1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

| I. | To prepare the students for successful career in electrical power industry, research and teaching institutions. |
| II. | To provide strong foundation in Power Engineering, necessary for day-to-day operation and planning of Power System. |
| III. | To develop the ability to design various controllers to enhance the stability and power transfer capability of the Power System. |
| IV. | To provide knowledge in Renewable Energy Systems, Electric Vehicles and Grid Integrations using Power Converters. |
| V. | To develop a detailed understanding of various tools applied to the operation, design and investigation of modern electric power systems. |

2. PROGRAMME OUTCOMES (POs):

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<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<td>An ability to write and present a substantial technical report/document</td>
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<td>Ability to attain professional ethics and intellectual integrity to contribute to the community for sustainable development of society</td>
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<td>Apply knowledge of basic science and engineering in analysis and modeling of the power system components</td>
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<td>Implement cost effective and cutting edge technologies in Power System</td>
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4. PEO/PO Mapping:

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**PROFESSIONAL ELECTIVES**

**SEMESTER II**

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#### AUDIT COURSES - I

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## SUMMARY

**Name of the Programme:** M.E. POWER SYSTEMS ENGINEERING

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OBJECTIVES:

- To develop the ability to apply the concepts of matrix theory in Electrical Engineering problems.
- To familiarize the students in the field of differential equations to solve boundary value problems associated with engineering applications.
- To develop the ability among the students to solve problems using Fourier series associated with engineering applications.
- To impart deep knowledge and concepts to solve complicated problems using linear programming.
- To develop the capability of solving problems using non-linear programming techniques.

UNIT I MATRIX THEORY
The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Singular value decomposition - Pseudo inverses - Least square approximation.

UNIT II LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS

UNIT III FOURIER SERIES
Fourier Trigonometric series: Periodic function as power signals - Convergence of series - Even and odd functions: Cosine and sine series - Non periodic function - Extension to other intervals - Power signals: Exponential Fourier series - Parseval's theorem and power spectrum - Eigenvalue problems and orthogonal functions - Regular Sturm-Liouville systems - Generalized Fourier series.

UNIT IV LINEAR PROGRAMMING PROBLEMS
Formulation - Graphical solution - Simplex method - Big M method - Two phase method - Transportation and Assignment models.

UNIT V NON-LINEAR PROGRAMMING PROBLEMS
Lagrange multipliers - Equality constraints - Inequality constraints - Kuhn-Tucker Conditions - Quadratic programming.

OUTCOMES:

- Student can able to apply the concepts of matrix theory in Electrical Engineering problems.
- Students can be easily understood to solve boundary value problems associated with engineering applications.
- Able to solve problems using Fourier series associated with engineering applications.
- Able to understand the basic concepts and also to solve complicated problems using linear programming.
- Student have capability of solving problems using non-linear programming techniques.
REFERENCES:

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RM4151 RESEARCH METHODOLOGY AND IPR L T P C 2 0 0 2

UNIT I RESEARCH DESIGN 6
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES 6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 6
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

UNIT V PATENTS 6

TOTAL : 30 PERIODS
REFERENCES

PS4101 COMPUTER AIDED POWER SYSTEM ANALYSIS

OBJECTIVES:
- To introduce various solution techniques to solve the large scale power systems.
- To impart in-depth knowledge on different power flow solution methods for large power system networks.
- To perform various optimal power flow methods involving operating and security constraints.
- To perform short circuit fault analysis for various fault conditions on three phase basis.
- To Illustrate different numerical integration methods and factors influencing transient stability

UNIT I SOLUTION TECHNIQUE
Sparse Matrix techniques for large scale power systems - Optimal ordering schemes for preserving sparsity - Flexible packed storage scheme for storing matrix as compact arrays - Factorization by Bi-factorization and Gauss elimination methods - Repeat solution using Left and Right factors and L and U matrices.

UNIT II POWER FLOW ANALYSIS

UNIT III OPTIMAL POWER FLOW

UNIT IV SHORT CIRCUIT ANALYSIS
Formation of bus impedance matrix with mutual coupling (single phase basis and three phase basis) - Computer method for fault analysis using $Z_{bus}$ and sequence components - Derivation of equations for bus voltages -fault current and line currents - both in sequence and phase - symmetrical and unsymmetrical faults.
OUTCOMES:
CO1 Ability to solve large scale simultaneous linear equations and the ordering schemes for preserving sparsity.
CO2 Ability to solve large scale power flow problems
CO3 Ability to solve optimal power flow problem using various solution methods
CO4 Ability to do fault calculations for various fault conditions on three phase basis
CO5 Ability to do stability studies under various disturbances using numerical integration methods

REFERENCES:

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1 - low, 2-medium, 3-high, '-' no correlation
OBJECTIVES

- To understand the fundamentals of speed governing system and the concept of control areas.
- To get the insight of load frequency control and its modelling.
- To provide knowledge about Hydrothermal scheduling, Unit commitment and solution techniques.
- To realize the requirements and methods of real and reactive power control in power system.
- To be familiar with the power system security issues and contingency studies.

UNIT I  INTRODUCTION

System load variation: System load characteristics, load curves - daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation and Control: Load forecasting, techniques of forecasting, Indian power sector – Past and present status: Recent growth of power sector in India – An overview, A time line of the Indian power sector, Players in the Indian power sector, basics of power system operation and control.

UNIT II  LOAD FREQUENCY CONTROL

Need for frequency and voltage control - Plant and system level control - modeling of LFC of single area system - static and dynamic analysis - LFC of two area system - static and dynamic analysis - Tie line bias control - development of state variable model of single and two area system.

UNIT III  HYDROTHERMAL SCHEDULING PROBLEM


UNIT IV  UNIT COMMITMENT AND ECONOMIC DISPATCH

Statement of Unit Commitment (UC) problem; constraints in UC: spinning reserve, thermalunit constraints, hydro constraints, fuel constraints and other constraints; UC solution methods: Priority-list methods, forward dynamic programming approach, numerical problems. Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. Gradient method- Newton’s method – Base point and participation factor method. Economic dispatch controller added to LFC control.

UNIT V  POWER SYSTEM SECURITY


TOTAL 45 PERIODS

OUTCOMES:

Students able to

CO1: Explain about the operation and control of power system and List the past and present status of Indian power sector

CO2: Develop the static and dynamic model of Load Frequency Control in single and two area system

CO3: Analyse the problems associated with hydro thermal Scheduling and to construct the algorithm for feasible load management

CO4: Distinguish between various methods involved in unit commitment and economic dispatch problems

CO5: Define about the power system security factors and analyse the algorithms used for optimal power flow
REFERENCES
7. http://nptel.ac.in/courses/108101040/ (PSOCwebcourse)

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PS4151 SYSTEM THEORY

OBJECTIVES:
1. To educate on modeling and representing systems in state variable form.
2. To train on solving linear and non-linear state equations.
3. To illustrate the properties of control system.
4. To classify non-linearities and examine stability of systems in the sense of Lyapunov’s theory.
5. To educate on modal concepts, design of state, output feedback controllers and estimators.

UNIT I STATE VARIABLE REPRESENTATION
Introduction-Concept of State-Space equations for Dynamic Systems -Time invariance and linearity- Non uniqueness of state model- Physical Systems and State Assignment - free and forced responses- State Diagrams.

UNIT II SOLUTION OF STATE EQUATIONS
UNIT III PROPERTIES OF THE CONTROL SYSTEM

Controllability and Observability-Stabilizability and Detectability-Test for Continuous time Systems
Time varying and Time invariant case-Output Controllability-Reducibility-System Realizations.

UNIT IV NON-LINEARITIES AND STABILITY ANALYSIS


UNIT IV MODAL ANALYSIS

Controllable and Observable Companion Forms - SISO and MIMO Systems – Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

OUTCOMES:
Students able to
CO1 Understand the concept of State-State representation for Dynamic Systems
CO2 Explain the solution techniques of state equations
CO3 Realize the properties of control systems in state space form
CO4 Identify non-linearities and evaluate the stability of the system using Lyapnov notion
CO5 Perform Modal analysis and design controller and observer in state space form

REFERENCES:
2. Z. Bubnicki, “Modern Control Theory”, Springer, 2005
3. K. Ogatta, “Modern Control Engineering”, PHI, 2002

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OBJECTIVES:
- To provide the mathematical fundamentals necessary for deep understanding of power converter operating modes.
- To introduce the electrical circuit concepts behind the different working modes of power converters so as to enable deep understanding of their operation.
- To impart required skills to formulate and design inverters for generic load and for machine loads.
- To equip with required skills to derive the criteria for the design of power converters starting from basic fundamentals.
- To inculcate knowledge to perform analysis and comprehend the various operating modes of different configurations of power converters.

UNIT I  SINGLE PHASE AC-DC CONVERTER  12

UNIT II  THREE PHASE AC-DC CONVERTER  12

UNIT III  SINGLE PHASE INVERTERS  12
Introduction to self-commutated switches : MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques – Design of UPS - VSR operation

UNIT IV  THREE PHASE INVERTERS  12
180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques – VSR operation-Application – Induction heating, AC drive system – Current source inverters.

UNIT V  MODERN INVERTERS  12

TOTAL : 60 PERIODS

OUTCOMES:
After completing the above course, students will be able to
CO1 : Acquire and apply knowledge of mathematics in power converter analysis
CO2: Model, analyze and understand power electronic systems and equipments.
CO3 :Formulate, design and simulate phase controlled rectifiers for generic load and for machine loads
CO4 : Design and simulate switched mode inverters for generic load and for machine loads
CO5 : Select device and calculate performance parameters of power converters under various operating modes
REFERENCES:

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PS4111 POWER SYSTEM LABORATORY- I

OBJECTIVES:
1. Illustrate the power system issues under normal and abnormal conditions
2. Analyze the performance of power system under normal and abnormal conditions using simulation software
3. Evaluate the existing system and system under smart environment

LIST OF EXERCISES:
1. Power flow analysis by Newton-Raphson/ Fast decoupled method
2. Transient stability analysis of single machine-infinite bus system using classical machine model
3. Economic load dispatch using lambda-iteration method
4. Unit commitment: Priority-list scheme and dynamic programming
5. Contingency analysis: Generator shift factors and line outage distribution factors
6. Load flow analysis of two-bus system with STATCOM
7. Available Transfer Capability(ATC) calculation using an existing load flow program in deregulated environment.
8. Harmonic Analysis of Power system with nonlinear load
9. Study of protective relaying schemes of Power Apparatus
10. Demand Side Management in Smart Power Grid environment
11. Determination of Sequence Impedances of Power Network

(Any 10 for Conduct of end semester examination)

TOTAL : 45 PERIODS

OUTCOMES:
CO1: Acquire expertise in usage of simulation software as applied to power system
CO2: Apply tools to simulate the mathematical model of power network for power system Analysis
CO3: Analyze the power system through various numerical methods under normal and Abnormal conditions

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PX4161
POWER CONVERTERS LABORATORY
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OBJECTIVES:
- To provide the basic understanding of the dynamic behavior of the power electronic switches
- To make the students familiar with the digital processors used in generation of gate pulses for the power electronic switches
- To make the students acquire knowledge on the design of power electronic circuits and implementing the same using simulation tools
- To facilitate the students to design gate drive circuits for power converters
- To provide the fundamentals of DC-AC power converter topologies and analyze the harmonics.

LIST OF EXPERIMENTS:
1. Study of switching characteristics of Power MOSFET & IGBT.
4. Circuit Simulation of Three-phase Voltage Source Inverter in 180 and 120 degree mode of conduction
5. Circuit simulation of Three-phase PWM inverter and study of spectrum analysis for various modulation indices.
6. Simulation of Four quadrant operation of DC Chopper.
10. Simulation of a five-level cascaded multilevel inverter with R load.
11. Simulation of a Flyback DC-DC converter

TOTAL : 45 PERIODS

OUTCOMES:
- Comprehensive understanding on the switching behaviour of Power Electronic Switches
- Comprehensive understanding on mathematical modeling of power electronic system and ability to implement the same using simulation tools
- Ability of the student to use arduino/microcontroller for power electronic applications
- Ability of the student to design and simulate various topologies of inverters and analyze their harmonic spectrum
- Ability to design and fabricate the gate drive power converter circuits. Analyze the three-phase controlled rectifiers and isolated DC-DC converters for designing the power supplies

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COURSE OBJECTIVES:

1. To demonstrate the basic concepts and recent trends in power system protection
2. To design and work with the concepts of digital and numerical relaying of various power apparatuses
3. To train up with the relay coordination for the transmission line protection schemes
4. To expose PC applications for designing protective relaying schemes
5. To compare different protection schemes of a power apparatus through performance analysis

UNIT I  NUMERICAL PROTECTION
Introduction - Block diagram of numerical relay - Sampling theorem - Correlation with a reference wave - Least Error Squared (LES) technique - Digital filtering and numerical over-current protection.

UNIT II  DIGITAL PROTECTION OF TRANSMISSION LINE
Introduction - Protection scheme of transmission line – Distance relays - Traveling wave relays - Digital protection scheme based upon fundamental signal - Hardware design - Software design - Digital protection of EHV/UHV transmission line based upon traveling wave phenomenon - New relaying scheme using amplitude comparison.

UNIT III  DIGITAL PROTECTION OF SYNCHRONOUS GENERATOR & TRANSFORMER

UNIT IV  DISTANCE AND OVERCURRENT RELAY SETTING AND CO-ORDINATION
Directional instantaneous IDMT over current relay - Directional multi-Zone distance relay - Distance relay setting - Co-ordination of distance relays - Co-ordination of over current relays - Computer graphics display - Man-machine interface subsystem - Integrated operation of national power system - Application of computer graphics.

UNIT V  PC APPLICATIONS FOR DESIGNING PROTECTIVE RELAYING SCHEME
Types of faults – Assumptions - Development of algorithm for SC studies - PC based integrated software for SC studies - Transformation to component quantities - SC studies of multiphase systems - Ultra high speed protective relays for high voltage long transmission line.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Students able to

CO1  Familiarize the underlying principle of digital techniques for power system protection
CO2  Design the relaying scheme for protection of power apparatus using digital techniques
CO3  Evaluate and interpret relay coordination
CO4  Develop PC based algorithm for short circuit studies
CO5 Compare the performance of modern protection schemes with the conventional schemes

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PS4202 POWER SYSTEM DYNAMICS

COURSE OBJECTIVES:

- To impart knowledge on mathematical modeling of a synchronous machine in detail.
- To enable the students to develop the transfer function model for excitation and speed governing systems.
- To offer an opportunity to innovate newer procedures and better methods for effective design.
- To enable the students to model the single and multi-machine power systems with controllers for stability analysis.
- To provide knowledge on enhancing small signal stability concepts in power system.

UNIT I SYNCHRONOUS MACHINE MODELLING

Physical description of a synchronous machine: armature and field structure - direct and quadrature axes- Mathematical Description: Basic equations of a synchronous machine: stator circuit equations, stator self, stator mutual and stator to rotor mutual inductances, dq0 Transformation: flux linkage and voltage equations for stator and rotor in dq0 coordinates, Physical interpretation of dq0 transformation, Per Unit Representations: power invariant form of Park’s transformation; Equivalent Circuits for direct and quadrature axes, Steady-state Analysis: Voltage, current and flux-linkage phasor relationships, Computation of steady-state values.
UNIT II MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEMS


UNIT III SMALL-SIGNAL STABILITY ANALYSIS WITHOUT CONTROLLERS


UNIT VI SMALL-SIGNAL STABILITY ANALYSIS WITH CONTROLLERS

Effects of Excitation System: Thyristor Excitation System with AVR, Block diagram representation with Exciter and AVR, Effect of AVR on Synchronizing and Damping torque components, Power System Stabilizer: Block diagram representation with AVR and PSS, System state matrix including PSS-Illustration of principle of PSS application with numerical example -Small Signal Stability of Multi machine systems: illustration of formation of system state matrix for a two-machine system with classical models for synchronous machines

UNIT V ENHANCEMENT OF SMALL SIGNAL STABILITY


COURSE OUTCOMES:

Students will be able to

CO1 Analyze the mathematical modeling and inductance calculations in a synchronous machine.
CO2 Develop the transfer function model for excitation, speed governing and turbine systems.
CO3 Analyze the small signal stability of SMIB power systems.
CO4 Analyze the small signal stability of SMIB and Multi-machine power systems with damping controllers.
CO5 Describe feedback controllers for small signal stability enhancement in power systems.

REFERENCES:

4 Vijay Vittal, James D. McCalley, Paul, P.M Anderson and A.A Fouad, “Power
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PS4203   POWER SYSTEM TRANSIENTS   LT P C

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COURSEOBJECTIVES:
- To gain knowledge in sources of transients like lightning, switching and temporary overvoltages.
- To model power system components and estimate the overvoltages in power system.
- To analyze travelling wave phenomena against different overvoltages.
- To compute transient overvoltages using Electromagnetic Transient Program (EMTP).
- To coordinate the insulation of power system and protective devices.

UNIT I   LIGHTNING OVERVOLTAGES
Classification of over voltages- Mechanism and parameters of lightning flash, protective shadow, striking distance, electro geometric model for lightning strike, Grounding for protection against lightning – Steady state and dynamic tower-footing resistance, substation grounding Grid, Direct lightning strokes to overhead lines, without and with shield Wires

UNIT II   SWITCHING AND TEMPORARY OVERVOLTAGES

UNIT III   TRAVELLING WAVES ON TRANSMISSION LINE
Circuits and distributed constants, wave equation, reflection and refraction – behaviour of travelling waves at the line terminations – Lattice Diagrams – attenuation and distortion – multiconductor system and multivelocity waves

UNIT IV   INSULATION CO-ORDINATION
Insulation co-ordination –volt –time characteristics , Insulation strength and their selection- Evaluation of insulation strength standard BILs-Characteristics of protective devices, applications, location of arresters – insulation co-ordination in AIS and GIS
UNIT V  COMPUTATION OF POWER SYSTEM TRANSIENTS

Computation of transients using electromagnetic transient program-Modelling of power system components- Simple case studies - Application of simplified method: single line station, two line station, gas insulated substations, comparison with IEEE and IEC guides

COURSEOUTCOMES:

CO1: Ability to analyse various sources of transients
CO2: Ability to compute possible overvoltages in power systems
CO3: Ability to predict overvoltages in power system using travelling wave theory
CO4: Ability to compute overvoltages using EMTP with multiple sources
CO5: Ability to coordinate the insulation level of the power system

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COURSE OBJECTIVES;

Students will be able to:

- Describe the behavior of deregulated markets in power system.
- Describe the technical and non-technical issues in deregulated power industry.
- Identify the methods of Local Marginal prices calculation in transmission and the function of financial transmission rights.
- Analyze the energy and ancillary services management in deregulated power industry.
- Discriminate the restructuring framework US and Indian power sectors

UNIT I INTRODUCTION  9
Reasons for restructuring - Understanding the restructuring process - objectives of deregulation of various power systems across the world - Consumer behavior - Supplier behavior - Market equilibrium - Short-run and Long-run costs - Various costs of production. The Philosophy of Market Models: Market models based on contractual arrangements - Market architecture -

UNIT II TRANSMISSION CONGESTION MANAGEMENT  9
Importance of congestion management in deregulated environment - Classification of congestion management methods - Calculation of ATC - Non-market methods - Market based methods - Nodal pricing - Inter-zonal Intra-zonal congestion management - Price area congestion management - Capacity alleviation method.

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS  9

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK  9
Types of ancillary services -Load-generation balancing related services - Voltage control and reactive power support services - Black start capability service - Mandatory provision of ancillary services - Markets for ancillary services - Co-optimization of energy and reserve services - International comparison. Pricing of transmission network: wheeling - principles of transmission pricing - transmission pricing methods - Marginal transmission pricing paradigm - Composite pricing paradigm - loss allocation methods.

UNIT V MARKET EVOLUTION  9
US markets: PJM market - The Nordic power market - Reforms in Indian power sector: Framework of Indian power sector - Reform initiatives - availability based tariff (ABT) - The Electricity Act 2012 - Open Access issues - Power exchange

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Students will be able to:

CO1: Describe the requirement for deregulation of the electricity market and the principles of market models in power systems.

CO2: Analyze the methods of congestion management in deregulated power system

CO3: Analyze the locational marginal pricing and financial transmission rights

CO4: Analyze the ancillary services management

CO5: Differentiate the framework of US and Indian power sectors

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OBJECTIVES:

1. Solve the power system problems using computational intelligent techniques
2. Analyze the solution obtained for power system under normal and abnormal conditions using simulation software
3. Expose with real time monitoring of power system
4. Evaluate the new techniques used for power system problems with the conventional one.
5. Educate to integrate renewable energy sources

LIST OF EXERCISES

1. AC-DC power flow analysis
2. Application of neural networks to load forecasting and contingency analysis
3. Solution of Unit commitment Problem through Evolutionary algorithm
4. Solution of Economic Dispatch using Evolutionary algorithm
5. Automatic Voltage Regulator with Power System Stabilizer
6. Study of Relay Coordination
7. Simulation of Solar PV & Wind Energy Conversion System
8. Intelligent control techniques for Automatic Generation Control
10. State Estimation of Power System
11. Analysis of Power grid in presence of Renewable Energy Sources

(Any 10 for Conduct of end semester examination)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Apply advanced tools to simulate the model of power network for power system problems
CO2: Acquire expertise in usage of modern techniques for Power System Issues
CO3: Apply soft computing techniques to Power System problems and evaluate the solution
CO4: Analyze the solution obtained through soft computing techniques
CO5: Suggest suitable technique as applicable to power system problem

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OBJECTIVES:
- To emphasize the need for FACTS controllers.
- To learn the characteristics, applications and modeling of series and shunt FACTS controllers.
- To analyze the interaction of different FACTS controller and perform control coordination
- To impart knowledge on operation, modelling and control of HVDC link.
- To perform steady state analysis of AC/DC system.

UNIT I INTRODUCTION
Review of basics of power transmission networks-control of power flow in AC transmission line- Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers-Need for HVDC system-MTDC system- Review of basics of LCC and VSC HVDC system.Configurations-Monopolar Asymmetric and Symmetric MMC-HVDC Scheme- Bipolar and Homopolar HVDC Scheme- Multi-Terminal HVDC Configuration- Layout of HVDC system (LCC, VSC)

UNIT II THYRISTOR BASED FACTS CONTROLLERS

UNIT III ANALYSIS OF LCC HVDC CONVERTERS AND HVDC SYSTEM CONTROL

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS
Static synchronous compensator (STATCOM) - Static synchronous series compensator (SSSC) Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC-Modelling of STATCOM and SSSC for power flow and transient stability studies –operation of Unified and Interline power flow controllers (UPFC) - Modelling of UPFC and IPFC for power flow and transient stability studies-Concepts of Power Oscillation Damping using FACTS controllers

UNIT V VOLTAGE SOURCE CONVERTER BASED HVDC SYSTEM AND CONTROLS
Applications VSC based HVDC: Operation, Modelling for steady state and dynamic studies, Introduction to Modular Multilevel converters- Main circuit design-Converter Operating

TOTAL : 45 PERIODS

COURSE OUTCOMES:
1. Learners will be able to refresh on basics of power transmission networks and need for FACTS controllers
2. Ability to design series and shunt compensating devices for power transfer enhancement
3. Learners will understand the significance about different voltage source converter based FACTS controllers
4. Learners will attain knowledge on AC/DC system coordinated control with FACTS and HVDC link
5. Learners will be capable to explore the MMC converter applications FACTS and MTDC system

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COURSE OBJECTIVES:

- To introduce the state estimation on DC network.
- To impart in-depth knowledge on power system state estimation.
- To study alternative formulations of WLS state estimation.
- To get insight of network observability and bad data identification.
- To gain knowledge on Power System Security Assessment.

UNIT I  INTRODUCTION TO STATE ESTIMATION  9

UNIT II  WEIGHTED LEAST SQUARE ESTIMATION  9

UNIT III  ALTERNATIVE FORMULATION OF WLS STATE ESTIMATION  9
Weakness of normal equation formulation, Orthogonal factorization, Hybrid method, Method of Peters and Wilkinsons, Equality constraints WLS State estimation, Augmented matrix approach, Blocked formulation and comparison of techniques.

UNIT IV  NETWORK OBSERVABILITY AND BAD DATA DETECTION IDENTIFICATION  9

UNIT V  POWER SYSTEM SECURITY ASSESSMENT  9

TOTAL: 45 PERIODS
COURSE OUTCOMES:

Students able to
**CO1:** Define various concepts implied in State estimation and its need in DC networks.
**CO2:** Apply State estimation algorithms in modelling of transmission lines.
**CO3:** Compare the different types of formulation techniques of State estimation.
**CO4:** Analyse network observability and identify the bad data detection using different methods.
**CO5:** List the different types of assessing power system security and solve the issues.

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COURSE OBJECTIVES:

- Discriminate the capabilities of bio-inspired system and conventional methods in solving optimization problems
- Examine the importance of exploration and exploitation swarm intelligent system to attain near global optimal solution
- Distinguish the functioning of various swarm intelligent systems
- Employ various bio-inspired algorithms for Power systems engineering applications

UNIT I  FUNDAMENTALS OF SOFT COMPUTING TECHNIQUES  

UNIT II  GENETIC ALGORITHM AND PARTICLE SWARM OPTIMIZATION  
Genetic algorithms - Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators - different types of crossover and mutation operators - Bird flocking and Fish Schooling – anatomy of a particle - equations based on velocity and positions - PSO topologies - control parameters – GA and PSO algorithms for solving ELD problem.

UNIT III  ANT COLONY OPTIMIZATION and ARTIFICIAL BEE COLONY ALGORITHMS  
Biological ant colony system - Artificial ants and assumptions - Stigmergic communications - Pheromone updating - local-global - Pheromone evaporation - ant colony system- ACO Models - Touring ant colony system -max min ant system - Concept of elistic Ants - Task partitioning in honey bees - Balancing foragers and receivers - Artificial bee colony (ABC) algorithms - binary ABC algorithms – ACO and ABC algorithms for solving Economic Dispatch of thermal units.

UNIT IV  SHUFFLED FROG-LEAPING ALGORITHM and BAT OPTIMIZATION ALGORITHM 

UNIT V  MULTI OBJECTIVE OPTIMIZATION  
Multi-Objective Optimization Introduction - Concept of Pareto optimality - Non-dominant sorting Technique - Pareto fronts-best compromise solution solution - min-max method-NSGA-II algorithm and applications to power systems.

COURSE OUTCOMES:

Students able to

CO1 understand the capabilities of bio-inspired system and conventional methods in solving optimization problems

TOTAL: 45 PERIODS
CO2 implement the genetic algorithm and particle swarm optimization technique to solve the ED problems

CO3 understand and implement the ant colony algorithm and artificial bee colony algorithms to PS problems

CO4 implement the shuffled frog-leaping algorithm and bat optimization algorithm for solving ELD and optimal placement and sizing of the DG problem

CO5 understand and implement the multi-objective optimization techniques to implement in power system problems

REFERENCES:
1. Xin-She Yang, “Recent Advances in Swarm Intelligence and Evolutionary Computation”, Springer International Publishing, Switzerland, 2015.

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UNIT I  INTRODUCTION  

UNIT II  LINEAR QUADRATIC TRACKING PROBLEMS AND NUMERICAL TECHNIQUES FOR OPTIMAL CONTROL  

UNIT III  MODEL DECOMPOSITION AND CONVOLUTIONAL NEURAL NETWORK  
CNN Classification, CNN Algorithm ,model decomposition techniques, application of model decomposition and CNN based techniques for various power system fault digonesis problems, model predictive controllers for power system for power system stabilizers

UNIT IV  FILTERING AND ESTIMATION  

UNIT V  KALMAN FILTER  
Filter problem and properties – Linear estimator property of Kalman Filter – Time invariance and asymptotic stability of filters – Time filtered estimates and signal to noise ratio improvement – Extended Kalman filter , Application of Kalman filter for power system protection applications

TOTAL : 45 PERIODS

COURSE OUTCOMES: 
Ability to:
CO1: Understand the concept of Optim Optimization Technique for power system.
CO2: Identify, Formulate and measure the performance of Optimal Controllers for power system.
CO3: Understand the Linear Quadratic Tracking Problems and implement dynamic programming application for discrete and continuous systems.
CO4: Apply Filtering and Estimation techniques for power system applications.
CO5: Design Kalman filter for power system protection application

REFERENCES: 
1. Ajith Abraham and Swagatham Das.,"Computaional Intelligence in Power Engineering", 2010 Springer Verlag.
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ET4251  
IoT FOR SMART SYSTEMS

COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I  INTRODUCTION TO INTERNET OF THINGS
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II  IOT ARCHITECTURE

UNIT III  PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT
PROTOCOLS:
NFC, SCADA and RFID, Zigbee  MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe  GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.
UNIT IV       IOT PROCESSORS

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.

Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPERRY PI and Arduino.

UNIT V      CASE STUDIES

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

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REFERENCES:
PS4092 RENEWABLE ENERGY AND GRID INTEGRATION

COURSE OBJECTIVES:

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

UNIT I INTRODUCTION

Introduction to renewable energy systems, environmental aspects of electric energy conversion, impacts of renewable energy penetration to grid. Grid Codes in India and other countries. Basic power electronic converters for renewable energy integration to grid-Qualitative analysis -Boost and buck-boost converters, three phase AC voltage controllers- AC-DC-AC converters, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT II PHOTO VOLTAIC ENERGY CONVERSION SYSTEMS

Introduction, Photo Voltaic (PV) effect, Solar Cell, Types, Equivalent circuit of PV cell, PV cell characteristics (I/V and P/V) for variation of insolation, temperature and shading effect, Stand-alone PV system, Grid connected PV system, Design of PV system-load calculation, array sizing, selection of converter/inverter, battery sizing.

UNIT III WIND ENERGY CONVERSION SYSTEMS

Introduction, Power contained in wind, Efficiency limit in wind, types of wind turbines, Wind control strategies, Power curve and Operating area, Types of wind generators system based on Electrical machines-Induction Generator and Permanent Magnet Synchronous Generator (PMSG), Grid Connected-Single and Double output system, Self-excited operation of Induction Generator and Variable Speed PMSG.

UNIT IV MPPT TECHNIQUES IN SOLAR AND WIND SYSTEMS

Case studies of PV-Maximum Power Point Tracking (MPPT) and Wind Energy system
UNIT V HYBRID STORAGE SYSTEMS AND GRID MANAGEMENT

Energy Storage systems, Need for Hybrid Systems, Features of Hybrid Systems, Range and types of Hybrid systems (Wind-Diesel, PV-Diesel and Wind-PV).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1 Relate the power generation of different renewable energy sources to grid impact and grid codes
CO2 Explain the design principles of solar energy management systems
CO3 Understand the power conversion system of wind generators
CO4 Analyze the different Maximum Power Point tracking Techniques
CO5 Build grid connected and stand alone renewable energy management system

REFERENCES:
5. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995

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COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT I   INTRODUCTION TO SMART GRID  
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II  SMART GRID TECHNOLOGIES  
Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III  SMART METERS AND ADVANCED METERING INFRASTRUCTURE  
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV  POWER QUALITY MANAGEMENT IN SMART GRID  

Unit V   HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS  
Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME:
Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications

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PS4004 ELECTRICAL POWER DISTRIBUTION SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:
- To detail the function of electric power distribution network.
- To derive the voltage profile enhancement and protection schemes.
- To evaluate the reliability of the electrical distribution system.
- To detail the automation schemes in various sections like substation, feeder, etc.,
- To derive the strategies for distribution system expansion.
- To acquire wide knowledge in distribution system operation, protection, control and expansion planning of distribution system architecture

UNIT I DISTRIBUTION SYSTEMS
Distribution systems: Types of distribution systems - Section and size of feeders – Primary and secondary distribution – Distribution substations – Effect of working voltage on the size of feeders and
distributors – Effect of system voltage on economy – Voltage drop and efficiency of transmission - Qualitative treatment of rural distribution and industrial distribution.

UNIT II  CONTROL AND PROTECTION
Voltage control: Application of shunt capacitance for loss reduction – Harmonics in the system – Static VAR systems – Voltage profile enhancement schemes.
System protection: Fuses and section analyzers - Over current protection - Under voltage and under frequency protection – Coordination of protective device.

UNIT III  RELIABILITY ANALYSIS
Primary and secondary system design considerations - Primary circuit configurations - Primary feeder loading - Secondary networks design- Economic design - Unbalance loads and voltage considerations.

UNIT VI  DISTRIBUTION AUTOMATION

UNIT V  EXPANSION PLANNING

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1: Obtain fundamental knowledge in electric power distribution system.
CO2: Be proficient in control and protection schemes for distribution systems.
CO3: Gain familiarity to evaluate reliability of distribution systems.
CO4: Demonstrate the methodologies for distribution automation.
CO5: Able to develop strategies for expanding the existing distribution systems.

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**PS4005 WIND AND SOLAR ENERGY SYSTEMS**

**OBJECTIVES:**
- To study the concepts of wind energy system
- To understand the new developments in solar energy system
- To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve wind and solar energy problems

**UNIT I WIND ENERGY CONVERSION**
Wind resources – Nature and occurrence of wind – Power in the wind – Wind characteristics – Principles of wind energy conversions – Components of wind energy conversion system (WECS) – Classification of WECS – Advantages and disadvantages of WECS.

**UNIT II WIND ELECTRIC GENERATORS**

**UNIT III PHOTO VOLTAIC MODELS**
Solar cells and panels – Structure of PV cells – Semiconductor materials for PV cells – I-V characteristics of PV systems – PV models and equivalent circuits- Effects of irradiance and temperature on PV characteristics.

**UNIT IV PHOTO VOLTAIC ENERGY CONVERSION SYSTEM**
Basic photo voltaic system for power generation – Advantages and disadvantages of photo voltaic solar energy conversion –Application of solar photo voltaic system – Components of PV systems- Design of PV systems- Power conditioning and storage arrangement – Maximum power point tracking (MPPT) - Introduction to string inverters.
UNIT V     RECENT ADVANCEMENTS IN WIND AND PV SYSTEMS

Wind farms and grid connections – Grid related problems on absorption of wind – Grid interfacing arrangement – Operation, control and technical issues of wind generated electrical energy – Interconnected operation – Hybrid systems.

Recent Advances in PV Applications: Building Integrated PV systems, Grid Connected PV systems, Hybrid systems, Solar cars, Solar energy storage system and their economic aspects.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of this course, the students will be able to

CO1: Understand the basics of wind energy conversion systems & solar energy conversion systems.

CO2: Implement the appropriate power extraction techniques.

CO3: Apply power electronics to the renewable energy systems.

CO4: Understand the grid integration techniques, and power quality issues.

CO5: Apply the technology & techniques in variety of applications.

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COURSE OBJECTIVES:

- To familiarize with the concept of Distributed Generation
- To expose the various distributed energy resources
- To focus on the planning and protection of Distributed Generation
- To study the concept of MicroGrid and to analyze the impact of MicroGrid
- To understand the major issues on MicroGrid economics

UNIT I  INTRODUCTION TO DISTRIBUTED GENERATION  9
DG definition - Reasons for distributed generation-Benefits of integration - Distributed generation and the distribution system - Technical, Environmental and Economic impacts of distributed generation on the distribution system - Impact of distributed generation on the transmission system-Impact of distributed generation on central generation

UNIT II  DISTRIBUTED ENERGY RESOURCES  9
Combined heat and power (CHP) systems-Wind energy conversion systems (WECS)- Solar photovoltaic (PV) systems-Small-scale hydroelectric power generation-Other renewable energy sources-Storage devices-Inverter interfaces

UNIT III  DG PLANNING AND PROTECTION  9
Generation capacity adequacy in conventional thermal generation systems-Impact of distributed generation-Impact of distributed generation on network design-Protection of distributed generation- Protection of the generation equipment from internal Faults-Protection of the faulted distribution network from fault currents supplied by the distributed generator-Impact of distributed generation on existing distribution system protection.

UNIT IV  CONCEPT OF MICROGRID  9

UNIT V  IMPACTS OF MICROGRID  9
Microgrid economics-Main issues of Microgrid economics-Microgrids and traditional power system economics-Emerging economic issues in Microgrids-Economic issues between Microgrids and bulk power systems-Potential benefits of Microgrid economics.

TOTAL: 45 PERIODS
COURSE OUTCOMES:

Students able to

CO1: Understand the concepts of Distributed Generation and Microgrids.
CO2: Gain Knowledge about the various DG resources.
CO3: Familiarize with the planning and protection schemes of Distributed Generation.
CO4: Learn the concept of Microgrid and its mode of operation.
CO5: Acquire knowledge on the impacts of Microgrid.

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COURSE OBJECTIVES:

- To understand the various types of energy storage Technologies
  - To analyze thermal storage system
  - To analyze different battery storage technologies
  - To analyze the thermodynamics of Fuel Cell
  - To study the various applications of energy storage systems

UNIT I  INTRODUCTION

Necessity of energy storage – types of energy storage – energy storage technologies – Applications.

UNIT II  THERMAL STORAGE SYSTEM

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – Pressurized water storage system – Modelling of phase change storage system – Simple units, Packed bed storage units - Modelling using porous medium approach,

UNIT III  ELECTRICAL ENERGY STORAGE

Fundamental concept of batteries – Measuring of battery performance, charging and discharging of a battery, storage density, energy density, and safety issues - Types of batteries: – Lead Acid, Nickel-Cadmium, Zinc-Manganese dioxide - Mathematical Modelling for Lead Acid Batteries - Flow Batteries

UNIT IV  FUEL CELL


UNIT V  ALTERNATE ENERGY STORAGE TECHNOLOGIES

Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the physics of energy storage

CO2: Model the different energy technologies.

CO3: Recognize the applications of various techniques.

CO4: Design and analyze the energy storage technologies.

CO5: Select and apply the appropriate technique based on the application.

REFERENCES

3. Jiujun Zhang (Editor), Lei Zhang (Editor), Hansan Liu (Editor), Andy Sun (Editor), Ru-Shi Liu (Editor), “Electrochemical technologies for energy storage and conversion”, Two Volume Set, Wiley publications, 2012

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OBJECTIVES:
- To provide knowledge about various power quality issues.
- To understand the concept of power and power factor in single phase and three phase systems supplying nonlinear loads.
- To equip with required skills to design conventional compensation techniques for power factor correction and load voltage regulation.
- To introduce the control techniques for the active compensation.
- To understand the mitigation techniques using custom power devices such as DSTATCOM, DVR & UPQC

UNIT I INTRODUCTION

Introduction - Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves - power quality problems: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage - Power quality standards.
UNIT II  ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM  9

Single phase linear and non-linear loads - single phase sinusoidal, non-sinusoidal source - supplying linear and nonlinear loads - three phase balanced system - three phase unbalanced system - three phase unbalanced and distorted source supplying non-linear loads - concept of power factor - three phase- three wire - three phase - four wire system.

UNIT III  CONVENTIONAL LOAD COMPENSATION METHODS  9


UNIT IV  LOAD COMPENSATION USING DSTATCOM  9

Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced –Realization and control of DSTATCOM – DSTATCOM in Voltage control mode

UNIT V  SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM  9


TOTAL : 45 PERIODS

OUTCOMES:
After completing the above course, students will be able to
CO1: comprehend the consequences of Power Quality issues.
CO2: conduct harmonic analysis of single phase and three phase systems supplying non-linear loads.
CO3: design passive filter for load compensation.
CO4: design active filters for load compensation.
CO5: understand the mitigation techniques using custom power devices such as distribution static compensator (DSTATCOM), dynamic voltage restorer (DVR) & UPQC.

TEXTBOOKS:

REFERENCES:
COURSE OBJECTIVES:
The course is aimed at
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text,
Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

**COURSE OUTCOMES (CO):**

At the end of the course the student will be able to

CO1: Illustrate the categorization of machine learning algorithms.

CO2: Compare and contrast the types of neural network architectures, activation functions

CO3: Acquaint with the pattern association using neural networks

CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks

CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

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**REFERENCES:**


COURSE OBJECTIVES:

- To introduce the basic concepts of reliability engineering
- To understand hierarchical levels in power system reliability assessment
- To study the formation of system model
- To learn the importance of reliability indices in power system planning, expansion, operation and control

UNIT I  INTRODUCTION  

UNIT II  GENERATING CAPACITY: BASIC PROBABILITY METHODS  

UNIT III  GENERATING CAPACITY: FREQUENCY AND DURATION METHOD  

UNIT VI  COMPOSITE GENERATION AND TRANSMISSION SYSTEM  

UNIT V  DISTRIBUTION SYSTEM  

COURSE OUTCOMES:

Students able to
CO1: Acquire design knowledge of system components in reliability point of view.
CO2: Understand the importance of customer oriented and system oriented indices.
CO3: Familiarize with reliability evaluation methodologies.
CO4: Analyse the system performance with proper remedial strategies.
CO5: Enrich the capability of analysing reliability design alternatives in engineering systems.

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PS4007 EHV AC TRANSMISSION LT P C 3 0 0 3

COURSEOBJECTIVES:
- To understand power system structure and line configurations
- To compute line parameters and understand effect of ground return
- To analyse voltage gradients of transmission line conductors.
- To compute electrostatic field and design of EHV AC
- To design and know basic concepts of HVDC lines.

UNIT I INTRODUCTION 9
Standard transmission voltages-AC and DC – different line configurations– average values of line parameters – power handling capacity and line loss – costs of transmission lines and equipment – mechanical considerations in line performance

UNIT II CALCULATION OF LINE PARAMETERS 9
Calculation of resistance, inductance and capacitance for multi-conductor lines – calculation of sequence inductances and capacitances – line parameters for different modes of propagation – effect of ground return
UNIT III VOLTAGE GRADIENTS OF CONDUCTORS
Charge-potential relations for multi-conductor lines – surface voltage gradient on conductors – gradient factors and their use – distribution of voltage gradient on sub conductors of bundle - voltage gradients on conductors in the presence of ground wires on towers-I^2R loss and corona loss-RIV

UNIT IV ELECTROSTATIC FIELD AND DESIGN OF EHV LINES
Effect of EHV line on heavy vehicles - calculation of electrostatic field of AC lines- effect of high field on humans, animals, and plants - measurement of electrostatic fields - electrostatic Induction in energised circuit of a D/C line - induced voltages in insulated ground wires - electromagnetic interference, Design of EHV lines

UNIT V HVDC LINES
Introduction- Reliability and failure issues-Design-tower, ROW, clearances, insulators, electrical and mechanical protection-Maintenance-Control and protection-D.C Electric field and Magnetic field -Regulations and guide lines-under ground line design.

TOTAL : 45 PERIODS

COURSEOUTCOMES:
CO1: Ability to analyse the identify voltage level and line configurations
CO2: Ability to model EHV AC and HVDC lines
CO3: Ability to compute voltage gradients of transmission line conductors
CO4: Ability to analyze the effects of electrostatic field on living and nonliving organisms
CO5: Ability to analyze the design, control and protection aspects of HVDC lines.

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PS4008  ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN LT P C SYSTEM DESIGN 3 0 0 3

COURSE OBJECTIVES:
1. To provide fundamental knowledge on electromagnetic interference and electromagnetic compatibility.
2. To know about the importance of Grounding and shielding.
3. To study the important techniques to control EMI and EMC.
4. To expose the knowledge on testing techniques as per Indian and international standards in EMI measurement.

UNIT I  INTRODUCTION
Definitions of EMI/EMC – Sources of EMI- Inter systems and Intra system- Conducted and radiated interference- Characteristics – Designing for electromagnetic compatibility (EMC)- EMC regulation- Typical noise path- EMI predictions and modeling, Methods of eliminating interferences and noise mitigation

UNIT II  GROUNDING AND CABLING
Cabling- types of cables, mechanism of EMI emission / coupling in cables –capacitive coupling, inductive coupling- shielding to prevent magnetic radiation- shield transfer impedance, Grounding – safety grounds – signal grounds- single point and multipoint ground systems – hybrid grounds-functional ground layout – grounding of cable shields- guard shields- isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding- Earth measurement Methods

UNIT III  BALANCING, FILTERING AND SHIELDING
Power supply decoupling- decoupling filters-amplifier filtering – high frequency filtering- EMI filters characteristics of LPF, HPF, BPF, BEF and power line filter design – Choice of capacitors, inductors, transformers and resistors, EMC design components – shielding – near and far fields shielding effectiveness- absorption and reflection loss- magnetic materials as a shield, shield discontinuities, slots and holes, seams and joints, conductive gaskets-windows and coatings – grounding of shields
UNIT IV  EMI IN ELEMENTS AND CIRCUITS
Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive
inter modulation, transients in power supply lines, EMI from power electronic equipment, EMI as
combination of radiation and conduction

UNIT V  ELECTROSTATIC DISCHARGE, STANDARDS AND TESTING TECHNIQUES
Static Generation- human body model- static discharges- ESD versus EMC, ESD protection in
equipment- standards – FCC requirements – EMI measurements – Open area test site measurements
and precautions- Radiated and conducted interference measurements, Control requirements and
testing methods

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1 Ability to understand the types and sources of EMI.
CO2 Ability to understand the needs of rounding and cabling.
CO3 Ability to understand the design concept of filtering and shielding.
CO4 Ability to study the effect of EMI in elements and circuits.
CO5 Ability to know about the effects of electrostatic discharge and testing techniques.

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REFERENCES
street, Norwood, MA 02062 USA) 1987.
and sons, USA 1976.
Students will be able to:
- To impart knowledge on Motor Starting Studies.
- To understand the need for power factor correction and analyse the various methods that are used in the Power Factor Correction studies.
- To learn about the sources of harmonics, evaluate the harmonics present in the power system and mitigate them by filters.
- To analyse the sources that can cause the voltage flicker and find solutions to minimize the flicker.
- To impart knowledge on the ground grid analysis.

UNIT I  MOTOR STARTING STUDIES

UNIT II  POWER FACTOR CORRECTION STUDIES

UNIT III  HARMONIC ANALYSIS

UNIT IV  FLICKER ANALYSIS
Sources of Flicker-Flicker Criteria-Data for Flicker analysis- Case Study-Arc Furnace Load-Minimizing the Flicker Effects-Summary.

UNIT V  GROUND GRID ANALYSIS

TOTAL: 45 PERIODS

Students will be able to:
CO1: perform motor starting studies.
CO2: To model and carry out power factor correction studies.
CO3: Perform harmonic analysis and reduce the harmonics by using filters.
CO4: Carry out the flicker analysis by proper modeling of the load and its minimization.
CO5: Design the appropriate ground grid for electrical safety.
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PS4010 ADVANCED POWER SYSTEM DYNAMICS LT P C 3 0 0 3

COURSE OBJECTIVES

- To perform transient stability analysis using unified algorithm.
- To impart knowledge on sub-synchronous resonance and oscillations.
- To analyze voltage stability problem in power system.
- To familiarize the methods of transient stability enhancement.

UNIT I SUBSYNCHRONOUS RESONANCE (SSR) AND OSCILLATIONS


UNIT II TRANSMISSION, GENERATION AND LOAD ASPECTS OF VOLTAGE STABILITY ANALYSIS

UNIT III  SMALL SIGNAL STABILITY ANALYSIS AND ENHANCEMENT  
Multi machine small signal stability analysis - Effects of Excitation System - Power System Stabilizer:
Block diagram with AVR and PSS, Illustration of principle of PSS application with numerical example,
Block diagram of PSS with description, system state matrix including PSS, analysis of stability with
numerical example. Multi-Machine Configuration: Equations in a common reference frame, equations
in individual machine rotor coordinates, illustration of formation of system state matrix with classical
model and variable voltage behind transient reactant model of synchronous machines, illustration of
stability analysis using a numerical example. Principle behind small-signal stability improvement
methods: delta-omega and delta P-omega stabilizers.

UNIT IV  UNIFIED ALGORITHM FOR DYNAMIC ANALYSIS OF POWERSYSTEMS  
Need for unified algorithm- numerical integration algorithmic steps-truncation error- variable step size
– handling the discontinuities- numerical stability- application of the algorithm for transient. Mid-term
and long-term stability simulations.

UNIT V  INSTABILITY MECHANISM AND COUNTER MEASURES  
Types of Counter measures – Classification of Instability Mechanisms – Examples of Short term
Voltage Instability- Counter measures to Short – term Instability – Case studies of Long Term voltage
Instability – Corrective Actions against Long-term Instability.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Students will be able to:
CO1: Understand the concepts behind sub-synchronous resonance and detect the SSR by suitable
modeling
CO2: Analyze the effect of generation and transmission and load dynamics on voltage stability.
CO3: Analyze the effect of load dynamics on power system voltage stability.
CO3: analyze and enhance small signal stability of the power system.
CO4: Analyze the short-term and long-term stability of the power system using unified stability
algorithm.
CO5: study and analyze the various instability mechanisms of voltage stability.

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REFERENCES
Limited, New Delhi,2009

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ET4073 PYTHON PROGRAMMING FOR MACHINE LEARNING

COURSE OBJECTIVES:
1. Students will understand and be able to use the basic programming principles such as data types, variable, conditionals, loops, recursion and function calls.
2. Students will learn how to use basic data structures such as List, Dictionary and be able to manipulate text files and images.
3. To make the students familiar with machine learning concepts & techniques.
4. Students will understand the process and will acquire skills necessary to effectively attempt a machine learning problem and implement it using Python.
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved research/employability skills

UNIT I INTRODUCTION TO MACHINE LEARNING AND PYTHON
Introduction to Python and its significance – Difference between C, C++ and Python Languages; Compiler and Interpreters – Python3 Installation & Running – Basics of Python Programming Syntax: Variable Types, Basic Operators, Reading Input from User – Arrays/List, Dictionary and Set – Conditional Statements – Control Flow and loop control statements

UNIT II PYTHON FUNCTIONS AND PACKAGES

UNIT III IMPLEMENTATION OF MACHINE LEARNING USING PYTHON
UNIT IV  CLASSIFICATION AND CLUSTERING CONCEPTS OF ML  9
Types of Clustering Algorithms & Techniques – K-means Algorithm, Mean Shift Algorithm & Hierarchical Clustering Algorithm – Introduction to Python Visualization using Matplotlib: Plotting 2-dimensional, 3-dimensional graphs; formatting axis values; plotting multiple rows of data in same graph – Implementation of K-means Algorithm and Mean Shift Algorithm using Python

UNIT V  INTRODUCTION TO NEURAL NETWORKS AND EMBEDDED MACHINE LEARNING 9

TOTAL: 45 PERIODS

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

CO1: Develop skill in system administration and network programming by learning Python.
CO2: Demonstrating understanding in concepts of Machine Learning and its implementation using Python
CO3: Relate to use Python’s highly powerful processing capabilities for primitives, modelling etc
CO4: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.
CO5: Apply the concepts acquired over the advanced research/employability skills

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REFERENCES:
1. Mark Lutz,”LearningPython,Powerful OOPs,O’reilly,2011

PS4011 COMPUTER RELAYING AND WIDE AREA MEASUREMENT SYSTEMS  L T P C
3 0 0 3

COURSE OBJECTIVES:
The goal of this course is

1. To discriminate conventional relays and computer relays
2. To comprehend the operating values of a computer relay
3. To provide exposure to wide area measurement systems through the computer hierarchy in the substation, system relaying and control
4. To inculcate knowledge on phasor measurement unit and its application to power system
5. To enhance the conventional power system studies with wide area measurement techniques

UNIT I INTRODUCTION 9
Historical background - Expected benefits - Computer relay architecture - Analog to digital converters - Anti-aliasing filters - Substation computer hierarchy - Fourier series Exponential fourier series - Sine and cosine fourier series – Phasor.

UNIT II FILTERS IN COMPUTER RELAYING 9

UNIT III COMPUTATION OF PHASORS 9
Introduction - Phasor representation of sinusoids - Fourier series and Fourier transform and DFT Phasor representation - Phasor Estimation of Nominal Frequency Signals - Formulas for updating phasors – Non-recursive updates - Recursive updates - Frequency Estimation.

UNIT IV PHASOR MEASUREMENT UNITS 9
A generic PMU - The global positioning system - Hierarchy for phasor measurement systems - Functional requirements of PMUs and PDCs - Transient Response of: Phasor Measurement Units, of instrument transformers, filters. Transient response during electromagnetic transients and power swings.
UNIT V PHASOR MEASUREMENT APPLICATIONS


TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students able to

- CO1 Demonstrate knowledge of fundamental theories, principles and practice of computer relaying, Wide area measurement system
- CO2 Analyze the power system with computer relaying and Wide area measurement system
- CO3 Validate the recent relaying technologies which work towards smart grid
- CO4 Design wide area measurement systems for Smart grid.
- CO5 Compare the performance of modern relaying schemes and measurement techniques with the conventional one.

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COURSE OBJECTIVES:
- To expose the students to learn about DFT and Wavelet transforms.
- To provide an in-depth knowledge on the components used for the implementation of digital protection.
- To impart knowledge on different algorithms for digital protection of power system components.
- To implement digital protection for transformer.
- To understand different decision making methodologies in protective relays.

UNIT I  DIGITAL SIGNAL PROCESSING TECHNIQUES  9

UNIT II  DIGITAL PROTECTION               9

UNIT III  ALGORITHMIC TECHNIQUES              9
Finite difference techniques- Interpolation-Numerical differentiation-curve fitting and smoothing. Sinusoidal wave based algorithms -First and second derivative method -two and three sample technique .Walsh function analysis- least squares based methods-differential equation based techniques -Travelling wave protective schemes.FIR based algorithms-Least square curve fitting algorithm.

UNIT IV  DIGITAL PROTECTION TECHNIQUES             9

UNIT V  DIGITAL PROTECTIVE RELAYS              9

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: The students will be able to apply DSP techniques for digital protection.
CO2: The students will be capable of decision making algorithm suitable for digital relaying applications.
CO3: The students will be able to employ FIR based algorithms for digital relaying.
CO4: The students will be able to do transformer protection using digital techniques.
CO5: The students will be able to perform coordinated operation of relays for specific purposes.
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PS4013 POWER SYSTEM INSTRUMENTATION

COURSE OBJECTIVES:

- To use the processors in the process and their relative merits to be brought out.
- To explain the algorithms used in the investigation procedure and error analysis.
- To offer an opportunity to innovate newer procedures and better methods for effective design of instrumentation systems for power networks.
- To provide the knowledge on various controls and measurements involved in power plant
- To import knowledge on distribution automation and substation controls

UNIT I MEASUREMENTS AND SCADA SYSTEMS

Measurement and error analysis. Object and philosophy of power system instrumentation to measure large currents, high voltages, Torque and Speed - Standard specifications - Data acquisition systems for Power System applications - Data Transmission and Telemetry - PLC equipment - computer control of power system - Man Machine Interface.
UNIT II  POWER PLANT INSTRUMENTATION  9
Piping and Instrumentation diagram of thermal and nuclear power plants - Fuel measurement – gas
analysis meters - smoke measurement - Monitoring systems – measurement and control of furnace
draft – measurement and control of combustion – Turbine monitoring and control: speed, vibration,
shell temperature monitoring – radiation detection instruments – process sensors for nuclear power
plants – spectrum analyzers – nuclear reactor control systems and allied instrumentation.

UNIT III  DISTRIBUTION AUTOMATION  9
Definitions – automation switching control – management information systems (MIS) – remote terminal
units – communication method for data transfer – consumer information service (CIS) – graphical
information systems (GIS) - automatic meter reading (AMR) – Remote control load management.

UNIT VI  SUBSTATION INSTRUMENTATION  9
Sub-station automation – requirements – control aspects in substations – feeder automation –
consumer side automation – reliability - GPIB programmable test instruments - microprocessor /
 microcontroller based GPIB controllers

UNIT V  ENERGY MANAGEMENT TECHNIQUES AND INSTRUMENTS  9
Demand side management (DSM) – DSM planning – DSM Techniques – Load management as a DSM
strategy – energy conservation – tariff options for DSM - Energy audit – instruments for energy audit –
Energy audit for generation, distribution and utilization systems – economic analysis.

COURSE OUTCOMES:
Students able to
CO1: understand the basics of instrumentation and SCADA system implementation in PS
CO2: understand and implement the controls involved in power plant instrumentation
CO3: understand the functioning of distribution automation in power system network
CO4: understand concepts of substation automation and to implement the controls
CO5: analyse the energy management techniques and energy audit

REFERENCES:
2. Sherry A., Modern Power Station Practice, Vol.6 (Instrumentation, controls and Testing),

TOTAL: 45 PERIODS
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PS4014  HIGH VOLTAGE TECHNOLOGY LT P C 3 0 0 3

COURSE OBJECTIVES
- To provide strong knowledge on different types of electrical stresses on power system and equipment
- To impart knowledge on generation of high AC and DC voltages
- To provide adequate knowledge to simulate and generate impulse voltages and impulse currents
- To expose the different techniques of measuring High voltages and high currents
- To provide awareness on electro-static hazards and safety measures

UNIT I   GENERATION OF DIRECT VOLTAGES 9

UNIT II  GENERATION OF ALTERNATING VOLTAGE 9

UNIT III  GENERATION OF IMPULSE VOLTAGES AND CURRENTS 9
Impulse voltage, general shape and definition of lightning impulses, generator circuit – Marx generator – analysis of various impulse voltage generator circuits, controlled switching – multistage impulse generator circuits – Switching impulse generator circuits – Generation of impulse currents, generation of non-standard impulse voltages and very fast transient voltage (VFTO)- Relevant IS and IEC Standards

UNIT IV    MEASUREMENT OF HIGH VOLTAGES 9
Measurement of high AC, DC Impulse voltages - Peak voltage measurements by sphere gaps – Electrostatic voltmeter – generating voltmeters and field sensors – Chubb-Fortescue method – voltage
dividers, types, dynamic response and impulse voltage measurements- Relevant IS and IEC Standards, measurement of high DC, AC and impulse currents – shunts, measurement using magnetic potentiometers and magnetic coupling - Fast digital transient recorders for impulse measurements

UNIT V SAFETY AND ELECTROSTATIC HAZARDS 9

TOTAL : 45 PERIODS

COURSEOUTCOMES:
CO1: Ability to design, simulate and generate HVDC
CO2: Ability to design, simulate and generate HVAC
CO3: Ability to design, simulate and generate impulse voltage and current
CO4: Ability to design and analyze the suitable measuring circuits for HV
CO5: Ability to provide safety measures against electrostatic hazards

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REFERENCES
5. Indian Electricity Rules; IS-5216; Electrical Safety Handbook by John Cadick
OBJECTIVES:
- To understand the concept of electric vehicles and its operations
- To present an overview of Electric Vehicle (EV), Hybrid Electric vehicle (HEV) and their architecture
- To understand the need for energy storage in hybrid vehicles
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS 12
Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT II ARCHITECTURE OF EV’s AND POWER TRAIN COMPONENTS 12
Architecture of EV’s and HEV’s – Plug-n Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT III POWER ELECTRONICS AND MOTOR DRIVES 12

UNIT IV BATTERY ENERGY STORAGE SYSTEM 12
Battery Basics- Different types- Battery Parameters-Battery life & safety impacts -Battery modeling-Design of battery for large vehicles.

UNIT V ALTERNATIVE ENERGY STORAGE SYSTEMS 12
Introduction to fuel cell – Types, Operation and characteristics- proton exchange membrane (PEM) fuel cell for E-mobility– hydrogen storage systems –Super capacitors for transportation applications.

TOTAL : 60 PERIODS

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

CO1: Understand the concept of electric vehicle and energy storage systems.
CO2: Describe the working and components of Electric Vehicle and Hybrid Electric Vehicle
CO3: Know the principles of power converters and electrical drives
CO4: Illustrate the operation of storage systems such as battery and super capacitors
CO5: Analyze the various energy storage systems based on fuel cells and hydrogen storage
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PS4071 ENERGY MANAGEMENT AND AUDITING LT P C 3 0 0 3

OBJECTIVES:
- To study the concepts behind economic analysis and load management
- To emphasize the energy management of various electrical equipment and metering
- To illustrate the concept of energy management technologies

UNIT I ENERGY SCENARIO 9

UNIT II ENERGY COST AND LOAD MANAGEMENT 9
Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- Cost of electricity-Loss evaluation- Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification.
UNIT III       ENERGY MANAGEMENT  
Demand side management (DSM)– DSM planning – DSM techniques – Load management as a DSM strategy – Energy conservation – Tariff options for DSM.

UNIT IV       ENERGY AUDITING  

UNIT V       ENERGY EFFICIENT TECHNOLOGIES  
Energy saving opportunities in electric motors - Power factor improvement benefit and techniques- Shunt capacitor, Synchronous Condenserand Phase Advancer - Energy conservation in industrial drives, electric furnaces, ovens and boilers - Lighting techniques: Natural,CFL, LED lighting sources and fittings.

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of this course, the students will be able to
CO1: Understand the present energy scenario and role of energy managers.
CO2: Comprehend the Economic Models for cost and load management.
CO3: Configure the Demand side energy management through its control techniques, strategy and planning.
CO4: Understand the process of energy auditing.
CO5: Implement energy conservation aspects in industries.

REFERENCES
OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I         INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II  PRESENTATION SKILLS 6

UNIT III           TITLE WRITING SKILLS 6
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, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV          RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V          VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES

AX4092 DISASTER MANAGEMENT LT P C 2 0 0 0

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6
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 6

UNIT III DISASTER PRONE AREAS IN INDIA 6
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 6
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

TOTAL : 30 PERIODS

OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES

AX4093 CONSTITUTION OF INDIA L T P C

OBJECTIVES
Students will be able 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 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.

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 AND 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, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

UNIT VI ELECTION COMMISSION
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES
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.

SUGGESTED READING
1. The Constitution of India, 1950(Bare Act), Government Publication.
UNIT I

1. குறிப்பிட்டியப் பைட்டர்ஸ்
   - நூற்றாண்டு, நூற்றாண்டு, பாதை

2. அறிவியல் (82)
   - தொப்பக்கைலிட்டுக்காமை

3. தின்கணிப்பாட்டுத் தொகுப்பு

4. புத்தாண்டு (95,195)
   - கையேற்றுப்பாட்டுச் சுருக்கம்

UNIT II

1. அறிவியல் (82)
   - அமைப்புபின்னணியான, அறுப்பாலம், தின்கணிப்பு, கைத், பகுதி

2. பிரபலக்கையின் தின்கணிப்பு
   - குருதி, சிற்பக்கையம், பிரிக்கப்பட்டு, அருங்காட்சியான
     (கையேற்றுப்பாட்டுச் சுருக்கம்)

UNIT III

1. குறிப்பிட்டியப் பைட்டர்ஸ்
   - சிற்பப்பின்னணியான கைத்

2. தின்கணிப்பாட்டுச் சுருக்கம்
UNIT IV

அம்பாதையின்

1. கிருத்தகையம்
   - பரிமாற்றுகையில் கையெடுப்பு
   - பல்கலைக்கழகத் பரிமாற்றங்கள்
   - கையெடுப்புக்கு உறுதியான கையெடுப்பு

2. தொகைநிலை
   - அதன்காலத் பேச்சுக் கலை

3. கிருத்தகையம் (617, 618)
   - தமிழில் பொருளாதார

4. கும்பாகவளாயத் பொருளாதார

5. புத்தகாசா
   - குறிப்பிட்டுக்காட்டுகள்

6. தொகைநிலை (4)

UNIT V

நிலாகத்துறைத் தகவல்

1. வளைநாட்டுகையில்
   - தமிழில் பொருளாதார
   - தமிழில் பொருளாதார
   - குறிப்பிட்டுக்காட்டுகளையே கையெடுப்பு
- பயணிலக்கியம்,
- நாடகம்,
2. பயணிலக்கியம்/நாடகம்,
3. செல்லத்திலக்கியம்,
4. பயணிலக்கியம்/நாடகம்/செல்லத்திலக்கியம்,
5. அறிவியல்,
6. தளச்சிலக்கியம்,
7. காத்திக்கியம்/பத்தகக்

தளச்சிலக்கியம்/பத்தகக்

1. தளச்சிலக்கியம்/பத்தகக் (Tamil Virtual University)
   - www.tamilvu.org
2. தளச்சில்கைழா (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. தளச்சில்கைழா (Tamil Encyclopedia)
4. வாழ்கைழா (Tamil Encyclopedia)
   - தளச்சில்கைழா, தக்காலம்
5. தளச்சில்கைழா (Tamil Encyclopedia)
   - தளச்சில்கைழா (thamilvalarchithurai.com)
6. அறிவியல்/சதுரம்
   - தளச்சில்கைழா, தக்காலம்

TOTAL: 30 PERIODS
OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I CONTEXT FOR IWRM

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

UNIT II WATER ECONOMICS

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III LEGAL AND REGULATORY SETTINGS

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM

Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security — Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, the student is expected to be able to

CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.

CO2 Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.

CO3 Apply law and governance in the context of IWRM.

CO4 Discuss the linkages between water-health; develop a HIA framework.

CO5 Analyse how the virtual water concept pave way to alternate policy options.
REFERENCES:

OCE432 WATER, SANITATION AND HEALTH L T P C 3 0 0 3

OBJECTIVES:
• Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

UNIT I FUNDAMENTALS WASH 9
Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT 9

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT 9
UNIT IV GOVERNANCE
Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)-Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -

UNIT V INITIATIVES
Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:
CO1 Capture to fundamental concepts and terms which are to be applied and understood all through the study.
CO2 Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.
CO3 Critically analyse and articulate the underlying common challenges in water, sanitation and health.
CO4 Acquire knowledge on the attributes of governance and its say on water sanitation and health.
CO5 Gain an overarching insight into the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects.

REFERENCES
OBJECTIVES:
- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I  SUSTAINABILITY AND DEVELOPMENT CHALLENGES

UNIT II  PRINCIPLES AND FRAMEWORK

UNIT III  SUSTAINABLE DEVELOPMENT AND WELLBEING

UNIT IV  SUSTAINABLE SOCIO-ECONOMIC SYSTEMS

UNIT V  ASSESSING PROGRESS AND WAY FORWARD
Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP-

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to
  CO1 Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.
  CO2 Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals
  CO3 Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption
  CO4 Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.
  CO5 Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.

REFERENCES:

OBJECTIVES:

- To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT I INTRODUCTION

UNIT II IMPACT IDENTIFICATION AND PREDICTION

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to
  CO1 Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles
  CO2 Understand various impact identification methodologies, prediction techniques and model of impacts on various environments
  CO3 Understand relationship between social impacts and change in community due to development activities and rehabilitation methods
  CO4 Document the EIA findings and prepare environmental management and monitoring plan
  CO5 Identify, predict and assess impacts of similar projects based on case studies
REFERENCES:
1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India

OIC431 BLOCKCHAIN TECHNOLOGIES

COURSE OBJECTIVES:
- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II BITCOIN AND CRYPTOCURRENCY

UNIT III INTRODUCTION TO ETHEREUM
Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING
UNIT V    BLOCKCHAIN APPLICATIONS
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

COURSE OUTCOMES:
After the completion of this course, student will be able to
CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

REFERENCES:

OIC432    DEEP LEARNING

COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I    DEEP LEARNING CONCEPTS

UNIT II    NEURAL NETWORKS
About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss

UNIT III  CONVOLUTIONAL NEURAL NETWORK  10

UNIT IV  NATURAL LANGUAGE PROCESSING USING RNN  10

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING  10

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL : 45 PERIODS

REFERENCES
1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
OME431 VIBRATION AND NOISE CONTROL STRATEGIES

OBJECTIVES

- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT I BASICS OF VIBRATION


UNIT II BASICS OF NOISE

Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.

UNIT III INSTRUMENTATION FOR VIBRATION MEASUREMENT


UNIT IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS

Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT V METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL


TOTAL: 45 PERIODS
OUTCOMES:
On Completion of the course the student will be able to
1. apply the basic concepts of vibration in damped and undamped systems 
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:

OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

COURSE OBJECTIVES:
1. To learn the present energy scenario and the need for energy conservation.
2. To understand the different measures for energy conservation in utilities.
3. Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
4. To identify the energy demand and bridge the gap with suitable technology for sustainable habitat
5. To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement

UNIT I ENERGY SCENARIO
Primary energy resources - Sectorial energy consumption (domestic, industrial and other sectors),

UNIT II HEATING, VENTILLATION & AIR CONDITIONING
UNIT III    LIGHTING, COMPUTER, TV

UNIT IV    ENERGY EFFICIENT BUILDINGS

UNIT V    ENERGY STORAGE TECHNOLOGIES
Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.

REFERENCES:
OME433 ADDITIVE MANUFACTURING

UNIT I INTRODUCTION

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

UNIT III VAT POLYMERIZATION

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION

POWDER BASED PROCESS

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES

REFERENCES:

TOTAL: 45 PERIODS
UNIT I NEED FOR ELECTRIC VEHICLES
History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges

UNIT II ELECTRIC VEHICLE ARCHITECTURE
Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III ENERGY STORAGE
Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell.

UNIT IV ELECTRIC DRIVES AND CONTROL
Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor -drives and control, AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers.

UNIT V DESIGN OF ELECTRIC VEHICLES

REFERENCES:

TOTAL: 45 PERIODS
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Applying the principles of Industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT

UNIT II OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS

UNIT IV CONCEPT GENERATION, SELECTION & TESTING

UNIT V INDUSTRIAL DESIGN & PROTOTYPING

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
2. Identify opportunity and plan for new product design and development.
3. Conduct customer need analysis; and set product specification for new product design and development.
4. Generate, select, and test the concepts for new product design and development.
5. Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

REFERENCES:

OBA431 SUSTAINABLE MANAGEMENT LT P C 3 0 0 3

COURSE OBJECTIVES:
- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY 9
Management of sustainability rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY 9
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES 9
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION 9
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.
UNIT V  SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS


TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

COURSE OBJECTIVES
- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I  INTRODUCTION TO SMALL BUSINESS

UNIT II  SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN
Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.
UNIT III  BUILDING THE RIGHT TEAM AND MARKETING STRATEGY  9
Management and Leadership – employee assessments – Tuckman’s stages of group development -
The entrepreneurial process model - Delegation and team building - Comparison of HR management
in small and large firms - Importance of coaching and how to apply a coaching model.
Marketing within the small business - success strategies for small business marketing - customer
delight and business generating systems, - market research, - assessing market performance- sales
management and strategy - the marketing mix and marketing strategy.

UNIT IV  FINANCING SMALL BUSINESS  9
Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and
profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance
of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for
profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V  VALUING SMALL BUSINESS AND CRISIS MANAGEMENT  9
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly
performing firms - Turnaround strategies - Concept of business valuation - Different valuation
measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying
an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES
business performance. The South Coast Small Firms Survey, 1997-2000.” Industrial and
2. Parker,R.(2000). “Small is not necessarily beautiful: An evaluation of policy support for small and
3. Journal articles on SME’s.
COURSE OBJECTIVE

➢ To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES
2. Intellectual Property rights and copyrights, EssEss Publications.
COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology- ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES
COURSE OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I  SYSTEM SECURITY  9

UNIT II  NETWORK SECURITY  9

UNIT III  SECURITY MANAGEMENT  9

UNIT IV  CYBER SECURITY AND CLOUD SECURITY  9

UNIT V  PRIVACY AND STORAGE SECURITY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

REFERENCES

MP4251
CLOUD COMPUTING TECHNOLOGIES
L T P C
3 0 0 3

COURSE OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I
VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE

UNIT II
CLOUD PLATFORM ARCHITECTURE

UNIT III
AWS CLOUD PLATFORM - IAAS

114
UNIT IV  PAAS CLOUD PLATFORM

UNIT V  PROGRAMMING MODEL
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

COURSE OUTCOMES:
CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

REFERENCES
IF4072  DESIGN THINKING  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I  UX LIFECYCLE TEMPLATE  8

UNIT II  CONTEXTUAL INQUIRY  10

UNIT III  DESIGN THINKING, IDEATION, AND SKETCHING  9

UNIT IV  UX GOALS, METRICS, AND TARGETS  8

UNIT V  ANALYSING USER EXPERIENCE  10
SUGGESTED ACTIVITIES:
1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

REFERENCES
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

MU4153 PRINCIPLES OF MULTIMEDIA L T P C
3 0 0 3

COURSE OBJECTIVES:
- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION 9
Suggested Activities:
1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:
1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA
Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:
1. Flipped classroom on different file formats of various media elements.

Suggested Evaluation Methods:
1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS

Suggested Activities:
1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:
1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT IV MULTIMEDIA SYSTEMS

Suggested Activities:
1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.
Suggested Evaluation Methods:
1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V  MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS


Suggested Activities:
1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:
1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:
DS4015 BIG DATA ANALYTICS  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA  9

UNIT II SEARCH METHODS AND VISUALIZATION  9

UNIT III MINING DATA STREAMS  9

UNIT IV FRAMEWORKS  9
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V R LANGUAGE  9

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

TOTAL: 45 PERIODS
REFERENCE:

NC4201
INTERNET OF THINGS AND CLOUD
L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I  FUNDAMENTALS OF IoT
Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges, Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT II  PROTOCOLS FOR IoT

UNIT III  CASE STUDIES/INDUSTRIAL APPLICATIONS
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV  CLOUD COMPUTING INTRODUCTION

UNIT V  IoT AND CLOUD

TOTAL:45 PERIODS
COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Understand the various concept of the IoT and their technologies..
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

MX4073 MEDICAL ROBOTICS

COURSE OBJECTIVES:
- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I INTRODUCTION TO ROBOTICS
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II MANIPULATORS & BASIC KINEMATICS
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor
UNIT III     SURGICAL ROBOTS
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

UNIT IV     REHABILITATION AND ASSISTIVE ROBOTS
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V     WEARABLE ROBOTS
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES
COURSE OBJECTIVES:
- To learn about the process involved in the design and development of real-time embedded system
- To develop the embedded C programming skills on 8-bit microcontroller
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming
- To build a home automation system

UNIT I INTRODUCTION TO EMBEDDED C PROGRAMMING 9
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

UNIT II AVR MICROCONTROLLER 9
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT III HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS 9
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT IV VISION SYSTEM 9

UNIT V HOME AUTOMATION 9
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor - Proximity Garage Door Opener - Vision Based Authentic Entry System

COURSE OUTCOMES:
On successful completion of this course, students will be able to
CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

TOTAL: 45 PERIODS
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<td>Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics</td>
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REFERENCES

TX4092 TEXTILE REINFORCED COMPOSITES L T P C
UNIT I REINFORCEMENTS 9
Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II MATRICES 9
Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III COMPOSITE MANUFACTURING 9
Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements

UNIT IV TESTING 9
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS 9
Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware

REFERENCES

NT4002 NANOCOMPOSITE MATERIALS

UNIT I BASICS OF NANOCOMPOSITES

UNIT II METAL BASED NANOCOMPOSITES
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal- Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III POLYMER BASED NANOCOMPOSITES
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V NANOCOMPOSITE TECHNOLOGY

TOTAL: 45 PERIODS

REFERENCES:

BY4016 IPR, BIOSAFETY AND ENTREPRENEURSHIP L T P C 3 0 0 3

UNIT I IPR

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

UNIT III BIOSAFETY

UNIT IV GENETICALLY MODIFIED ORGANISMS
Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol.
UNIT V  ENTREPRENEURSHIP DEVELOPMENT


TOTAL : 45 PERIODS

REFERENCES