGORITHMS-I

Sinusoidal-Wave-Based algorithms: Sample and first-derivative methods, First and second-derivative methods, Two-sample technique, Three-sample technique, an early relaying scheme.

Fourier analysis-based algorithms: Full cycle window algorithm, Fractional-cycle window algorithms, Fourier-transform based algorithm, and Walsh-function-based algorithms.

UNIT-IV:

DIGITAL RELAYING ALGORITHMS-II

Least squares-based methods: Integral LSQ fit, Power series LSQ fit, multi-variable series LSQ technique, Determination of measured impedance estimates.

Differential equation-based techniques: Representation of transmission lines with capacitance neglected, Differential equation protection with selected limits, Simultaneous differential equation techniques.

Travelling-wave based protection: Fundamentals of Travelling-wave based protection, Bergeron's-equation based protection scheme, Ultra-high-speed polarity comparison scheme, Ultra-high-speed wave differential scheme, Discrimination function-based scheme, superimposed component trajectory- b a s e d scheme.

UNIT-V:

DIGITAL PROTECTION OF TRANSFORMERS AND TRANSMISSION LINES

Principles of transformer protection, Digital protection of Transformer using FIR filter-based algorithm, least squares curve fitting-based algorithms, Fourier-based algorithm, and Flux-restrained current differential relay.

Digital Line differential protection: Current-based differential schemes, Composite voltage- and current-based scheme.

TEXTBOOKS:

1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies Press, 2009.
2. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press, 1999.

REFERENCES:

1. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006.
2. S.R.Bhide, "Digital Power System Protection", PHI Learning Pvt.Ltd, 2014.

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M. Tech – II Semester

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ENERGY STORAGE SYSTEMS

(Program Core-IV)

Prerequisite:

Course Objectives:

- To introduce generalized storage techniques
- To analyze the different features of energy storage systems
- To know the management and application of energy storage technologies
- To have an idea about electrical energy storage market potential by different forecasting methods

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

- Understand the role of electrical energy storage technologies in electricity usage
- Know the behavior and features of electrical energy storage systems
- Analyze the applications of energy storage system
- Understand the hierarchy, demand for energy storage and valuation techniques.
- Get knowledge about energy storage forecasting methods

UNIT-I:

THE ROLES OF ELECTRICAL ENERGY STORAGE TECHNOLOGIES IN ELECTRICITY USE

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, 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-II:

TYPES AND 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, Lead-Acid Batteries, Lithium-Ion Batteries, Flow batteries, Other Batteries in Development, Chemical energy storage, Hydrogen (H2), Synthetic Natural Gas (SNG), Electrical storage systems, Double-Layer Capacitors (DLC), Superconducting Magnetic Energy Storage (SMES),Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT-III:

APPLICATIONS OF EES

Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), EES installed capacity worldwide, New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles.

UNIT-IV:

MANAGEMENT AND CONTROL HIERARCHY OF EES

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.

DEMAND FOR ENERGY STORAGE

Growth in Variable Energy Resources, Relationship between balancing services and variable energy resources, Energy Storage Alternatives, Variable Generator Control, Demand Management, Market Mechanisms, Longer Term Outlook.

VALUATION TECHNIQUES

Overview, Energy Storage Operational Optimization, Market Price Method, Power System Dispatch Model Method, Ancillary Service Representation, Energy Storage Representation, Survey of Valuation Results.

UNIT-V:

FORECAST OF EES MARKET POTENTIAL BY 2030

EES market potential for overall applications, EES market estimation by Sandia National Laboratory (SNL), EES market estimation by the Boston Consulting Group (BCG), EES market estimation for Li-ion batteries by the Panasonic Group, EES market potential estimation for broad introduction of renewable energies, EES market potential estimation for Germany by Fraunhofer, Storage of large amounts of energy in gas grids, EES market potential estimation for Europe by Siemens, EES market potential estimation by the IEA, Vehicle to grid concept, EES market potential in the future.

TEXTBOOKS:

1. Paul Breeze, "Power System Energy Storage Technologies", 1st Edition, Academic Press.
2. Alfred Rufer, "Energy Storage: Systems and Components", CRC Press, 2017.

REFERENCES:

1. Huggins and Robert, "Energy Storage Fundamentals, Materials and Applications", Springer.
2. andreasoberhofer@gmx.de
3. www.ecofys.com/com/publications
4. www.iec.ch.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – II Semester

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RESTRUCTURED POWER SYSTEMS

(Program Elective-III**)**

Prerequisite: Power Systems and Electrical Machines

Course Objectives:

- To understand what is meant by restructuring of the electricity market
- To understand the need behind requirement for deregulation of the electricity market
- To understand the money, power & information flow in a deregulated power system

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

- Describe various types of regulations in power systems.
- Identify the need of regulation and deregulation.
- Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
- Identify and give examples of existing electricity markets.
- Classify different market mechanisms and summarize the role of various entities in the market.

UNIT-I:

Fundamentals of restructured system, Market architecture, Load elasticity, social welfare maximization.

UNIT-II:

OPF: Role in vertically integrated systems and in restructured markets, Congestion management.

UNIT-III:

Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power.

UNIT-IV:

Ancillary services, Standard market design, Distributed generation in restructured markets.

UNIT-V:

Developments in India, IT applications in restructured markets, working of restructured power systems**,** PJM, Recent trends in Restructuring.

TEXTBOOKS:

1. Lorrin Philipson, H. Lee Willis, “Understanding electric utilities and de-regulation”, Marcel Dekker Pub., 1998.
2. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley and Sons, 2002.

REFERENCES:

1. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, “Operation of restructured power systems”, Kluwer Academic Pub., 2001.
2. Mohammad Shahidehpour, MuwaffaqAlomoush, “Restructured electrical power systems: operation, trading and volatility”, Marcel Dekker.

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M. Tech – II Semester

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ENERGY CONVERSION PROCESS

(Program Elective-III)

Prerequisite:

Course Objectives:

- To analyze pros and cons of Conventional energy conversion techniques
- To understand the working principle of Direct energy conversion systems
- To study the need and necessity of energy storage systems and their desirable characteristics & Fuel cells

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

- Describe various types of energy storage, their merits, constraints and drawbacks.
- Get awareness on the existence of various mechanisms for conversion

UNIT-I:

CONVENTIONAL ENERGY CONVERSION CYCLES

Reversible and irreversible cycles – Thermodynamics analysis of Carnot – Stirling – Ericsson – Otto – Diesel – Dual – Lenoir – Atkinson – Brayton - Rankine.

.

UNIT-II:

DIRECT CONVERSION OF THERMAL TO ELECTRICAL ENERGY

Thermoelectric Converters –Thermionic converters – MHD – Ferro electric converter – Nernst effect generator.

UNIT-III:

CHEMICAL & ELECTROMAGNETIC ENERGY TO ELECTRICAL ENERGY

Batteries – types – working – performance governing parameters – Hydrogen energy – Solar photovoltaic cells.

UNIT-IV:

ENERGY STORAGE SYSTEMS

Energy Storage Technologies - Mechanical energy, Electrical energy, Chemical energy, Thermal energy.

UNIT-V:

FUEL CELLS

Basics – types – working - comparative analysis – thermodynamics and kinetics of fuel cell process – performance of fuel cell – applications - advantages and drawbacks.

TEXTBOOKS:

1. ArchieW.Culp, “Principles of Energy Conversion”, McGraw-Hill Inc., Singapore, 1991.
2. Kettari M.A., “Direct Energy Conversion”, Addison-Wesley Pub. Co 1997. 6. Kordesch K. and Simader G., “Fuel Cell and Their Applications”, Wiley-Vch, Germany 1996

REFERENCES:

1. Barclay F.J., “Fuel Cells, Engines and Hydrogen”, Wiley, 2009.
2. Hart A.B. and Womack G.J., “Fuel Cells: Theory and Application”, Prentice Hall Newyork Ltd., London 1989.
3. Ibrahim Dincer and Mark A. Rosen, “Thermal Energy Storage Systems and Applications”, John Wiley & Sons 2002.

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M. Tech – II Semester

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POWER QUALITY IMPROVEMENT TECHNIQUES

(Program Elective-III**)**

Prerequisite: Power Systems and Power Electronics

Course Objectives:

- To know different terms of power quality.
- To illustrate power quality issues for short and long interruptions.
- To study of characterization of voltage sag magnitude and three-phase unbalanced voltage sag.
- To know the behavior of power electronics loads, induction motors, synchronous motor etc. by the power quality issues
- To know mitigation of power quality problems by using VSI converters.

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

- Know the severity of power quality problems in distribution system
- Understand the concept of voltage sag transformation from up-stream (higher voltages) to down-stream (lower voltage)
- Compute the power quality improvement by using various mitigating custom power devices.

UNIT-I:

INTRODUCTION AND POWER QUALITY STANDARDS

Introduction, Classification of Power Quality Problems, Causes, Effects and Mitigation Techniques of Power Quality Problems, Power Quality Terminology, Standards, Definitions, Monitoring and Numerical Problems.

UNIT-II:

CAUSES OF POWER QUALITY PROBLEMS

Introduction to Non-Linear Loads, Power Quality Problems caused by Non-Linear Loads, Analysis of Non-Linear Loads, Numerical Problems.

UNIT-III:

PASSIVE SHUNT AND SERIES COMPENSATION

Introduction, Classification and Principle of operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators for Single-Phase System, Three-Phase Three Wire System and Three-Phase Four Wire System.

UNIT-IV:

ACTIVE SHUNT AND SERIES COMPENSATION

Introduction to Shunt compensators: Classification of DSTATCOM's, Principle of Operation of DSTATCOM.

Different Control Algorithms of DSTATCOM: PI Controller, I-Cosφ Control Algorithm, Synchronous Reference Frame Theory, Single-Phase PQ theory and DQ Theory Based Control Algorithms, Analysis and Design of Shunt Compensators, Numerical Problems.

Introduction to Series Compensators: Classification of Series Compensators, Principle of Operation of DVR.

Different Control Algorithms of DVR: Synchronous Reference Frame Theory-Based Control of DVR, Analysis and Design of Active Series Compensators, Numerical Problems.

UNIT-V:

UNIFIED POWER QUALITY COMPENSATORS

Introduction to Unified Power Quality Compensators (UPQC), Classification of UPQCs, Principle of Operation of UPQC.

Control of UPQCs: Synchronous Reference Frame Theory-Based UPQC, Analysis and Design of UPQCs, Numerical Problems.

TEXTBOOKS:

1. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality Problems and Mitigation Techniques", Wiley Publications, 2015.
2. Math H J Bollen, "Understanding Power Quality Problems", IEEE Press, 2000.

REFERENCES:

1. R.C. Dugan, M.F. McGranaghan and H.W. Beaty, "Electric Power Systems Quality", New York, McGraw-Hill, 1996.
2. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007.
3. J. Arrillaga, "Power System Quality Assessment", John wiley, 2000.
4. G.T. Heydt," Electric Power Quality", 2ndEdition, West Lafayette, IN, Stars in Circle Publications,1994.
5. R. SastryVedamMulukutlaS.Sarma, "Power Quality VAR Compensation in Power Systems", CRC Press.
6. A Ghosh, G. Ledwich," Power Quality Enhancement Using Custom Power Devices", Kluwer Academic, 2002.

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M. Tech – II Semester

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ELECTRIC VEHICLE CHARGING TECHNIQUES

(Program Elective-III)

Prerequisite: Electric and Hybrid Vehicles, Power Electronics, Smart Grid Technologies

Course Objectives:

- To understand the charging infrastructure for EV's
- To explore the working of grid connected with EV's.

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

- Understand the planning and operational issues related to EV's charging.
- Acquire knowledge about EV's charging implementation models.

UNIT-I:

AN OVERVIEW OF EV CHARGING INFRASTRUCTURE:

Orients the reader to EV charging infrastructure, providing a brief introduction to technical concepts of electric vehicle supply equipment, AC and DC charging, power ratings, and charging standards.

UNIT-II:

LOCATION PLANNING AND LAND ALLOCATION:

Covers the location and site planning aspects for EV charging, by framing the principles of location planning and demonstrating a methodology for spatial allocation of charging demand, and identifies enabling processes and policies to integrate public charging in urban planning.

UNIT-III:

CONNECTING EVs TO THE ELECTRICITY GRID:

Focuses on supply of electricity for charging infrastructure, familiarizing readers with the regulations that govern electricity supply for EV charging, the role of DISCOMs in provision of EV charging connections, and the three methods of arranging for power supply for charging infrastructure.

UNIT-IV:

ACHIEVING EFFECTIVE EV-GRID INTEGRATION:

Zooms out from site-level considerations for supply of electricity to assess grid-level impacts, and then highlights the need for smart charging to minimize adverse impacts of EV charging loads on the grid.

UNIT-V:

MODELS OF EV CHARGING IMPLEMENTATION

Defines the typical roles within an implementation model for EV charging infrastructure and identifies three models in India – the government-driven model, the consumer-driven model and the charge point operator-driven model – for charging infrastructure implementation.

TEXTBOOKS:

1. Sulabh Sachan, P. Sanjeevikumar, Sanchari Deb, "Smart Charging Solutions for Hybrid and Electric Vehicles", Wiley Publications, March 2022.
2. Handbook of Electric Vehicle Charging Infrastructure Implementation Version-1

REFERENCES:

1. Vahid Vahidinasab, Behnam Mohammadi-Ivatloo, "Electric Vehicle Integration via Smart Charging, Springer, 2022.
2. Alam, Mohammad Saad, Pillai, Reji Kumar, Murugesan, N, "Developing Charging Infrastructure and Technologies for Electric Vehicles", IGI Global Publisher, December 2021

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M. Tech – II Semester

L	T	P	C
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DATA SCIENCE APPLICATIONS IN POWER ENGINEERING

(Program Elective-IV.1)

Prerequisite: None
Prerequisite: -
Course Objectives:

- To introduce the fundamental concepts of data science and machine learning.
- To understand the process of data preparation and analysis for engineering problems.
- To learn various machine learning algorithms and their applications.
- To apply machine learning techniques to real-world problems in the power generation industry.
- To analyze specific case studies related to power system forecasting and maintenance

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

- Differentiate between data science, machine learning, and AI concepts and their relevance to engineering disciplines.
- Analyze and prepare datasets for use in machine learning models, including handling outliers and performing feature engineering.
- Apply various machine learning algorithms to solve regression and classification problems.
- Understand and articulate the practical applications of machine learning within the power generation industry.
- Develop and evaluate forecasting models for specific power system challenges, such as electrical consumption and wind power failures.

Unit I - Introduction to Data Science
Introduction to data science, introduction to machine learning, overview of the power generation industry, artificial intelligence in the power generation industry, climate change and the power industry, machine learning for industry transition, mitigation of problems using machine learning.

Unit II - Data Science, Statistics, and Time Series
Preparing a clean dataset, measuring and storing data in control systems, data uncertainty, time-series analysis, data correlation, mathematical representation and modeling, data representation and significance, outlier removal, model goodness, feature engineering, dimensionality reduction, practical checklist for dataset preparation.

Unit III - Machine Learning
Introduction to machine learning concepts, supervised and unsupervised learning, regression and classification, bias-variance trade off, model complexity, neural networks (feed-forward and recurrent), support vector machines (SVM), random forest, self-organizing maps (SOM), Bayesian networks, training a model, splitting datasets (training, testing, validation), cross-validation, assessing model performance, role of a domain expert, practical advice for a machine learning project.

Unit IV - Machine Learning in the Power Generation Industry & Electrical Consumption Forecasting
Machine learning studies in power plants and for power users, predictive maintenance, forecasting supply and demand, modeling physical relationships, consumer modeling, practical applications of machine learning in the power industry, case study of electrical consumption forecasting in a medical clinic, integration with Building Management Systems, artificial neural network (ANN) implementation, multilayer perceptron ANN, backpropagation training algorithm, ANN inputs (loads, day type, time, weather), formal procedure for ANN parameter selection.

Unit V - Forecasting Wind Power Plant Failures Topic
Wind power plant damage mechanisms, impact on lifetime cost and power production, vibration spectra analysis for damage detection, predictive maintenance, forecasting failures on turbine blades, rotors, and generators

TEXTBOOKS:

1. Machine Learning and Data Science in the Power Generation Industry: Best Practices, Tools, and Case Studies, edited by Patrick Bangert, Elsevier, ISBN: 9780128197424.
2. Machine Learning for Energy Systems, edited by Denis N. Sidorov, MDPI Books, Publication Date: December 2020, ISBN (Hardback): 978-3-03943-382-7, ISBN (PDF): 978-3-03943-383-4.
3. Data Science for Engineers, by Raghunathan Rengaswamy and Resmi Suresh, CRC Press, Publication Date: December 16, 2022, ISBN (Hardback): 9780367754266, ISBN (eBook): 9781003353584.

REFERENCES:

1. Application of Machine Learning and Deep Learning Methods to Power System Problems, edited by Morteza Nazari-Heris, Somayeh Asadi, Behnam Mohammadi-Ivatloo, Moloud Abdar, Houtan Jebelli, and Milad Sadat-Mohammadi, Springer International Publishing, 2021.
2. Real-World Applications of Artificial Intelligence and Machine Learning in Power Systems: A Code Approach, by T. Mariprasath and V. Kirubakaran, Nova Science Publishers, 2025.

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WIND ENERGY CONVERSION SYSTEMS

(Program Elective-IV.2**)**

Prerequisite: Artificial Intelligence Techniques in Electrical Engineering

Course Objectives:

- To understand the fundamentals of wind energy and its conversion system
- To learn gear coupled generator wind turbine components
- To learn modern wind turbine control & monitoring.
-

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

- Know the energy conversion techniques in wind energy
- Learn about wind turbine components and their constructions.
- Understand the modern wind turbine control & monitoring.

UNIT-I:

Wind Energy Fundamentals & Wind Measurements: Wind Energy Basics, Wind Speeds and scales, Terrain, Roughness, Wind Mechanics, Power Content, Class of wind turbines, Atmospheric Boundary Layers, Turbulence. Instrumentation for wind measurements, Wind data analysis, tabulation, Wind resource estimation, Betz's Limit, Turbulence Analysis.

UNIT-II:

Aerodynamics Theory & Wind Turbine Types: Airfoil terminology, Blade element theory, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads Vertical Axis Type, Horizontal Axis, Constant Speed Constant Frequency, Variable speed Variable Frequency, Up Wind, Down Wind, Stall Control, Pitch Control, Gear Coupled Generator type, Direct Generator Drive /PMG/Rotor Excited Sync Generator.

UNIT-III:

Gear Coupled Generator Wind Turbine Components And Their Construction: Electronics Sensors/Encoder/Resolvers, Wind Measurement : Anemometer & Wind Vane, Grid Synchronisation System, Soft Starter, Switchgear[ACB/VCB], Transformer, Cables and assembly, Compensation Panel, Programmable Logic Control, UPS, Yaw & Pitch System : AC Drives, Safety Chain Circuits, Generator Rotor Resistor controller (Flexi Slip), Differential Protection Relay for Generator, Battery/Super Capacitor Charger & Batteries/ Super Capacitor for Pitch System, Transient Suppressor/Lightning Arrestors, Oscillation & Vibration sensing.

UNIT-IV:

Direct Rotor Coupled Generator (Multipole) [Variable Speed Variable Freq.]: Excited Rotor Synch, Generator/PMG Generator, Control Rectifier, Capacitor Banks, Step Up/Boost Converter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltage and Current), Transformer, Safety Chain Circuits

UNIT-V:

Modern Wind Turbine Control & Monitoring System: Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Wind turbines, Wind Turbine Monitoring with Error codes, SCADA & Databases: Remote Monitoring and Generation Reports, Operation & Maintenance for Product Life Cycle, Balancing technique (Rotor & Blade), FACTS control & LVRT & New trends for new Grid Codes.

TEXTBOOKS:

1. Renewable Energy Sources, Twidell J.W. and Weir A., EFN Spon Ltd., 1983.
2. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle Oxford University Press, 1996.

REFERENCES:

1. C-Wet: Wind Energy Resources Survey in India VI.
2. Solar Engineering of Thermal Processes, Duffie A. and Beckmann W. A., John Wiley, 1991.
3. Wind Energy Conversion Systems, Freris L.L., Prentice Hall, 1990.
4. Wind Energy Systems, John D Sorensen and Jens N Sorensen, Woodhead Publishing Ltd, 2011.
5. Stand – alone and Hybrid Wind Energy Systems, Kaldellis J.K., CRC Press, 2010.
6. Wind Energy Systems, Mario Garcia –Sanz, Constantine H. Houpis, CRC Press 2012.

7. Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, Spera D.A., ASME Press, 1994.
8. NPTEL online course, Non-Conventional Wind Energy Systems, https://www.youtube.com/playlist?list=PL3QMEfkolRFbGhXveCE7RFDBgY0_gRxkh
9. NPTEL online course, Energy Resouces and Technology, https://www.youtube.com/playlist?list=PLB8D62518BDBD6B9C

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ENERGY AUDITING AND MANAGEMENT

(Program Elective-IV.3)

Prerequisite:

Course Objectives:

- To understand the fundamentals of energy auditing and management
- To understand the energy utilization pattern including wastage and its management.

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

- Apply energy auditing and management methods in various domains.
- Carry out the energy audit in any type of building and suggest the relevant and appropriate conservation measures.

UNIT-I:

INTRODUCTION TO ROLE OF ENERGY AUDITING IN IDUSTRY

Basic elements and measurements - Mass and energy balances - Scope of energy auditing industries - Evaluation of energy conserving opportunities.

UNIT-II:

ENERGY AUDIT

Need of Energy audit - Types of energy audit - Energy management (audit) approach - understanding energy costs - Bench marking - Energy performance - Matching energy use to requirements - Maximizing system efficiencies - Optimizing the input energy requirements - Duties and responsibilities of energy auditors - Energy audit instruments - Procedures and Techniques.

UNIT-III:

ENERGY MANAGEMENT

Design of Energy Management Programs - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Some case study and potential energy savings.

UNIT-IV:

THERMAL ENERGY MANAGEMENT

Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery - Thermal insulation - Heat exchangers and heat pumps - Building Energy Management.

UNIT-V:

ELECTRICAL ENERGY MANAGEMENT

Supply side Methods to minimize supply-demand gap - Renovation and modernization of power plants - Reactive power management - HVDC - FACTS - Demand side - Conservation in motors - Pumps and fan systems - Energy efficient motors.

TEXTBOOKS:

1. Energy Management: W.R.Murphy, G.Mckay 109
2. Hamies, Energy Auditing and Conservation; Methods Measurements, Management and Case study, Hemisphere, Washington, 1980.

REFERENCES:

1. Energy Management Principles: C.B.Smith
2. Efficient Use of Energy: I.G.C.Dryden
3. Energy Economics A.V.Desai

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DIGITAL CONTROL SYSTEMS

(Program Elective-IV.4)

COURSE OBJECTIVES: The course should enable the students to:

- To recall the significance of modern developments, a strong foundation necessary in digital control systems.

COURSE OUTCOMES: After successful completion of this course, student should be able to:

1. Develop mathematical models for controlling system behavior.
2. Apply z-transform to digital control systems for nonlinear behavior.
3. Learn fundamentals and applications of digital control for multidisciplinary engineering problems.
4. Learn fundamentals of intelligent/smart control systems used for industrial automation.
5. Design digital algorithms for Digital compensators using root locus plots and z-plane synthesis.

UNIT-I: INTRODUCTION:

Control System Terminology, Computer-Based Control: History and Trends, An Overview of the Classical Approach to Analog Controller Design.

UNIT-II: SIGNAL PROCESING IN DIGITAL CONTROL:

Configuration of the Basic Digital Control Scheme, Principles of Signal Conversion, Discrete- Time Signals, Time-Domain Models for Discrete-Time Systems, The z-Transform, Transfer Function Models, Frequency Response, Stability on the z-Plane and the Jury Stability Criterion.

UNIT-III: SAMPLE-AND-HOLDSYSTEMS:

The Sampling operation, The Hold operation, Practical Sample-and-Hold Circuit, Sampled Spectra and Aliasing, Reconstruction of Analog Signals, Practical Aspects of the Choice of Sampling Rate, Principles of Discretization

UNIT-IV: MODELS OF DIGITAL CONTROL DEVICES AND SYSTEMS:(11Hours)

aa- Domain Description of Sampled Continuous-Time Plants, z-Domain Description of Systems with Dead-Time, Implementation of Digital Controllers, Tunable PID Controllers, Digital Temperature Control System, Digital Position Control System, Stepping Motors and Their Control, Programmable Logic Controllers.

UNIT-V: DESIGN OF DIGITAL CONTROL ALGORITHMS:

Z Plane Specifications of Control System Design, Digital Compensator Design using Frequency Response Plots, Digital Compensator Design using Root Locus Plots, z-Plane Synthesis

Textbooks:

1. M.Gopal,“DigitalControlandStateVariableMethods4/E”,McGrawHillEducation.
2. Hemchandra Madhusudan Shertukde, "Digital Control Applications Illustrated with MATLAB"2015,CRCPress

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References:

1. B.C.Kuo, “Digital Control Systems2/E”,Oxford University Press-New Delhi
2. LandauLandau,ZitoLandau,"DigitalControlSystems:Design,IdentificationandImp lement ation,1/E",Springer-Verlag
3. V.I.George,C.P.Kurian,"DigitalControlSystems1/E",CengageLearning
4. KavitaSingh,RashmiVashisth,"DigitalControlSystem",GalgotiaPublications

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ENERGY SYSTEMS LAB

Prerequisite:

Course Objectives:

- To Develop Programs for Power System Analysis.
- To Design models for Power Systems and Power Electronics.
- To Develop Programs of Power System Reliability and Power Electronics.

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

- Power System Analysis using Software.
- Models of Power Systems and Power Electronics.
- Programs of Power System Reliability and Power Electronics.

List of Experiments

1. Develop Program for Y_{BUS} formation.
2. Develop Program for G-S Load Flow Analysis.
3. Develop Program for N-R Load Flow Analysis.
4. Develop Program for FDLF Load Flow Analysis.
5. Develop Program for Short Circuit Analysis.
6. Develop Program for Transient Stability Analysis for Single Machine connected to Infinite Bus by Point-by-Point Method.
7. Develop Program for Generation System Reliability Analysis.
8. Develop Program for Distribution System Reliability Analysis.
9. Develop Simulation of RLC Circuit
10. Develop Simulation of Single-Phase Full Converter with RLE Load
11. Develop Program model for Closed Loop Speed Control of Separately Excited D.C Motor.
12. Develop Program model for Sinusoidal Pulse Width Modulation.

Note: From the above list minimum 10 experiments are to be conducted using suitable software.

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POWER SYSTEM PROTECTION LAB

Prerequisite: Power System Protection

Course Objectives:

- To understand practically different types of Faults occurring in power systems
- To study the characteristics of different types of relays
- To apply different protection schemes and understand the principle of operation

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

- Calculate various faults
- Analyze the various time-current characteristics of protective relays
- Know the Performance and Testing of various electrical models and systems

List of Experiments:

1. Characteristics of Electromechanical Non-Directional over current relay
2. Characteristics of Electromechanical Directional Over Current Relay
3. Characteristics of Electromechanical differential protection relay
4. Characteristics of Numerical Distance relay
5. Characteristics of Integrated Numerical under Voltage Relay
6. Characteristics of Numerical over current Relay
7. Zones protection characteristics of distance Relay
8. Differential protection on Single Phase Transformer
9. Performance and Testing of Feeder Protection System
10. Performance and Testing of Generator Protection System

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FUEL CELL TECHNOLOGIES

(Program Elective-V.1)

Prerequisite:

Course Objectives:

- To know about the fundamental principles, electrochemistry, and design of various fuel cell systems.
- To understand the properties and storage of hydrogen and other fuels, along with the impact of operating conditions on performance.
- To apply knowledge of fuel cell technology for performance calculation and evaluating its economic and environmental feasibility for various applications.

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

- Evaluate fuel cell performance through electrochemical kinetics, polarization curves, and key operational parameters.
- Design and calculate critical performance metrics for fuel cells and stacks, including mass flow rates and system configurations.
- Assess the economic and environmental viability of fuel cell technology for diverse applications like transportation, stationary power, and portable devices.

UNIT-I:

Fuel Cell Fundamentals: What is a fuel cell, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency.

UNIT-II:

Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others, liquid hydrogen and compressed hydrogen-metal hydrides, alkaline fuel cell.

UNIT-III:

Fuel cell electrochemistry: electrode kinetics, types of voltage losses, polarization curve, efficiency, Tafel equation, exchange currents, current density, power density Fuel cell process design: Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates, Fuel cell operating conditions: pressure, temperature, flow rates, humidity

UNIT-IV:

Fuel Cell Design And Performance: Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serial connection, , Introduction to direct methanol fuel cell, DMFC operation scheme, general issues-water flooding and water management, polarization in PEMFC

UNIT-V:

Application And Economics: Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells

TEXT BOOKS:

1. Hoogers G., Fuel Cell Technology Hand Book, CRC Press, 2003.
2. Karl Kordesch & Gunter R. Simader., Fuel Cells and Their Applications, 1st ed., VCH Publishers, NY, 2001.
3. Fuel cells: Principles and Applications, Viswanathan B and AuliceScibioh, University Press

REFERENCES:

1. Barbir F., PEM Fuel Cells: Theory and Practice, 2nd edition, Elsevier/Academic Press, 2013.
2. Subhash C., Singal and Kevin Kendall, High Temperature Fuel Cells: Fundamentals, Design and Applications, Elsevier Advanced Technology, 2003.
3. O'Hayre R. P., S. Cha., W. Colella., F. B. Prinz., Fuel Cell Fundamentals, Wiley, NY, 3rd edition,2016.
4. Hydrogen and Fuel Cells: A Comprehensive Guide, Rebecca L. and Busby, Penn Well Corporation, Oklahoma (2005).
5. Hydrogen and Fuel Cells: Emerging Technologies and Applications, Bent Sorensen (Sørensen), Elsevier, UK (2005).

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FACTS AND CUSTOM POWER DEVICES

(Program Elective-V.2**)**

Prerequisite: Power Electronics and Power Systems

Course Objectives:

- To understand uncompensated lines and their behavior under heavy loading conditions.
- To understand the concept and importance of controllable parameters of FACTS controllers.
- To emphasize the objectives of Shunt compensation and basic operation of SVC and STATCOM.
- To analyze the functioning of series controllers like GCSC, TSSC and TCSC

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

- Choose proper controller for the specific application based on system requirements
- Understand various systems thoroughly and their requirements
- Interpret the control circuits of Shunt Controllers SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
- Detect the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

UNIT-I:

FACTS CONCEPTS

Transmission interconnections power flow in an AC system, Loading capability limits, Dynamic stability considerations, Importance of controllable parameters basic types of FACTS controllers, Benefits from FACTS controllers.

UNIT-II:

VOLTAGE SOURCE CONVERTERS

Single phase & three phase full wave bridge converters, Transformer connections for 12 pulse, 24 and 48 pulse operation. Three level voltage source converter, Pulse width modulation converter, Basic concept of current source Converters, Comparison of current source converters with voltage source converters.

UNIT-III:

STATIC SHUNT COMPENSATION

Objectives of shunt compensation, Mid-point 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, Hybrid VAR generators.

UNIT-IV:

SVC AND STATCOM

The regulation and slope transfer function and dynamic performance, Transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT-V:

STATIC SERIES COMPENSATORS

Concept of series capacitive compensation, Improvement of transient stability, Power oscillation damping and functional requirements of GTO thyristor-controlled series capacitor (GSC), Thyristor switched series capacitor (TSSC) and thyristor-controlled series capacitor (TCSC). Control schemes for GSC, TSSC and TCSC.

TEXT BOOKS:

1. Hingorani H G and Gyugyi. L, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", New York, IEEE Press, 2000.
2. Padiyar.K.R, "FACTS Controllers in Power Transmission and Distribution", New Age Int. Publishers, 2007.

REFERENCES:

1. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash, "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012.
2. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET, 1999.

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GAS INSULATED SYSTEMS

(Program Elective-V.3)

Prerequisite: Switch Gear and Protection

Course objectives:

- To know the GIS concepts and principles
- To distinguish Air Insulated and Gas insulated Substations
- To demonstrate the design and constructional aspects of GIS
- To analyze transient phenomenon, problems and diagnostic methods in GIS

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

- Know the advantages of GIS systems over air insulated systems
- Observe constructional design features of GIS design
- Discriminate the problems and design diagnostic methods of GIS

UNIT–I:

INTRODUCTION TO GIS AND PROPERTIES OF SF_6

Characteristics of GIS- Introduction to SF_6 , Physical properties, Chemical properties, Electrical properties, Specification of SF_6 gas for GIS application, Handling of SF_6 gas before use, Safe handling of Sf_6 gas in electrical equipment, Equipment for handling the SF_6 Gas, SF_6 and environment.

UNIT–II:

LAYOUT OF GIS STATIONS

Advancement of GIS station, Comparison with Air Insulated Substation, Economics of GIS, User Requirements for GIS, Main Features for GIS, Planning and Installation components of a GIS station.

UNIT–III:

DESIGN AND CONSTRUCTION OF GIS STATION

Introduction, Rating of GIS components, Design Features, Estimation of different types of Electrical Stresses, Design Aspects of GIS components, Insulation Design for Components, Insulation Design for GIS, Thermal Considerations in the Design of GIS, Effect of Very Fast Transient Over-voltages (VFTO) on the GIS design, Insulation Coordination systems, Gas handling and Monitoring System Design.

UNIT-IV:

FAST TRANSIENT PHENOMENA IN GIS

Introduction, Disconnector Switching in Relation to Very fast Transients-Origin of VFTO, Propagation and Mechanism of VFTO, VFTO Characteristics, Effects of VFTO, Testing of GIS for VFTO.

UNIT–V:

SPECIAL PROBLEMS IN GIS AND GIS DIAGNOSTICS

Introduction, Particles their effects and their control, Insulating Spacers and their Reliability, SF_6 Gas Decomposition, Characteristics of imperfections in insulation, Insulation Diagnostic methods, PD Measurement and UHF Method.

TEXTBOOKS:

1. M. S. Naidu," Gas Insulated Substations", IK International Publishing House.
2. Hermann J. Koch, "Gas Insulated Substations", Wiley-IEEE Press, Jun, 2014.

REFERENCES:

1. Olivier Gallot-Lavellee, "Dielectric materials and Electrostatics", Wiley-IEEE Press.
2. Jaun Martinez, "Dielectric Materials for Electrical Engineering", Wiley-IEEE Press.

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SCADA SYSTEMS AND APPLICATIONS

(Program Elective-V.4**)**

Prerequisite: -

Course Objectives:

- To understand what is meant by SCADA and its functions.
- To know SCADA communication.
- To get an insight into its application**.**

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

- Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical Applications.
- Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
- Acquire knowledge about single unified standard architecture IEC 61850.
- Learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
- Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

UNIT–I:

Introduction to SCADA, Data acquisition systems, Evolution of SCADA, Communication technologies. Monitoring and supervisory functions, SCADA applications in utility Automation, Industries SCADA.

UNIT–II:

Industries SCADA System Components, Schemes, Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

UNIT–III:

SCADA Architecture**,** Various SCADA architectures, Advantages and disadvantages of each System, Single unified standard architecture -IEC 61850.

UNIT–IV:

SCADA Communication, Various industrial communication technologies, Wired and wireless methods and fiber optics, Open standard communication protocols.

UNIT–V:

SCADA Applications: Utility applications**,** Transmission and Distribution sector operations, Monitoring, analysis and improvement**.** Oil, gas and water industries case studies: Implementation, Simulation exercises.

TEXTBOOKS:

1. Stuart A. Boyer, “SCADA-Supervisory Control and Data Acquisition”, Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders, “Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes Publications, Oxford, UK, 2004.

REFERENCES:

1. William T. Shaw, “Cyber Security for SCADA systems”, PennWell Books, 2006.
2. David Bailey, Edwin Wright, “Practical SCADA for industry”, Newnes, 2003.
3. Michael Wiebe, “A guide to utility automation: AMR, SCADA, and IT systems for electric power”, Penn Well, 1999.

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BUSINESS ANALYTICS

(Open Elective**)**

Prerequisite: None

Course objectives:

- To understand the role of business analytics within an organization.
- To analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- To use decision-making tools/Operations research techniques.
- To Mange business process using analytical and management tools.
- To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

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

- Demonstrate knowledge of data analytics.
- Demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Demonstrate the ability to translate data into clear, actionable insights.

UNIT-I:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies with and without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making. Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXTBOOKS:

1. “Business analytics Principles, Concepts, and Applications” by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. “Business Analytics by James Evans”, persons Education.

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INDUSTRIAL SAFETY

(Open Elective**)**

Prerequisite: None

UNIT-I:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV:

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

TEXTBOOKS/ REFERENCES:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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OPERATIONS RESEARCH

(Open Elective)

Prerequisite: None

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

- Apply the dynamic programming to solve problems of discreet and continuous variables.
- Apply the concept of non-linear programming
- Carry out sensitivity analysis
- Model the real-world problem and simulate it.

UNIT-I:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT-II:

Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming

UNIT-III:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT

UNIT-IV:

Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT-V:

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

TEXTBOOKS/ REFERENCES:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – III Semester

L	T	P	C
3	0	0	3

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective**)**

Prerequisite: None

UNIT-I:

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT-II:

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT-III:

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

UNIT-IV:

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-V:

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXTBOOKS/ REFERENCES:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – III Semester

L	T	P	C
3	0	0	3

COMPOSITE MATERIALS

(Open Elective**)**

Prerequisite: None

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

MANUFACTURING OF METAL MATRIX COMPOSITES: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV:

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXTBOOKS/ REFERENCES:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – III Semester

L	T	P	C
3	0	0	3

PHOTOVOLTAIC SYSTEMS

(Open Elective)

Prerequisite: None

Course Objectives:

- To introduce photovoltaic systems
- To deal with various technologies of solar PV cells
- To understand details about manufacture, sizing and operating techniques
- To have knowledge of design considerations.

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

- Identify photovoltaic system components and system types
- Calculate electrical energy and power
- Correctly size system components, design considerations of solar equipment
- Design a basic grid-tie PV system.

UNIT-I:

SOLAR ENERGY

Sun and Earth, Solar Spectrum, Solar Geometry, Solar radiation on horizontal and inclined planes, Instruments for measurement of solar radiation, Solar cell, Equivalent circuit, V-I characteristics, Performance improvement.

UNIT-II:

SOLAR CELLS

Manufacture of Solar Cells-Technologies, Design of Solar cells, Photovoltaic modules, Design requirements, Encapsulation systems, Manufacture, Power rating, Hotspot effect, Design qualifications.

UNIT-III:

PROTECTION AND MEASUREMENTS

Flat plate arrays, Support structures, Module interconnection and cabling, Lightning protection, Performance measurement using natural sun light and simulator, Determination of temperature coefficients, Internal series resistance, Curve correction factor.

UNIT-IV:

PHOTOVOLTAIC SYSTEMS

Photovoltaic systems, Types, General design considerations, System sizing, Battery sizing, Inverter sizing, Design examples, Balance of PV systems.

UNIT-V:

MAXIMUM POWER POINT TRACKERS

Maximum power point trackers, Perturb and observe, Incremental conductance method, Hill climbing method, , Hybrid and complex methods, Data based and other approximate methods, Instrument design, Other MPP techniques, Grid interactive PV system.

TEXTBOOKS:

1. F.C.Treble, “Generating electricity from Sun”, Pergamon Press.
2. A.K.Mukherjee, Nivedita Thakur,”Photovoltaic systems: Analysis and design”, PHI, 2011.

REFERENCES:

1. C.S.Solanki,” Solar Photovoltaic’s: Fundamentals, Technologies and applications”, PHI, 2009.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I& II Semester

L	T	P	C
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ENGLISH FOR RESEARCH PAPER WRITING

(Audit-I &II .1**)**

Prerequisite: None

Course objectives:

- To Understand that how to improve your writing skills and level of readability
- To Learn about what to write in each section
- To Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT-I:

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions

UNIT-VI:

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXTBOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book
4. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I& II Semester

L	T	P	C
2	0	0	0

DISASTER MANAGEMENT

(Audit-I &II .2**)**

Prerequisite: None

Course Objectives:

- To learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- To evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- To understand the strengths and weaknesses of disaster management approaches,
- To plan and program in different countries, particularly their home country or the countries they work

UNIT-I:

Introduction:

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II:

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III:

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-IV:

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-V:

Risk Assessment Disaster Risk:

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT-VI:

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXTBOOKS/ REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I& II Semester

L	T	P	C
2	0	0	0

SANSKRIT FOR TECHNICAL KNOWLEDGE

(Audit-I &II .3**)**

Prerequisite: None

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To learn of Sanskrit to improve brain functioning
- To Learn of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- To equip engineering scholars with Sanskrit will be able to explore the huge knowledge from ancient literature

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

- Understand basic Sanskrit language
- Know ancient Sanskrit literature about science & technology can be understood
- Get logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXTBOOKS/ REFERENCES:

1. “Abhyaspustakam”, Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I& II Semester

L	T	P	C
2	0	0	0

VALUE EDUCATION

(Audit-I &II .4**)**

Prerequisite: None

Course Objectives:

- To understand value of education and self-development
- To imbibe good values in students
- To know about the importance of character

Course outcomes: After completion of the course, students will be able to:

- Get Knowledge of self-development
- Learn the importance of Human values
- Develop the overall personality

UNIT-I:

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT-II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT-III:

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness -Avoid fault Thinking. Free from anger, Dignity of labor-Universal brotherhood and religious tolerance - True friendship - Happiness Vs suffering, love for truth - Aware of Self-destructive habits - Association and Cooperation - Doing best for saving nature

UNIT-IV:

Character and Competence –Holy books vs. Blind faith - Self-management and good health - Science of reincarnation - Equality, Nonviolence, Humility, Role of Women - All religions and same message - Mind your Mind, Self-control - Honesty, Studying effectively

TEXTBOOKS/ REFERENCES:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I& II Semester

L	T	P	C
2	0	0	0

CONSTITUTION OF INDIA

(Audit-I &II .5**)**

Prerequisite: None

Course Objectives:

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

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

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:

History of Making of the Indian Constitution: History Drafting Committee, (Composition& Working)

UNIT-II:

Philosophy of the Indian Constitution: Preamble**,** Salient Features

UNIT-III:

Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies, Directive Principles of State Policy**,** Fundamental Duties.

UNIT-IV:

Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-V:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-VI:

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXTBOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn. Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I& II Semester

L	T	P	C
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PEDAGOGY STUDIES

(Audit-I &II.6**)**

Prerequisite: None

Course Objectives:

- To review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- To identify critical evidence gaps to guide development.

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

- Understand what pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- Understand what is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Understand how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and searching.

UNIT-II:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

TEXTBOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I& II Semester

L	T	P	C
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STRESS MANGEMENT BY YOGA

(Audit-I &II.7**)**

Prerequisite: None

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

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

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:

Definitions of Eight parts of yoga. (Ashtanga)

UNIT-II:

Yam and Niyam.

UNIT-III:

Do`s and Don'ts in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:

Asan and Pranayam

UNIT-V:

i) Various yoga poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXTBOOKS/ REFERENCES:

1. Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Tarining" Part-I, Nagpur
2. Swami Vivekananda, AdvaitaAshrama, "Rajayoga or conquering the Internal Nature", PublicationDepartment, Kolkata.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech – I& II Semester

L	T	P	C
2	0	0	0

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Audit-I &II.8**)**

Prerequisite: None

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awake wisdom in students

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

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

- Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXTBOOKS/ REFERENCES:

1. Swami Swarupananda Advaita Ashram, "Srimad Bhagavad Gita", Publication Departmen, Kolkata.
2. P.Gopinath, Rashtriya Sanskrit Sansthanam, "Bhartrihari's Three Satakam (Niti-sringar-vairagya), New Delhi.