ANDHRA UNIVERSITY

DEPARTMENT OF ELECTRICAL ENGINEERING

PROGRAM : M.TECH(POWER SYSTEMS AND AUTOMATION)

REGULATION AND SYLLABUS

EFFECTIVE FROM 2020-2021 BATCH

ANDHRA UNIVERSITY: : VISAKHAPATNAM
DEPARTMENT OF ELECTRICAL ENGINEERING
Syllabus for M.Tech. (Power Systems and Automation)
Common with V/VI and VI/VI (B.Tech+M.Tech) Dual Degree Course
(effective from the 2020-21admitted batch)

SEMESTER – III

Sub. Code	Subject Name	Periods/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS 3.1	Professional Elective - V a) Power System Deregulation b) Power System Reliability c) Smart Grid Technologies	3	--	30	70	100	3
EEPS 3.2	Open Elective	3	--	30	70	100	3
EEPS 3.3	Major Project (Phase-I Dissertation)	--	--	--	100	100	10

SEMESTER – IV

Sub. Code	Subject Name	Periods/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS 4.1	Major Project (Phase-II Dissertation)	--	--	--	100	100	16

ANDHRA UNIVERSITY: : VISAKHAPATNAM
DEPARTMENT OF ELECTRICAL ENGINEERING

Syllabus for M.Tech. (Power Systems and Automation)

Common with V/VI and VI/VI (B.Tech+M.Tech) Dual Degree Course
(effective from the 2020-21admitted batch)

SEMESTER – I

Sub. Code	Subject Name	Periods/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS 1.1	Advanced Power System Operation & Control	3	--	30	70	100	3
EEPS 1.2	Power System Dynamics & Stability	3	--	30	70	100	3
EEPS 1.3	Professional Elective - I a) Optimisation Techniques b) Artificial Intelligence Techniques. c) Evolutionary Algorithms and Applications Power System	3	--	30	70	100	3
EEPS 1.4	Professional Elective - II a) HVDC Transmission b) Flexible AC Transmission Systems c) EHV AC Transmission	3	--	30	70	100	3
EEPS 1.5	Research Methodology and IPR	3	--	30	70	100	2
EEPS 1.6	Audit Course – I	3	--	30	70	100	--
EEPS 1.7	Power Systems Simulation Lab – I	--	3	50	50	100	2
EEPS 1.8	Power Systems and Protection Lab.	--	3	50	50	100	2
TOTAL		18	06	280	520	800	18

SEMESTER – II

Sub. Code	Subject Name	Periods / week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS 2.1	Electrical Distribution Systems & Automation	3	--	30	70	100	3
EEPS 2.2	Automation in Power Systems	3	--	30	70	100	3
EEPS 2.3	Professional Elective - III (a) Real Time Control of Power Systems (b) Advanced Power System Protection (c) FACTS Modelling and Simulation	3	--	30	70	100	3
EEPS 2.4	Professional Elective - IV (a) Programmable Logic Controllers and Applications (b) Renewable Energy Technologies (c) Power Quality	3	--	30	70	100	3
EEPS 2.5	Audit Course – II	3	--	30	70	100	2
EEPS 2.6	Power Systems Simulation Lab – II	--	3	30	70	100	--
EEPS 2.7	Smart Grid Laboratory	--	3	50	50	100	2
EEPS 2.8	Seminar	--	--	100	--	100	2
TOTAL		18	03	280	520	800	18

Andhra University College of Engineering
Andhra University

Department
of
Electrical Engineering

PROGRAMME : *M.TECH. (POWER SYSTEMS ANDAUTOMATION)*

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The graduates shall be able to :

PEO-1: To develop specialized manpower for electrical power and energy industry.

PEO-2: To enhance analytical skills so as to enable to solve complex industrial problems.

PEO-3: To augment the students' capacity in pursuing research in emerging areas of power system.

PEO-4: To improve students' perspective towards environmental issues by sensitizing and building the awareness of green technologies.

PEO-5. To inculcate the culture of research oriented projects with state-of-art facility laboratories in power system.

PROGRAMME OUTCOMES (POs)

The Graduate will be able to:

Program Outcomes		EEE Graduates will be able to
PO1	Engineering knowledge	Acquire in depth knowledge in the domain of power system control and automation.
PO2	Problem analysis	Apply soft computing techniques for Power System problems in optimal planning and utilization of electrical energy.
PO3	Design/development ofsolutions	Understand and Design of large electrical systems involved through Modeling, Analysis and Simulation.
PO4	Conduct investigations of complex problems	Apply and Analyze present day techniques and tools to solve the complex electrical systems relevant to India and other countries.
PO5	Modern tool usage	Use recent state-of-the-art simulation tools in electrical engineering such as Matlab, Homer Pro, Proteus, DSPACE, MULTISIM, LABVIEW and other Tools.
PO6	The engineer and society	Be capable of contribute positively to collaborative and multidisciplinary research to achieve common goals.
PO7	Environment and sustainability	Demonstrate knowledge and understanding of power engineering and management principles and Undertake research in emerging areas of power systems with due consideration to economical, Environment and financial factors.

PO8	Ethics	Become aware of social issues and become socially responsible and follow ethical practices to contribute to the community for sustainable development of society.
PO9	Individual and teamwork	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10	Communication	Communicate confidently, make effective presentations and write good reports to power engineering community and society.
PO11	Project management andfinance	Independently observe and examine critically the outcomes of his/her actions, apply corrective measures subsequently and move forward positively through a self corrective approach.
PO12	Life-long learning	Recognize the need for life-long learning and have the ability to do it independently.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

The Graduates of EEE will be able to:

PSO1	The graduates are capable of applying the Knowledge in modern power industry.
PSO2	Analyse and design efficient systems to generate, transmit, distribute and utilize electrical energy to meet social needs using advanced tools.
PSO3	Electrical Engineers are capable to apply principles of management and economics for providing better services to the society with the technical advancements in renewable and sustainable energy integration.

ANDHRA UNIVERSITY
DEPARTMENT OF ELECTRICAL ENGINEERING

SCHEME AND SYLLABI
(With effect from 2020-2021 admitted batch on wards)

M.Tech Power Systems and Automation (PS&A)
Common with Dual Degree Course V/VI (B.TECH+M.TECH)

SEMESTER–I

Sub. Code	Subject Name	Periods/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS1.1	Advanced Power System Operation & Control	3	--	30	70	100	3
EEPS1.2	Power System Dynamics & Stability	3	--	30	70	100	3
EEPS1.3	Professional Elective -I a) Optimization Techniques b) Artificial Intelligence Techniques. c) Evolutionary Algorithms and Applications Power System	3	--	30	70	100	3
EEPS1.4	Professional Elective -II a) HVDC Transmission b) Flexible AC Transmission Systems c) EHV AC Transmission	3	--	30	70	100	3
EEPS1.5	Research Methodology and IPR	3	--	30	70	100	2
EEPS1.6	Audit Course– I	3	--	30	70	100	--
EEPS1.7	Power Systems Simulation Lab– I	--	3	50	50	100	2
EEPS1.8	Power Systems and Protection Lab.	--	3	50	50	100	2
Total							**18**

SEMESTER–II

Sub. Code	Subject Name	Period/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS2.1	Electrical Distribution Systems & Automation	3	--	30	70	100	3
EEPS2.2	Automation in Power Systems	3	--	30	70	100	3
EEPS2.3	Professional Elective-III (a) Real Time Control of Power Systems (b) Advanced Power System Protection (c) FACTS Modelling and simulation	3	--	30	70	100	3
EEPS2.4	Professional Elective -IV (a) Programmable Logic Controllers and Applications (b) Renewable Energy Technologies (c) Power Quality	3	--	30	70	100	3
EEPS2.5	Audit Course–II	3	--	30	70	100	2
EEPS2.6	Power Systems Simulation Lab–II	--	3	30	70	100	--
EEPS2.7	Smart Grid Laboratory	--	3	50	50	100	2
EEPS2.8	Seminar	--	--	100	--	100	2
Total							**18**

SEMESTER–III

Sub.Code	Subject Name	Periods/ week		Maximum Marks			Credits
		T	P	Int.	Ext.	Total	
EEPS3.1	Professional Elective -V a) Power System Deregulation b) Power System Reliability c) Smart Grid Technologies	3	--	30	70	100	3
EEPS3.2	Open Elective	3	--	30	70	100	3
EEPS3.3	Major Project (Phase-I Dissertation)	--	--	--	100	100	10
Total							**16**

SEMESTER–IV

Sub.Code	Subject Name	Periods / week		MaximumMarks			Credits
		T	P	Int.	Ext.	Total	
EEPS4.1	Major Project (Phase-II Dissertation)	--	--	--	100	100	16
Total							**16**

Audit Course I &II

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

EEPS 1.1: ADVANCED POWER SYSTEM OPERATION AND CONTROL

Course Objectives

To enable the student:

- To apply different problem-solving techniques in solving the Unit Commitment and Hydro-thermal coordination problems.
- To solve issues related to reactive power requirements in power systems.
- To explain various concepts related to optimal power flow and voltage control concepts.
- To practice the solutions of states estimation problems of power systems.
- To underline the concepts related to electricity markets.

Course Outcomes

By the end of the course, student will be able to:

- Demonstrate the various techniques in solving the Unit Commitment and Hydro-thermal coordination problems.
- Debate various issues related to reactive power issues in power systems.
- Review basic concepts related to formulation of optimal power flow and voltage control concepts.
- Formulate the problems for solving the states estimation of power systems.
- Record the various concepts related to electricity markets.

SYLLABUS

Unit Commitment: Constraints in unit commitment, Generation of state, optimizing the states using Priority-list method, Unit commitment problem solution using Priority-list method and Dynamic Programming; **Hydro-thermal Coordination:** Characteristics of various types of hydro-electric plants and their models, Introduction to hydro-thermal Coordination, Scheduling energy with hydro-thermal coordination, Short-term hydro-thermal scheduling.

Reactive Power Control: Requirements in ac power transmission, factors affecting stability &voltagecontrol,fundamentaltransmissionlineequation,surgeimpedance,Naturalloading,uncompensatedlineonopencircuit,uncompensatedlineunderload,typesofcompensationsoncompensatedtransmissionlines,passiveandactivecompensators,uniformlydistributedfixed and regulated shunt compensation, series compensation, compensation by sectioning.

Optimal Power Flow: Optimal power flow problem formulation for loss and cost minimisation, Solution of optimal power flow problem using Newton's method and Linear Programming technique; **Voltage Control:** Automatic voltage regulator, Exciter types, Exciter modelling, Generator modelling, Static and Dynamic response of AVR loop.

State Estimation: Maximum Likelihood Weighted Least Square State Estimation, State estimation of an AC networks, State estimation by orthogonal decomposition, Basic concepts about network observability, Pseudo-measurements, Bad data detection and identification.

Operation of Modern Power Systems: Principle of economics, utility functions, power exchanges, electricity market models, market power indices, ancillary services, transmission and distribution charges, principles of transmission charges, transmission pricing methods, demand-side management, regulatory frame work.

Text Books:

1. Power Generation, Operation and Control,Allen J.Wood and BruceF. Wollenberg, John Wiley & Sons ,Inc., NewYork, 2nd edition,1996.
2. Reactive Power Control in Electric Systems,T JEMiller,John Wiley & Sons,NewYork,1982.
3. Electric Energy Systems Theory: An Introduction, OlleI.Elgerd, TMH Publishing Company Ltd. ,New Delhi,2nd edition,1983.
4. Power System Engineering, D P Kothari and I J Nagrath, McGraw Hill Education India Pvt .Limited, Chennai,3e,2019.

EEPS 1.2: POWER SYSTEM DYNAMICS & STABILITY

Course Objectives

To enable the student:

- To understand the modeling of synchronous machines and its various controller components.
- To understand the modeling of transmission line, SVC and loads.
- To analyze various models of synchronous machine including SVC.
- To evaluate the dynamics of single machine connected to infinite bus system.
- To assess the small signal stability of a single and multi-machine system.
- To design the PSS and its role in damping power system oscillations.

Course Outcomes

By the end of the course, student will be able to:

- The student would understand the modeling of synchronous machines and its various controller components.
- The student would understand the modeling of transmission line, SVC and loads.
- The student would analyze various models of synchronous machine including SVC.
- The student would evaluate the dynamics of single machine connected to infinite bus system.
- The student would assess the small signal stability of a single and multi-machine system.
- The student would design the PSS and its role in damping power system oscillations.

SYLLABUS

Modeling: Basic concepts, Review of classical methods, modeling of synchronous machine,Park'stransformation,Analysisofsteadystateperformance,Excitationsystem,excitationsystem modeling, Excitation systems-standard block diagram, System representation by state equations, Prime mover control system, Transmission lines, SVC and Loads modeling, D-Q transformation using α-β variables.

Dynamics of a Synchronous generator connected to infinite bus: System model, synchronous machine model, Application model(1.1), Calculation of initial conditions, System simulation, Consideration of other machine models, Inclusion of SVCmodel,.

Small Signal Stability Analysis: Analysis of single machine system, small signal analysis with block diagram representation, Characteristic equation and application of Routh-Hurwitz criterion, synchronizing and damping torque analysis, small signal model state equations.

Application of Power System Stabilizers: Introduction, Basic concepts in applying PSS, Control signals, structure and tuning of PSS.

Analysis of Multi- Machine system: A simplified system model, detailed models, Case I and II, Inclusion of load and SVC dynamics, modal analysis of large power systems.

Text Books:

1. Power System Dynamics, stability and control by K.R.Padiyar, Interline Publishing private limited, Bangalore,India.
2. Power system control and stability by PM Anderson and AAFouad, Ezalgotia publications.KUNDUR

EEPS 1.3(a): OPTIMISATION TECHNIQUES

Course Objectives

To enable the student to:

- To impart knowledge in basic concept of Optimization Techniques relevant to power and control engineering applications.
- Enumerate the fundamental knowledge of Classical Optimization Techniques and Linear Programming problems.
- To familiarize basic concepts about various applications of Non-Linear Programming problems.
- Explain different programming techniques and apply different optimization techniques to solve various models arising from engineering areas.

Course Outcomes:

By the end of the course, student will be able to:

- Explain the fundamental knowledge of Linear Programming and Non-Programming problems.
- Use classical optimization techniques and numerical methods of optimization.
- Describe the basics of different evolutionary algorithms.
- Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.

SYLLABUS

Introduction to Optimization: Introduction, Historical Development, Engineering Applications of Optimization, Statement of Optimization Problem.

Classical Optimization Techniques: Introduction, Single variable optimization, Multivariable optimization with no constraints; Multivariable optimization with Equality constraints – Solution by Direct Substitution method, Method of constrained variation, Method of Lagrangian multipliers; Multivariable optimization with inequality constraints: Kuhn-Tucker conditions.

Linear Programming: Introduction, Applications of Linear Programming, Standard Form of a Linear Programming, Basic Terminology and Definitions, Exceptional cases, Simplex method, Big-M method, Two-phase method, Revised Simplex method, Duality, Decomposition Principle.

Non Linear Programming I: Unconstrained optimisation- Univariate method, Pattern Directions, Powell's method, Gradient of a function, Steepest descent method, Conjugate Gradient Method, Newton's method, MarquardtMethod,Quai-NewtonMethods,Davidon-Fletcher-PowellMethod, Broyden-Fletcher-Goldfarb-Shanno Method.

Non Linear Programming II: Constrained optimization- Characteristics of a Constrained Problem, Sequential linear programming, Basic approach in the methods of feasible directions, Zoutendijk's method of feasible directions, Sequential Quadratic Programming.

Text Books:

1. Engineering Optimization: Theory and Applications' By S.S.Rao, New Age International Publishers, Revised ThirdEdition,2005.

EEPS 1.3(b): ARTIFICIAL INTELLIGENCE TECHNIQUES

Course Objectives

To enable the student to:

- To learn the difference between optimal reasoning Vs human like reasoning
- To learn different knowledge representation techniques
- Understand the concepts of Fuzzy Logic.
- Understand the concepts of artificial neural networks
- To learn General Design Methodology for Neuro-Fuzzy Systems
- Analyze the applications of AI techniques to Electrical Engineering

Course Outcomes

By the end of the course, student will be able to:

- Analyze and design knowledge based systems intended for computer implementation.
- Realize the concepts of Fuzzy Logic
- Realize the concepts of ANN Algorithms.
- Able to realize the concepts of Neuro-Fuzzy Systems
- Apply AI techniques to real-world problems.

SYLLABUS

Expert System Principles: Introduction, Expert System Principles –Knowledge Base, Frame Structure, Meta-Knowledge – ES Language – Inference Engine, User Interface; Expert System Shell – Shell Features, External Interface, Program Development Steps; Design Methodology, Applications.

Fuzzy Logic Principles: Introduction, Fuzzy Sets, Membership Functions, Operations on Fuzzy Sets, Fuzzy System, Implication Methods - Mamdani Type, Lusing Larson Type, Sugeno Type; Defuzzification Methods – Center of Area (COA) Method, Height Method, Mean of Maxima (MOM) Method and Sugeno Method.

Fuzzy Control: Concept of Fuzzy Control, Historical Perspective, Control Principle, Control Implementation, General Design Methodology and Applications.

Neural Network Principles: Introduction, the Structure of a Neuron, the Concept of a Biological Neuron, Artificial Neuron, Activation Functions of a Neuron, Artificial Neural Network, Training of Feed forward Neural Network, Learning Methods, Alphabet Character Recognition by an ANN, Back Propagation Training, On-Line Training, Other Networks-Radial Basis Function Network, Kohonen's Self-Organizing Feature Map Network, Recurrent Neural Network for Dynamic System, Training an RNN by the EKF Algorithm.

Neural Network in Identification and Control: Time-Delayed Neural Network, Dynamic System Models, ANN Identification of Dynamic Models, Inverse Dynamics Model, Neural Network-Based Control, General Design Methodology, Neuro-Fuzzy Systems, ANN Based Fuzzy Inference System (ANFIS),Applications.

Text Books:

1. M.W.Firebaugh,Artificial intelligence,BoydandFraser,Boston
2. S.Haykin,“Neural Networks”,Macmillan,NY

Reference Books:

1. Bimal K.Bose,Modern Power Electronics and AC Drives by Prentice Hall PTR, NJ07458
2. L.H.Tsoukalas,R.E.Uhrig,“Fuzzy and Neural Approaches in engineering”,WileyNY
3. W.Hines,“MATLAB Supplement to Fuzzy and Neural Approaches in Engineering”, John Wiley. NY

EEPS 1.3(c): EVOLUTIONARY ALGORITHMS AND APPLICATIONS

Course Objectives

To enable the student to:

- To learn the difference between optimal reasoning Vs human like reasoning
- To learn different knowledge representation techniques
- Understand the concepts of Fuzzy Logic.
- Understand the concepts of artificial neural networks
- To learn General Design Methodology for Neuro-Fuzzy Systems
- Analyze the applications of AI techniques to Electrical Engineering

Course Outcomes

By the end of the course, student will be able to:

- Analyze and design knowledge based systems intended for computer implementation.
- Realize the concepts of Fuzzy Logic
- Realize the concepts of ANN Algorithms.
- Able to realize the concepts of Neuro-Fuzzy Systems
- Apply AI techniques to real-world problems.

SYLLABUS

Fundamentals of Soft Computing Techniques: Definition-Classification of optimization problems-Unconstrained and Constrained optimization Optimality conditions- Introduction to intelligentsystems–Softcomputingtechniques-ConventionalComputingversusSwarmComputing– Classificationofmeta–heuristictechniques–Singlesolutionbasedandpopulationbasedalgorithms – Exploitation and exploration in population based algorithms – Properties of Swarmintelligent Systems – Application domain – Discrete and continuous problems – Single objectiveandmulti-objective problems.

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 withoutloss, Selective Harmonic Elimination in inverters and PI controller tuning.

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–ACOmodels–Touring ant solony system-max min ant system–Concept of Elitist 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 without loss and PI controller tuning.

Shuffled Frog-Leaping Algorithms and Bat Optimization Algorithm: Bat Algorithm-Echolocation ofbats – Behaviour of micro bats – Acoustics of Echolocation- Movement of Virtual Bats – Loudness and Pulse Emission – Shuffled frog algorithm-virtual population of frogscomparison of

memesand genes – memeplex formation – memplex updation – BA and SFLA alogrithms for solving ELD without loss and PI controller tuning.

Multi Objective Optimization : Multi-Objective optimization introduction-Concept of Paretooptimality – Non-dominant sorting technique-Pareto fronts-best compromise solution-min-max method-NSGA-II algorithm and application togeneral two objective optimization problem.

Text Books:

1. Xin-she Yang, "Recent Advance in Swarm Intelligence and Evolutionary Computation", Springer International Publishing, Switzerland,2015.
2. Kalyanmoy Ded, "Multi-Objective Optimization using Evolutionary Algorithms", John Wiley &Sons, 2001.
3. James Kennedy and Russel E Eberheart, "Swarm Intelligence", The Morgan Kaufmann Series in Evolutionary Computation,2001

Reference Books:

1. Eric Bonabeau, Macro Dorigo and Guy Theraulaz, "Swarm Intelligence- From natural to Artificial Systems",Oxford universityPress,1999.
2. David Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning",Pearson Education,2007.
3. Konstantinos E. Parsopoulos and Michael N. Vrahatis, "Particle Swarm Optimization and Intelligence:Advances and Applications", Information science Reference Books,IGIGlobal,,2010.
4. N P Padhy,"Artificial Intelligence and Intelligent Systems",Oxford University Press,2005.

EEPS 1.4(a): HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

Course Objectives

To enable the student to:

- Compare the HVDC Transmission and EHVAC transmission
- Identify and analyse converter configurations used in HVDC and list the performancemetrics.
- Understand the characteristics of different types of converter circuits.
- Understand controllers for controlling the power flow through a dc link
- Identify the mis-operation of DC links and study the protection of various DC links.

Course Outcomes

By the end of the course, student will be able to:

- Students will be able to compare the HVDC Transmission and EHVAC transmission.
- Students will be able to identify and analyse converter configurations used in HVDC and list the performance metrics.
- Students will be able to understand the characteristics of different types of converter circuits and converters for controlling the power flow.
- Students will be able to identify the mis operation of DC links and study the protection of various DC links.

General aspects of DC transmission and comparison of it with AC transmission: Introduction, General aspects of transmission, Transmission links, types- Monopolar, Homopolar, Bipolar and Back-to-Back, Constitution of dc and ac links. Technical aspects, Economic aspects, Reliability aspects and Environmental aspects of HVDC Transmission (HVDCT),Advantages and disadvantages of HVDCT, Applications of DC Transmission, HVDC light.

Converters: Definition,Thury system, Valves, Valve characteristics, Components of circuits, Properties of converter circuits, Pulse number, Single phase and three phase converters, Assumptions in converter circuit analysis, Analysis of Greatz circuit, Analysis of bridge with grid control without overlap, Analysis of bridge with grid control with overlap less than 60^0

HVDC Links and Converters: Characteristics of converter circuits– Rectifier and inverter characteristics, complete characteristics of rectifier and inverter, Equivalent circuit of HVDC Link, Brief description of 12-pulse, 24-pulse and48-pulse converters transformer configurations, Choice of converter circuit for HVDC transmission,

HVDC Converter control: Desired features and means of control, control of the direct current transmission link, Constant current control, Constant ignition angle control, Constant extinction angle control, Converter firing-angle control-IPC and EPC, frequency control and Tap changer control, Starting, Stopping and Reversal of power flow in HVDC links.

Misoperation and Protection of DC links: Malfunction of converter valves, Arc-back, Arc-through, Misfire, Quenching, Commutation failure, Valve blocking and bypass, Short circuits within the converter station. DC reactors, valve dampers, line dampers , circuit breakers.

Text Book:

1. E.W.Kimbark, Direct current transmission,Vol.I,Wiley Interscience,NewYork,1971.
2. PKundur,Power System Stability and Control,McGraw Hill Inc.,NewYork,1994.

Reference Books:

1. K.R.Padiyar, HVDC Power Transmission Systems: Theory and System Interactions, New Age International Publishers, NewDelhi, 2009.
2. Erich Uhlmann, Power Transmission by Direct Current, Springer-Verlag, Berlin/Heidelberg, 1975.

EEPS 1.4(b): FLEXIBLE AC TRANSMISSION SYSTEMS

Course Objectives

To enable the student to:

- To understand the fundamentals of FACTS Controllers.
- To know the importance of controllable parameters and types of FACTS controllers & their benefits.
- To understand the objectives of Shunt and Series type compensation and methods of controllable shunt Var Generation, Series Var Generation and their comparison.
- To understand the objectives of combined Compensators their control structures and characteristics.

Course Outcomes

By the end of the course, student will be able to:

- Learn about transmission system performance improvements with FACTS.
- Based on the system requirements, select the appropriate controller for the specific application.
- Become familiar with the impact of series compensation and shunt compensation.
- Understand the operating principle and the various controls of UPFC and IPFC.

SYLLABUS

Introduction: Electrical Transmission Networks, Conventional Control Mechanisms-Automatic Generation Control, Excitation Control, Transformer Tap-Changer Control, Phase-Shifting Transformers; Advances in Power-Electronic Switching Devices, Principles and Applications of Semiconductor Switches; Limitations of Conventional Transmission Systems ,Emerging Transmission Networks, HVDC and FACTS options.

Flexible AC Transmission Systems (FACTS): Power Flow and Dynamic Stability Considerations, Importance of Controllable Parameters, Types of FACTS Controllers. Brief Description (only theoretical explanation, No analysis) and Definitions of FACTS Controllers.

FACTS Converters: Types of converter, Concept and operation of Voltage sourced converters, Current Source dc converters, Operation of Single-Phase and Three-Phase Bridge Converters, Description of Three-Level VSC and PWM Converters, Transformer Connections for 12-pulse, 24-pulse and 48-pulseoperation.

Shunt, Series Type FACTS Controllers: Objective of Shunt Compensation, Methods of Controllable shunt Var Generation (Variable Impedance type, Switching Converter type and Hybrid type), Objective of Series Compensation, Methods of Controllable Series Var Generation(Variable Impedance type, Switching Converter type and Hybridtype).

UPFC and IPFC : Unified Power Flow Controller (UPFC) – Principle of operation, Transmission Control Capabilities, Independent Real and Reactive Power Flow Control; Principle of operation and Characteristics of Interline Power Flow Controller (IPFC), UPFC and IPFC control structures.

Text Books:

1. Narain G.Hingorani and Laszlo Gyugyi,Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, IEEE Press, Wiley-Interscience, New Jersey, 2000.
2. RMohan Mathur and Rajiv K Varma, Thyristor Based FACTS Controllers for Electrical Transmission Systems, IEEE Press, Wiley-Interscience, NewJersey,2002.

Reference Books:

1. K R Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International Publishers, New Delhi, 2007.
2. Anrique Acha,Claudio R.Fuerte-Esquivel, Hugo Ambriz-Pérez and César Angeles-Camacho, FACTS: Modelling and Simulation in Power Networks, John Wiley & Sons, West Sussex, 2004.

EEPS 1.4(c) : EXTRA HIGH VOLTAGE AC TRANSMISSION

Course Objectives

To enable the student to:

- understand issues of concern with EHVAC transmission
- identify and calculate the various parameters of EHV line for modelling
- assess the effects of corona and methods to limit the audible noise.
- Understand the electrostatic and magnetic fields of EHV lines.
- Estimate the over–voltages in EHV AC systems.

Course Outcomes

By the end of the course, student will be able to:

- Students will be able to understand the issues of concern with EHVAC transmission.
- Students will be able to identify and calculate the various parameters of EHV line for modelling.
- Students will be able to assess the effects of corona and methods to limit the audible noise.
- Students will be able to understand the electrostatic and magnetic fields of EHV lines and estimate the over–voltages in EHV AC systems.

SYLLABUS

Transmission Preliminaries: Role of EHV Ac transmission, Standard transmission voltages, Average values of line parameters, Power-handling capacity and line loss, Giant power pools and number of lines, Cost of transmission lines and equipment, Mechanical considerations in line performance.

Voltage Gradients of Conductors: Electrostatics, Field of sphere gaps, Field of line charges and their properties, 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.

Corona Effects-I : I2R loss and Corona loss, Corona loss formulae, Charge-Voltage diagram and Corona loss, Attenuation of travelling waves due to Corona loss, Audible noise-Generation and characteristics, Limits for audible noise, Audible noise measurement and meters, Formulae for audible noise and use in design, Relation between single-phase and three-phase audible noise levels, Day-Night equivalent noise level,

Corona Effects-II : Corona pulses-generation and properties, Properties of pulse train and filter response, limits for Radio Interference Fields, Frequency spectrum of the RI field of line, Lateral profile of RI and modes of propagation, The CIGRE formula, RI excitation function, Measurement of RI, RIV and excitation function, Design of filter,Televisioninterference.

Electrostatic and Magnetic Fields of EHVLines: Electric shock and threshold currents , Capacitance of long object, Calculation of electrostatic field of AC lines, Effect of high Electrostatic field on Human, Animals and Plants, Meters and measurement of electrostatic fields, Electrostatic induction in un energized circuit of DC line, Induced voltage in insulated ground wire, Magnetic field effects, Magnetic field of 3-phase and 6-phase line, effect of power frequency magnetic fields on human health.

Lightning and Lightning Protection : Lightning strokes to lines, Lightning stroke mechanism, General Principles of the lightning protection problem, Tower footing resistance, Insulator flash over and withstand voltages, probability of occurrence of lightning stroke currents, Lightning arresters and protective characteristics, Dynamic voltage rise and arrester ratings, Operating characteristics of lightning arresters, Insulation co ordination based on lightning.

Text Book:

1. Rakosh Das Begamudre, "Extra High Voltage Transmission Engineering", New Academic Science Limited, Kent,UK, 4th edition,2013.

EEPS 1.5: RESEARCH METHODOLOY AND IPR

Course Objectives

To enable the student to:

- To introduce the students to Intellectual Property Rights (IPR) which is a key component in modern knowledge management processes
- To create consciousness on IPR in students at an early stage of their education so that they develop an appreciation for ethical and rightful use of existing knowledge
- To make them understand how to take ownership of knowledge they may develop as a result of their creative innovations, take ownership and either drive themselves in becoming entrepreneurs or become responsible knowledge users in society
- To expose students some of the recent debates on the societal implications of IPR and its role in national/international trade and socio-economic development.

Course Outcomes

By the end of the course, student will be able to:

- Identify the types of intellectual property protection available for their research Outcome.
- Conduct patent search and analyze patentability of the invention.
- Understand the basic structure of Patent document.
- Understand the registration and prosecution of different IPs .
- Understand the basics of IP commercialization and techno/commercial/legal issues in IPR commercialization.

SYLLABUS

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem- Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Effective literature studies approaches, analysis Plagiarism, Research ethics.

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property - Procedure for grants of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights - Licensing and transfer of technology - Patent information and data bases-Geographical Indications.

New Developments in IPR: Administration of Patent System - New developments in IPR; IPR of Biological Systems, Computer Software etc.-Traditional knowledge Case Studies, IPR and IITs.

Reference Books:

1. Stuart Melville and Wayne Goddard,"Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville,"Research Methodology: An Introduction"
3. RanjitKumar,2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert,"Resisting Intellectual Property",Taylor & FrancisLtd,2007.
5. Mayall,"Industrial Design",McGrawHill,1992.
6. Niebel,"Product Design",McGrawHill,1974.
7. Asimov,"Introduction to Design",PrenticeHall,1962.
8. Robert P.Merges, PeterS.Menell, MarkA.Lemley, "Intellectual Property in New Technological Age", 2016.
9. T.Ramappa,"Intellectual Property Rights Under WTO", S.Chand,2008

EEPS 1.6(a): ENGLISH FOR RESEARCH PAPER WRITING

Course Objective

Students will be able to:

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

Course Outcome

At the end of this course, the students should be able to:

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

SYLLABUS

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

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

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

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.

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

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

Reference Books:

1. Goldbort R(2006) Writing for Science, Yale University Press(available on Google Books)
2. Day R(2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N(1998),Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork,English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 20

EEPS 1.6(b): DISASTER MANAGEMENT

Course Objective

Students will be able to:

- To familiarize the students about the disaster management and the need for its study.
- To familiarize the students about the concept of risk and vulnerability analysis
- To create awareness about disaster prevention and risk reduction
- To know about the relationship between disasters and developments.
- To understand the concepts of Rehabilitation, Reconstruction and Recovery in the event of Disaster

Course Outcome

At the end of this course, the students should be able to:

- Understand the need and significance of studying the disaster management
- To gain the knowledge of different types of disasters and causes for disasters.
- Gain knowledge on the impacts of Disasters on environment and society
- Ability to assess the vulnerability of a geographical area.
- Students will be able to know various methods of risk reduction measures and risk mitigation.
- Understands the role of Information Technology in Disaster Management
- Understands the Geographical Information System applications in Disaster Management

SYLLABUS

Introduction to Disaster: Definition, Factors And Significance ;Difference Between Hazard And Disaster; Natural And Man made Disasters: Difference, Nature,Types and Magnitude.

Repercussions Of Disasters And Hazards: Economic Damage, Loss of Human And Animal Life,DestructionOfEcosystem.NaturalDisasters:Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Disaster Prone Areas in IndiaStudy Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas ProneTo Cyclonic And Coastal Hazards With Special Reference Books To Tsunami; Post-Disaster Diseases And Epidemics Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, DataFrom Meteorological and Other Agencies, Media Reports: Governmental And Community Preparedness.

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

Disaster Mitigation Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Reference Books:

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

EEPS 1.6(c): SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objective

Students will be able to:

- Learning the Sanskrit language and its grammar in order to understand and analyze technical texts written in Sanskrit.
- Developing proficiency in reading and comprehending technical texts written in Sanskrit, such as those on mathematics, astronomy, physics, engineering, medicine, and other sciences.
- Enhancing the ability to translate technical texts written in Sanskrit into modern languages in order to make them accessible to a wider audience.
- Developing a deep understanding of the technical concepts and terminology used in Sanskrit texts and their relevance to modern scientific and technological advancements.
- Learning about the historical and cultural contexts in which the technical knowledge was developed in ancient India.
- Gaining an appreciation for the rich philosophical and spiritual traditions that have influenced the development of Sanskrit language and technical knowledge.
- Developing the ability to apply the insights gained from studying Sanskrit technical texts to modern scientific and technological challenges.

Course Outcome

At the end of this course, the students should be able to:

- To make the students understand in Sanskrit Grammar and Composition
- To help the students know the basic Sanskrit Grammar and Literature
- Appreciation for the cultural and historical context in which Sanskrit technical knowledge was developed.
- Enhanced understanding of the philosophical and spiritual traditions that have influenced the development of Sanskrit language and technical knowledge.
- Ability to apply insights gained from studying Sanskrit technical texts to modern scientific and technological challenges.
- Development of a deeper understanding of Indian civilization and culture, and its contributions to science and technology.

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Order - Introduction of roots - Technical information about Sanskrit

Literature Technical concepts of Engineering-Electrical,Mechanical,Architecture,Mathematics

Reference Books:

1. Abhyaspustakam"–Dr.Vishwas,Samskrita-Bharti Publication,New Delhi
2. Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. India's Glorious Scientific Tradition"SureshSoni, Ocean books (P) Ltd.,NewDelhi.

EEPS 1.6(d): VALUE EDUCATION

Course Objective

Students will be able to:

- To teach and inculcate the importance of value based living.
- To give students a deeper understanding about the purpose of life.
- To teach and inculcate the essential qualities to become a good leader.

Course Outcome

At the end of this course, the students should be able to:

- Students will understand the importance of value based living
- Students will gain deeper understanding about the purpose of their life.
- Students will understand and start applying the essential steps to become good leaders.
- Students will emerge as responsible citizens with clear conviction to practice values and ethics in life.
- Students will become value based professionals.
- Students will contribute in building a healthy nation.

SYLLABUS

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

Importance of cultivation of values- Sense of duty - Devotion, Self-reliance - Confidence, Concentration. Truthfulness,Cleanliness -Honesty, Humanity - Power of faith,NationalUnity– Patriotism-Lovefornature, Discipline

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

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

Reference Bookss:

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

EEPS 1.6(e): CONSTITUTION OF INDIA

Course Objective

Students will be able to:

- To learn the history of Indian constitution
- To understand the rights and duties of the citizens
- To understand the administration and its hierarchy
- To understand the role and functionality of election commission

Course Outcome

At the end of this course, the students should be able to:

- Understands the meaning and importance of Constitution
- Understands the Administration, its role
- Understands the Role and functioning of Election commission

SYLLABUS

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

Philosophy of the Indian Constitution: Preamble- Salient Features

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

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

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

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

Reference Books:

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

EEPS 1.6(f): PEDAGOGY STUDIES

Course Objective

Students will be able to:

- To understand conceptual framework and terminology of teaching
- To understand effectiveness of pedagogical practices
- To know the research gaps and learn the future directions

Course Outcome

At the end of this course, the students should be able to:

- Understands the conceptual framework and terminology of teaching
- Understands the effectiveness of pedagogical practices
- Learns the research gaps and the future directions

SYLLABUS

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

Thematic overview: Pedagogical practices are being used by teachers in formal and informalclassroomsindevelopingcountries,Curriculum,Teachereducation.

Evidence on the effectiveness of pedagogical practices , Methodology for the in depth stage: quality assessment of included studies, Theory of change, Strength and nature of the bodyofevidenceforeffectivepedagogicalpractices,Pedagogictheoryandpedagogicalapproaches, Teachers' attitudes and beliefs and Pedagogic strategies.

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

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

Reference Books:

1. Ackers J, Hardman F(2001)Class room interaction in Kenyan primary schools, Compare, 31(2):245-261.
2. Agrawal M (2004) Curricular reform in schools : The importance of evaluation, Journal of Curriculum Studies,36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report1.ondon:DFID.
4. Akyeampong K, Lussier K,Pryor J, Westbrook J(2013)Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Black well.

EEPS 1.6(g): STRESS MANAGEMENTBY YOGA

Course Objective

Students will be able to:

- Understand higher consciousness and how to attain it.
- To understand philosophy of pure consciousness
- To understand relation of mind and body
- To identify stressors and manage them

Course Outcome

At the end of this course, the students should be able to:

- Learns the higher consciousness and how to attain it.
- Understands philosophy of pure consciousness
- Understands relation of mind and body
- Identifies stressors and stress management

SYLLABUS

Yoga: Royal Road to Higher Consciousness: Consciousnessor Chaitanya in Mandukya Upanishad, Bhagavad Gita, Yoga Sutras, Astavakra Gita; methods of accessing higher states of consciousness – overcoming body consciousness, overcoming mind consciousness; higher consciousness and person transformation; higher consciousness and parapsychic powers (siddhis).

Vedanta: A Philosophy of Pure Consciousness – Consciousness according to Advaita, Dvaitaand Visistadvaita schools, Consciousness according to Nyaya, Vaisesika and Sankya Schools. Self - awareness – Ramana Maharshi; Buddhism: A Psychology of Consciousness: - viññā a,5aggregates,12nidhanasm, cetasikas, nirvana.
The Mind-Body Relationship, the concept of Psychological Health in India, Scope of Health Psychology Emergence of Behavioural Medicine.

Stress – Stressors: Environmental, Social and Psychological, stress and illness, control and stress.

Reference Books:

1. S. Menon, B.V.Sreekantan, Anindya Sinha, Philip Clayton, R Narasimha (2004). Science and Beyond: Cosmology, consciousness and technology in Indic traditions. National Institute of Advanced Studies, Bangalore
2. Nakamura (1989).Indian Buddhism, Motilāl Banārsidass,Delhi.
3. Goleman,D & Gurin,J.(1993).Mind– Body Medicine,NewYork.

EEPS 1.6(h): PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objective

Students will be able to:

- To learn holistic development through neetisatakam
- To learn how to deal with day to day work and duties
- To learn to apply basic knowledge from BhagwadGeetha to daily life

Course Outcome

At the end of this course, the students should be able to:

- Learns holistic development through neetisatakam
- Able to deal with day to day work and duties
- Able to apply basic knowledge from BhagwadGeetha to daily life

SYLLABUS

Neetisatakam- Holistic development of personality

- Verses-19,20,21,22(wisdom)
- Verses-29,31,32(pride&heroism)
- Verses-26,28,63,65(virtue)
- Verses-52,53,59(dont's)
- Verses-71,73,75,78(do's)

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta:Chapter2-Verses41,47,48,
- Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
- Chapter18-Verses45,46,48.

Statements of basic knowledge.

- ShrimadBhagwadGeeta:Chapter2-Verses56,62,68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. Shrimad Bhagwad Geeta:

- Chapter2-Verses17,Chapter3-Verses36,37,42,
- Chapter4-Verses18,38,39
- Chapter18–Verses37,38,63

REFERENCE BOOKSS:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath
3. Rashtriya Sanskrit Sansthanam,NewDelhi.

EEPS 1.7: POWER SYSTEM SIMULATION LAB-1

Course Objective

Students will be able to:

- To understand the formation of Y and Z bus matrices.
- To understand the load flow analysis of gauss seidel , newton raphson and fast decoupled method
- To understand the economic dispatch in power system with and without losses.
- To perform fault analysis and load frequency control with and without AGC.
- To understand stability of power system during fault condition and to calculate AC and DC voltage distribution.

Course Outcome

At the end of this course, the students should be able to:

- To form the Y bus and Z bus matrices for a given power transmission system.
- Ability to perform the load flow analysis on given power system.
- Develop a program to obtain economic dispatch of a power system.
- Develop a program to illustrate fault analysis and load frequency control on given power system.
- Develop a program to stability studies and voltage drop calculation on distribution system.

LIST OF EXPERIMENTS

1. Formation of Y-Bus matrix for a 5-bus power system network using inspection method in MATLAB.
2. Formation of Z-bus matrix for a 5-bus power system using Z-bus building algorithm.
3. Load flow analysis of 5-bus power system with PQ and PV buses using Gauss seidel method.
4. Load flow analysis of 5-bus power system with PQ and PV buses using Newton raphson method.
5. Load flow analysis of 5-bus power system with PQ and PV buses using Fast decoupled method.
6. Economic dispatch in a power system with and without losses using lagrange method.
7. Determination of fault current and voltages in a transmission line under L-L, L-L-G, L-L-L fault conditions.
8. Load frequency control of single area with and without AGC(Automatic generator control).
9. Power system transient stability study of single machine power system under a selected fault condition.
10. Voltage drop calculation in AC and DC distribution systems.

EEPS 1.8: POWER SYSTEM AND PROTECTION LAB

Course Objective

Students will be able to:

- To study characteristics of different types of electromechanical relays.
- To study characteristics of microprocessor based relays in different modes.
- To understand the static negative sequence relay.
- To perform the over current and directional protection in matlab Simulink.
- To study the single phase differential relay test kit.

Course Outcome

At the end of this course, the students should be able to:

- Ability to understand and analysis power systems equipment protection and their operation.
- Ability to apply the over current protection scheme in power system.
- Ability to apply under and over voltage relays in transmission line protection.
- Develop a matlab Simulink model for over current and directional protection relays.
- Ability to test the single phase differential relay test kit.

LIST OF EXPERIMENTS

1. To study the operation of electro mechanical relay type under voltage relay.
2. To study the operation of overcurrent relay in transmission line protection.
3. To study the operation of under voltage and over voltage relays in transmission line protection.
4. To study the operation of microprocessor based directional and non directional relay by DMT and IDMT method.
5. To study the operation of negative sequence current relay in transmission line.
6. To study the operation of microprocessor based directional and non directional relay by PC mode.
7. To study the simulation of over current relay.
8. To study the operation of single phase differential relay kit.
9. To study the transmission line fault detection, classification and location estimation using distance relays.
10. To study the impacts of power swing on distance relay based transmission line protection.

EEPS 2.1: ELECTRICAL DISTRIBUTION SYSTEMS AND AUTOMATION

Course Objectives

To enable the student to:

- To study the transmission and distribution systems.
- To learn the importance of economic distribution of electrical energy
- To study the concepts of voltage drop and power loss.
- To study the distribution system substation and loads
- To study the distribution system automation functions.
- To study the distribution system load flow algorithms

Course Outcomes

By the end of the course, student will be able to:

- Understand the transmission and distribution systems.
- Determine the voltage drop and power loss.
- Understand the distribution system substation and loads.
- Understand distribution system automation functions
- Understand the distribution system load flow algorithms.

SYLLABUS

Distribution System Fundamentals : Brief description about electrical power transmission and distribution systems, Different types of distribution sub-transmission systems, Substation bus schemes, Factors effecting the substation location, Factors effecting the primary feeder rating, types of primary feeders, Factors affecting the primary feeder voltage level, Factors affecting the primary feeder loading.

Distribution System Substations and Loads: Substations: Rating of a distribution substation for square and hexagonal shaped distribution substation service area, Derivation of K constant, Radial feeder with uniformly and non-uniformly distributed loading. **Loads:** Various types of loads, Definitions of various terms related to system loading, detailed description of distribution transformer loading, feeder loading, Modelling of star and delta connected loads, two-phase and single-phase loads shunt capacitors.

Distribution System Load Flow : Exact line segment model, Modified line model, approximate line segment model, Review of the two-winding transformer theory, two-winding auto transformer, Step-Voltage Regulators, Line drop compensator, Forward/Backward sweep distribution load flow algorithm.

Voltage Drop And Power Loss Calculation : Detailed analysis of non-three phase primary lines, concepts of four-wire multi-grounded common-neutral distribution system, Percent power loss calculation, Distribution feeder cost calculation methods, Capacitor installation types, types of three-phase capacitor-bank connections, Economic justification for capacitors.

Distribution automation functions: Electrical system automation, EMS functional scope, DMS functional of DMS–Steady state and dynamic performance improvement;Geo graphic information systems – AM/FM functions and Database management; communication options, supervisory control and data acquisition: SCADA functions and system architecture; Synchro phasors and its application in power systems.

Text Books:

1. William H. Kersting, “Distribution System Modelling and Analysis”, CRC Press, Newyork,2002.
2. Turan Gonen, “Electric Power Distribution System Engineering”, McGraw-Hill Inc., New Delhi,1986.
3. Juan M Gers, “Distribution System Analysis and Automation”, The Institution of Engineering and Technology, London,UK, 2013.

EEPS 2.2: AUTOMATION IN POWER SYSTEMS

Course Objectives

To enable the student to:

- To learn fundamentals of power system automation.
- To study SCADA, its objectives and its importance in power systems.
- To study different communication in power system automation.
- To learn power system automation architectures.
- To study substation and feeder automations.

Course Outcomes

By the end of the course, student will be able to:

- Understand the fundamentals of power system automation.
- Understand different communication in power system automation.
- Understand power system automation architectures.
- Understand substation and feeder automations.
- Understand SCADA, its objectives and its importance in power systems.

SYLLABUS

INTRODUCTION TO POWER SYSTEM AUTOMATION: Historical development of power system automation, Fundamentals of electrical protection and automatic power control system, development of protective relays, controller relays and relaying devices, elements of automation systems.

SCADA: Basis of a real-time control system (SCADA), Requirement and background, SCADA system principles, Data acquisition, monitoring and event processing, control functions, data storage, archiving and analysis; hardware system configurations, SCADA programming, SCADA master station.

COMMUNICATION IN POWER SYSTEM AUTOMATION: Basics of data communication, The OSImodel, Media access control principles, CSMA/CD Ethernet MAC, Fullduplex Ethernet,Communicationprotocols,Mode bus and Mode bus TCP/IP, Profibus, TCP/IP,DNP3, IEC61850

POWER SYSTEM AUTOMATION ARCHITECHURES: Types of power system automation architecture, Automation of HV substations, automation of MV substations, principles and functions of distribution automation, substation automation and feeder automation.

Substation Automation: State and trends of substation automation, intelligent affordable substation monitoring and control, Standard for substation automation – Logical Nodes (LN),LogicalDevice(LD),IntelligentElectronicDevices(IEDs),Processlevelfunctions,Baylevelfunctions,StationLevelFunctions, Station Bus and ProcessBus

Text Books:

1. Helfrick–Cooper,Modern electric instrumentation and measurement technique,PHI1994.
2. T.S.Rathore, Digital measurement techniques, Narosa publishingHouse,1996.
3. JohnWebb, Ronald Reis-Programmable Logic Controllers,PHI,2003.
4. Klaus-Peter and Others – Substation Automation Handbook, Utility Automation Consulting Lohmann, ISBN3-85758-951-5
5. PIZabolotny,“AutomationinElectricalPowerSystems”,MIRPublishers,Moscow.

6. James Northcote-Green and Robert Wilson, “Control and Automation of Electrical Power Distribution Systems”, CRC Taylor &Francis, NewYork,2007.
7. M K Khedkar and G M Dhole, “A Textbook of Electric Power Distribution Automation”, University Science Press, New Delhi,2010.

EEPS 2.3(a): REALTIME CONTROL OF POWER SYSTEMS

Course Objectives

To enable the student to:

- To understand the importance of state estimation in power systems.
- To know the importance of security and contingency analysis.
- To understand SCADA, its objectives and its importance in power systems.
- To know the significance of voltage stability analysis.
- To know the applications of AI to power systems problems.

Course Outcomes

By the end of the course, student will be able to:

- Calculate the transmission line parameters.
- Calculate the field effects on EHV and UHV AC lines.
- Determine the corona, RI and audible noise in EHV and UHV lines.
- Analyse voltage control and compensation problems in EHV and UHV transmission systems.
- Understand reactive power compensation using SVC and TCR

SYLLABUS

Power System Security: Introduction, Factors affecting the power system security, Contingency analysis procedure, Linear sensitivity factors: Line outage distribution factors and Generation shift factors, and its derivation; AC power flow method, contingency selection.

Voltage Control : Production and absorption of reactive power, Methods of voltage control, Shunt reactors, Shunt capacitors, Series capacitors, Synchronous condensers, Static Var systems, Principles of transmission system compensation, Modelling of reactive compensating devices, Application of tap-changing transformers to transmission systems, Distribution system voltage regulation, Modelling of transformer ULTC control systems.

Voltage Stability: Basicconceptsrelatedtovoltagestability–Transmissionsystemcharacteristics, Generator characteristics, Load characteristics, reactive compensating devices characteristics; Voltage collapse – Typical scenario, General characterisation, Classification of voltage stability; Voltage stability analysis – Modelling requirements, Dynamic analysis, Static analysis, Determination of shortest distance to instability, continuation power flow analysis, Prevention of voltage collapse.

Synchro phasor Measurement units: Introduction, Phasor representation of sinusoids, a generic PMU,GPS,Phasormeasurementsystems,CommunicationoptionsforPMUs,Functional requirements of PMUs and PDCs, Phasors for nominal frequency signals, types of frequency excursions in power systems, DFT estimation at off nominal frequency with a nominal frequency clock.

Operation of Modern Power Systems: Principle of economics ,utility functions, power exchanges, electricity market models, market power indices, ancillary services, transmission and distribution charges, principles of transmission charges, transmission pricing methods, demand-side management, regulatory framework.

Text Books:

1. Allen J.Wood, Bruce F.Wollenberg and Gerald B Sheble “Power Generation, Operation and Control”, John Wiley & Sons, Inc., NewJersey,3nd edition,2014.

2. Prabha Kundur, “Power System Stability and Control”,McGraw-Hill,Inc.,New Delhi,1994.
3. A G Phadke and J S Thorp, “Synchronized Phasor Measurements and Their Applications”, Springer, 2008.
4. Power System Engineering, D P Kothari and I J Nagrath, McGraw Hill Education India Pvt. Limited, Chennai, 3e, 2019.

EEPS 2.3(b) :ADVANCED POWER SYSTEMS PROTECTION

Course Objectives

To enable the student to:

- To know construction of static relays
- To understand the operation of amplitude and phase comparators
- To comprehend the concepts of Static over current, static differential and static distance relays.
- To know the operation of microprocessor based protective relays.

Course Outcomes

By the end of the course, student will be able to:

- Describe the construction of static relay and identify the advantages of static relay over electromagnetic relay.
- Explore the operation of rectifier bridge comparators, instantaneous comparators, phase comparators, multi input comparators, static differential and distance relays
- Describe instantaneous, definite time and inverse definite minimum time over current relays.
- Analyze the concept of power swings on distance relays and to identify the microprocessor based protective relays and their operation

SYLLABUS

Static Relays classification and Tools : Composition of Static with Electromagnetic Relays, Basic classification, Level detectors and Amplitude and phase Comparators – Duality – Basic Tools –Schmitt Trigger Circuit, Multi-vibrators, Square wave Generation–Polarity detector–Zero crossing detector – Thyristor and UJT Triggering Circuits. Phase sequence Filters – Speed and reliability of static relays.

Amplitude and Phase Comparators (2 Input) : Generalized equations for Amplitude and Phase comparison – Derivation of different characteristics of relays – Rectifier Bridge circulating and opposed voltage type amplitude comparators – Averaging & phase splitting type amplitude comparators – Principle of sampling comparators. **Phase Comparison :** Block Spike and phase Splitting Techniques–Transistor Integrating type, phase comparison, Rectifier Bridge Type Comparison–Vector product devices.

Static over current (OC) relays – Instantaneous, Definite time, Inverse time OC Relays, static distance relays, static directional relays, static differential relays, measurement of sequence impedances in distance relays, multi input comparators, elliptic & hyperbolic characteristics, switched distance schemes, Impedance characteristics during Faults and Power Swings.

PILOT Relaying schemes: Wire pilot protection: circulating current scheme – balanced voltage scheme – translay scheme – half wave comparison scheme – carrier current protection: phase comparison type–carrier aided distance protection–operational comparison of transfer trip and blocking schemes–optical fibre channels.

Microprocessor based relays and Numerical protection: Introduction – over current relays – impedance relay – directional relay – reactance relay. **Numerical Protection:** Introduction –

numerical relay – numerical relaying algorithms – mann – Morrison technique – Differential equation technique and discrete fourier transform technique–numerical over current protection–numerical distance protection.

Text Books:

1. Power System Protection with Static Relays–by TSM Rao,TMH.
2. Power System Protection & Switch gear by Badri Ram & DN Viswakarma,TMH.
3. Protective Relaying Vol-II Warrington, Springer.
4. Art &Science of Protective Relaying –CR Mason,Willey.
5. Power System Stability Kimbark Vol-II,Willey.
6. Electrical Power System Protection–C.Christopoulos and A.Wright-Springer.
7. Protection & Switchgear–Bhavesh Bhalaja, R.P Maheshwari, Nilesh G. Chothani-Oxford publisher.

EEPS 2.3(c): FACTS MODELLING AND SIMULATION

Course Objectives

To enable the student to:

- To understand the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits.
- To Repeat the various fundamental concepts required to analyse the modelling of FACTS devices.
- To analyse the impact of FACTS devices used for shunt and series compensations.
- To Explain the impact of STATCOM, UPSC, HVDC-VSC, etc. devices on power system performance.
- To apply the optimal power flow concepts in the presence of FACTS devices.

Course Outcomes

By the end of the course, student will be able to:

- Relate the basic power system concepts required for modelling FACTS controllers.
- Related various fundamental concepts like power flow, tap changes, etc., required to analyse the modelling of FACTS devices.
- compare the impact of FACTS devices used for shunt and series compensations with power systems without FACTS devices.
- Compute the impact of STATCOM, UPSC, HVDC-VSC, etc. devices on power system performance.
- Prepare optimal power flow models of the system under consideration in the presence of FACTS devices.

SYLLABUS

Modeling of FACTS controllers: Modeling philosophy, Controllers based on conventional thyristors, Power electronics controllers based on fully controlled semi conductor devices, Control capabilities of controllers based on voltage source converters.

Power flow solutions: Newton-Raphson load flow method, Fast decoupled load flow method, Constrained power flow solutions–Loadtap-changing transformers, Phase shifting transformers, Truncated adjustments, Special load tap changer configurations.

FACTS Simulation–I: Power flow solutions including FACTS controllers, Static Var compensator – Conventional power flow models, Shunt variable susceptance model, Firing Angle model, Integrated transformer firing angle model, Nodal voltage control using static Var compensators, Control coordination between reactive sources; TCSC–Variable series impedance power flow model, Firing angle power flow model, Numerical properties of TCSC power flow model.

FACTS simulation – II : Static synchronous compensator power flow model, UPFC power flow model, HVDC-VSC–power flow equations, back-to-back model, full model.

FACTS simulation – III : Optimal Power Flow with power flow controllers – Load tap-changing transformer, Phase-shifting transformer, StaticVar Compensator, TCSC and UPFC.

Text Books:

1.Enrique Acha, Claudio R Fuerte-Esquivel, Hugo Ambriz-Perez and Cesar Angeles-Camacho, “FACTS modeling and simulation in power network”, John Wiley & Sons Ltd., Chichester, UK,2004.

EEPS 2.4(a): PROGRAMMABLE LOGIC CONTROLLERS & APPLICATIONS

Course Objectives

To enable the student to:

- An introduction to programmable logic controllers (PLCs),
- To process control algorithms.
- To simulation and networking.
- To know PID principles, position indicator with PIDcontrol, PID modules, PID tuning , PID functions.

Course Outcomes

By the end of the course, student will be able to:

- Demonstrate knowledge of programmable logic controllers.
- Demonstrate knowledge of process control systems.
- Program using ladder logic programming of software.
- Design PLC based system for process control.

SYLLABUS

PLC Basics: PLC System, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils, Drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flowchart for spray process system.

PLC Registers: Characteristics of Registers, module addressing, holding registers, input registers, output registers, PLC Functions: Timer functions and Industrial applications, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

Data Handling functions: SKIP, Master control Relay, Jump, Move, FIFOFAL, ONS, CLR and Sweep functions and their applications, Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axis and three axis Robots with PLC, Matrix functions..

Analog PLC operation: Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

Text Books:

1. Programmable Logic controllers-Principle and Applications by JohnW.Webb and Ronald A.Reiss, Fifth Edition, PHI
2. Programmable Logic Controllers Programming Method and Applications by JR.Hackworth and F.DHackworth Jr. –Pearson,2004.

Reference Books:

1. Introduction to Programmable Logic Controllers-Gary Dunning–Cengage Learning.
2. Programmable Logic controllers-W.Bolton-Elsevier publisher.

EEPS 2.4(b): RENEWABLE ENERGY TECHNOLOGIES

Course Objectives

To enable the student to:

- To learn the technical challenges in Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics.
- To learn the basics of wind energy conversion & PV power generation.
- To outline utilization of renewable energy sources for both domestic and industrial applications.
- To solve the problems related to Calculation of Electricity Generation Costs.
- Understanding the concepts of fuel cells: the fuel cell.
- Discussion of the concepts of Photovoltaic Effect.

Course Outcomes

By the end of the course, student will be able to:

- Demonstrate the various general aspects of renewable energy technologies Debate various issues related to reactive power issues in power systems.
- Review and analyze engineering problems reaching substantiated conclusions using first principles of analyzing induction generator for power generation from wind, fuel cell, PV cells, and Induction generators.
- Designing the induction generator for power generation from wind, fuel cell, PV cells, Induction generators and MPPT controller for solar power utilization.
- Problem solving in the various concepts related to utilization wind, fuel cell, PV cells systems for power generation.
- To understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for wind, fuel cell, PV cells and Induction generators.

SYLLABUS

Introduction: Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics – Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power systems.

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

Wind Power Plants: Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation – General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines – Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system.

Photovoltaic Power Plants: Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance input-output Characteristics–Equivalent Models and Parameters for Photovoltaic Panels; MPPT schemes: P&O, INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy.

Fuel Cells: The Fuel Cell; Low– and High–Temperature Fuel Cells; Commercial and Manufacturing Issues–Constructional Features of Proton Exchange-Membrane Fuel Cells; Reformers; Electrolyser Systems; Advantages and Disadvantages of Fuel Cells – Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters ; Aspects of Hydrogen for storage.

Text Books:

1. Felix A.Farret, M.Godoy Simo'es, Integration of Alternative Sources of Energy, John Wiley & Sons, 2006.
2. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley& Sons, 2011.
3. Gilbert M.Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

EEPS 2.4(c): POWER QUALITY IMPROVEMENT

Course Objectives

To enable the student to:

- Understand the significance of power quality, its types and to study various harmonic indices.
- To study the various types of harmonics and its effects on rotating machines and various control and protection strategies.
- Analyse various types of filters and its configuration with different types of control strategies
- Understand the various voltage quality standards and the sources of unbalanced voltages and harmonics.
- Understand various voltage quality improvement devices and its operation.

Course Outcomes

By the end of the course, student will be able to:

- Students will be able to understand the significance of power quality, its types and to study various harmonic indices.
- Students will be able to analyse various types of filters and its configuration with different types of control strategies.
- Students will be able to understand various voltage quality standards and the sources of unbalanced voltages and harmonics and methods to improve it.

SYLLABUS

Introduction: Significance of power quality, Various power quality parameters, Voltage vs Current distortion, Harmonic indices – THD, TDD; Harmonic analysis, Harmonic phase sequence, Triplen harmonics,Inter harmonics.

Harmonics effects: Sources of harmonics, Resonance, effects of harmonics on rotating machine, measuring instruments, ripple control systems, power system protection, consumer equipment, communication systems.

Harmonic elimination : Passive filters – design, advantages and disadvantages; Shunt active filters – Principle of operation, configurations, design and control strategies; Three phase four wire shunt active power filters.

Voltage Quality : Sources of Sags, Swell, Unbalance and Harmonics; Voltage quality standards, effects of Sags, Swell, Unbalance and Harmonics; Voltage sag due to faults, sag calculations, classification of voltage sags, voltage sag transformation due to transformers.

Voltage Quality Improvement: Principle of operation, configuration, design and control strategies of series active power filters, three phase four wire series active power filters, UPQC principle, topologies.

Text Books:

1. Dugan Roger C, Santoso Surya, McGranaghan, Marks F Beaty and H Wayre, " Electrical Power System Quality",McGraw Hill, 3rd edition,2012.
2. J Arrilaga and N R Watson,"Power System Harmonics", John Wiley & Sons Ltd., 2nd edition, 2003.

3. Hirofumi Akagi, Edson Hirokazu Watanabe and Mauricio Aredes, “Instantaneous Power Theory and Applications to Power Conditioning”, Wiley-IEEE Press,2007.
4. Math H Bollen, “Understanding Power Quality Problems”,IEEE Press.

EEPS 2.5(a): ENGLISH FOR RESEARCH PAPER WRITING

Course objectives

To enable the student to:

- Improving academic writing skills.
- Building knowledge of research writing conventions.
- Developing vocabulary for academic writing.
- Enhancing critical thinking and analysis
- Providing feedback and peer review.

Course Outcomes

By the end of the course, student will be able to:

- Enhancing one's ability to write academically.
- Acquiring an understanding of the conventions of research writing.
- Expanding one's vocabulary in preparation for academic writing.
- Improving one's capacity for analytical and critical thinking
- Giving feedback and participating in peer reviews.

SYLLABUS

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

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

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

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.

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

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

Reference Books:

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

EEPS 2.5(b): DISASTER MANAGEMENT

Course objectives

To enable the student to:

- Understanding disasters and their impacts.
- Developing emergency response skills.
- Building knowledge of disaster risk reduction.
- Enhancing community preparedness.
- Promoting disaster recovery and rehabilitation.

Course Outcomes

By the end of the course, student will be able to:

- Having an understanding of natural disasters and the effects they have.
- Improving emergency response abilities.
- Expanding one's understanding of how to mitigate the effects of disasters.
- Improving the level of readiness among the community.
- Facilitating post-disaster recovery and reconstruction efforts.

SYLLABUS

Introduction to Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters :Difference, Nature, Types and Magnitude.

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

Disaster Prone Areas in India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference Books To Tsunami; Post-Disaster Diseases And Epidemics

Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports : Governmental And Community Preparedness.

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

Disaster Mitigation Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Reference Books:

1. R.Nishith, Singh AK, "Disaster Management in India : Perspectives ,issues and strategies New Royal book Company.

2. Sahni, Pardeep Et.Al.(Eds.),"Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt.Ltd., New Delhi.

EEPS 2.5(c): SANSKRIT FOR TECHNICAL KNOWLEDGE

Course objectives

To enable the student to:

- Building proficiency in reading technical texts.
- Developing a technical vocabulary in Sanskrit.
- Understanding Sanskrit grammar and syntax.
- Enhancing translation skills.
- Applying Sanskrit knowledge to contemporary technical fields.

Course Outcomes

By the end of the course, student will be able to:

- Improving one's reading skills with regard to specialized books.
- Expanding one's Sanskrit vocabulary with specialized terms.
- Knowing Sanskrit grammar and syntax.
- Improving translation skills.
- Using one's knowledge of Sanskrit in contemporary scientific and technological sectors.

SYLLABUS

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Order - Introduction of roots - Technical information about Sanskrit Literature

Technical concepts of Engineering-Electrical, Mechanical,Architecture,Mathematics

Reference Books:

1. Abhyaspustakam"–Dr.Vishwas,Samskrita-Bharti Publication,New Delhi
2. TeachYourselfSanskrit"PrathamaDeeksha Vempati Kutumbshastri ,Rashtriya Sanskrit Sansthanam, New Delhi Publication.
3. India's Glorious Scientific Tradition"SureshSoni, Ocean books (P) Ltd., New Delhi.

EEPS 2.5(d): VALUE EDUCATION

Course objectives

To enable the student to:

- Developing ethical and moral values.
- Fostering a positive attitude and mindset.
- Encouraging social responsibility and civic engagement.
- Enhancing intercultural and interpersonal understanding.
- Encouraging environmental awareness and sustainability

Course Outcomes

By the end of the course, student will be able to:

- The formation of ethical and moral principles.
- Cultivating a constructive frame of mind and optimistic attitude.
- Motivating individuals to take on more civic and social responsibilities.
- Improving both the understanding between individuals and between cultures.
- Promoting environmental consciousness as well as sustainable practises

SYLLABUS

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

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

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

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

Reference Books:

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

EEPS 2.5(e): CONSTITUTION OF INDIA

Course objectives

To enable the student to:

- Acquiring an understanding of the structure and operation of the Indian Constitution.
- Knowing one's rights and obligations as a citizen of India.
- Familiarity with Indian politics.
- An understanding of Indian law is fundamental.
- Hone one's analytical skills by learning to dissect intricate problems in law and government.

Course Outcomes

By the end of the course, student will be able to:

- Learning how the Indian Constitution is put together and how it works.
- Being aware of one's basic freedoms and responsibilities as an Indian citizen.
- Familiarity with Indian politics.
- Familiarity with Indian law as an essential aspect.
- Learning to think critically and analyze complex political and legal concerns.

SYLLABUS

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

Philosophy of the Indian Constitution: Preamble- Salient Features

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

Organs of Governance: Parliament - Composition - Qualifications and Disqualifications – Powers and Functions – Executive - President- Governor - Council of Ministers - Judiciary, AppointmentandTransferofJudges,Qualifications-PowersandFunctions

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

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

Reference Books:

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

EEPS 2.5(f): PEDAGOGY STUDIES

Course objectives

To enable the student to:

- Increase the critical awareness of pedagogy's principles, theories, and practices and their implications for teaching and learning in many educational contexts.
- Examine how pedagogy affects social, cultural, and political settings that determine schooling.
- Evaluate various pedagogical methods and initiatives for student learning and engagement.
- Evaluate one's teaching and learning practises and find opportunities for improvement.
- Use pedagogical knowledge to create, administer, and evaluate engaging, relevant learning experiences.

Course Outcomes

By the end of the course, student will be able to:

- Develop a critical understanding of the principles, theories, and practices of pedagogy and their implications for teaching and learning in various educational contexts.
- Explore the relationship between pedagogy and the broader social, cultural, and political contexts that shape educational systems and practices.
- Analyze different pedagogical approaches, techniques, and strategies, and evaluate their effectiveness in promoting student learning and engagement.
- Reflect on one's own pedagogical practices and beliefs, and identify areas for growth and improvement in teaching and learning.
- Synthesize and apply pedagogical knowledge to design, implement, and assess learning experiences that are engaging, relevant.

SYLLABUS

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

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

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

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

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

Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare,31(2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculumStudies,36(3):361-379.
3. Akyeampong K (2003)Teacher training in Ghana-does it count? Multi-site teacher education research project(MUSTER) country report. london: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development,33(3):272–282.
5. Alexander RJ(2001)Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

EEPS 2.5(g): STRESS MANAGEMENT BY YOGA

Course objectives

To enable the student to:

- Learn how yoga can alleviate stress and its affects on the body and mind.
- Learn yoga postures, breathing techniques, and relaxation exercises to calm the mind, ease tension, and improve health.
- Regular yoga and stress management promote physical, mental, and emotional wellbeing.
- Practice self-care and mindfulness outside of yoga to manage stress.
- Develop tools to relax and balance under stress and uncertainty by increasing awareness of the mind-body link.

Course Outcomes

By the end of the course, student will be able to:

- Understand the causes and effects of stress on the body and mind, and explore how yoga can be used as a tool to manage and reduce stress levels.
- Learn various yoga postures, breathing techniques, and relaxation exercises that can be used to calm the mind, relieve tension in the body, and promote overall wellbeing.
- Develop a regular yoga practice and integrate stress management techniques into daily routines, leading to improved physical, mental, and emotional health.
- Recognize the importance of self-care and mindfulness practices in managing stress, and apply these techniques to other areas of life beyond the yoga mat.
- Cultivate a deeper awareness of the mind-body connection and develop tools to create a sense of calm and balance during times of stress and uncertainty.

SYLLABUS

Yoga: Royal Road to Higher Consciousness: Consciousness or Chaitanya in Mandukya Upanishad, Bhagavad Gita, Yoga Sutras, Astavakra Gita; methods of aces sing higher states of consciousness Over coming body consciousness, overcoming mind consciousness; higher consciousness and person trans formation; higher consciousness and parapsychic powers(siddhis).

Vedanta: A Philosophy of Pure Consciousness – Consciousness according to Advaita, Dvaita and Visistadvaita schools, Consciousness according to Nyaya, Vaisesika and Sankya Schools. Self -awareness–RamanaMaharshi; Buddhism: A Psychology of Consciousness:-viññāa,5aggregates,12nidhanasm, cetasikas,nirvana.
The Mind-Body Relationship, the concept of Psychological Health in India,Scope of Health Psychology Emergence of Behavioural Medicine.

Stress–Stressors: Environmental,SocialandPsychological,stressandillness,control and stress.

Reference Books:

1. S. Menon, B.V.Sreekantan, Anindya Sinha, Philip Clayton, R Narasimha (2004). Science and Beyond: Cosmology, consciousness and technology in Indictraditions. National Institute of Advanced Studies,Bangalore
2. Nakamura (1989).Indian Buddhism,MotilālBanārsidass, Delhi.
3. Goleman,D &Gurin,J.(1993).Mind –Body Medicine,NewYork.

EEPS 2.5(h): PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course objectives

To enable the student to:

- Enhancing self-awareness.
- Improving communication skills.
- Building confidence and self-esteem.
- Cultivating emotional intelligence.
- Fostering personal growth and resilience.

Course Outcomes

By the end of the course, student will be able to:

- Improving one's level of self-awareness
- Developing one's capacity for effective communication
- Increasing one's self-confidence and sense of worth.
- Developing one's emotional quotient through practise.
- Encouragement of personal development and resiliency.

SYLLABUS

Neetisatakam- Holistic development of personality

- Verses-19,20,21,22(wisdom)
- Verses-29,31,32(pride&heroism)
- Verses-26,28,63,65(virtue)
- Verses-52,53,59(dont's)
- Verses-71,73,75,78(do's)

Approach today to day work and duties.

- ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
- Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
- Chapter18-Verses45,46,48.

Statements of basic knowledge.

- ShrimadBhagwadGeeta:Chapter2-Verses56,62,68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. ShrimadBhagwadGeeta:

- Chapter2-Verses17,Chapter3-Verses36,37,42,
- Chapter4-Verses18,38,39
- Chapter18–Verses37,38,63

Reference Books:

1. "Srimad Bhagavad Gita"by Swami Swarupananda Advaita Ashram
2. Bhartrihari's Three Satakam(Niti-sringar-vairagya) by P.Gopinath
3. Rashtriya Sanskrit Sanstha nam,New Delhi.

EEPS 2.6: POWER SYSTEM SIMULATION LAB-II

Course objectives

To enable the student to:

- To understand single and two area load frequency control.
- To understand the tuning of 2^{nd} order controllers.
- To study shunt capacitor compensation in transmission line
- To stud the various parameters and Ferranti effect of transmission line.
- To understand AVR and power flow control using UPFC.

Course Outcomes

By the end of the course, student will be able to:

- Ability to perform the single and two area load frequency control.
- Ability to Develop a Simulink model to understand tuning of 2^{nd} order controllers.
- Analyse shunt capacitor compensation in transmission line
- Analyse the Ferranti effect and transmission line parameters.
- Ability to understand AVR and power flow control using UPFC.

LIST OF EXPERIMENTS

1. Load frequency control of single area power system using supplementary control.
2. Load frequency control of two area power system using supplementary control.
3. Tuning of second order systems using classical P,PI,PD and PID controllers.
4. Control of generator terminal voltage using automatic voltage regulator.
5. Power flow control of transmission system using UPFC.
6. Determination of Ferranti effect of long transmission lines.
7. Determination of ABCD parameters of transmission lines.
8. To study the effect of shunt capacitor compensation in transmission line.
9. To study the power factor correction using capacitor banks across load.
10. To evaluate the string efficiency of a suspension insulator.

EEPS 2.7: SMART GRID LABORATORY

Course objectives

To enable the student to:

- To understand the features of Smart Grid
- To assess the role of automation and digitization in Smart grids and distribution
- To understand the Design and Implementation of IoT Based monitoring and control in smart Grids
- To understand the Design and Implementation of different MPPT Charge Controllers
- To learn Arduino based Smart Energy Monitoring in smart Grid

Course Outcomes

By the end of the course, student will be able to:

- Understand the principles and technologies behind smart grids, including advanced sensing, communication, control i.e IoT and Arduino.
- Design and analyze smart grid systems using software tools for modeling, simulation.
- Implement and test smart grid systems using hardware and software platforms for real-time control and monitoring.
- Understands the basics and modelling of smart grids
- Will be able to assess the automation and digitalization in the grid systems
- Able to implement IoT and Arduino based monitoring and control for smart grid systems
- Able to implement energy management for grids with energy storage devices

LIST OF EXPERIMENTS

1. Simulation Of Microgrid for for AC and DC supply Loads
2. Analysis of INC logic technique in pv system
3. Analysis of fuzzy logic technique in pv system
4. Buck Converter based Battery Charger for Wind & Solar Energy Conversion
5. IoT based Energy Monitoring System using Solar Energy
6. Dual Management System of Solar Panel using IoT
7. Solar Power Charge Controller
8. Energy Measurement System within microgrid
9. Solar Tracking System Design
10. Arduino based Smart Energy Monitor
11. MPPT Charge Controller using Arduino
12. Solar Tracker Panel with Dual Axis using Auto & Manual Mode
13. Compost Monitoring Powered by Solar
14. Smart Automation System for Controlling Various Appliances using a Mobile Device
15. Design and Implementation of IoT Based Smart Energy Meter
16. Emulation of Vehicle Speed and Impact on Vehicle Event Data Recorder
17. Power Factor Correction in Feeders With Distributed Photovoltaics Using Residential Appliances as Virtual Batteries

EEPS 2.8: SEMINAR

Course Objectives

To enable the student to:

1. Get awareness about Raising Meta-Disciplinary concepts
2. Analyse and design Power Systems concepts
3. learn new expectations, conventions, and ways of structuring an argument when researching and writing in a Power Systems discipline.
4. Strengthen Practices for Reading, and Writing in a Power Systems discipline.
5. Improve Presentation Skills, Discussion Skills, Listening Skills, Argumentative Skills, and Critical Thinking, Questioning, Interdisciplinary Inquiry, Engaging with Big Questions and Studying advanced current trending topics related to power systems.

Course Outcomes

At the end of this course, students has the ability to:

1. Will get awareness about Raising Meta-Disciplinary concepts
2. Analyse and design Power Systems concepts
3. learn new expectations, conventions, and ways of structuring an argument when researching and writing in a Power Systems discipline.
4. Practice for Reading, and Writing in a Power Systems discipline.
5. have Presentation Skills, Discussion Skills, Listening Skills, Argumentative Skills, and Critical Thinking, Questioning, Interdisciplinary Inquiry, Engaging with Big Questions and Studying Major Works

EEPS 3.1(a): POWERSYSTEM DEREGULATION

Course Objectives

To enable the student to:

- To infer the fundamentals of Electricity Markets in operating the power systems.
- To mind-map the various models of electricity structure owernerships/managements.
- To deduce the frame work and various methods to analyse the bilateral and pool markets.
- To illustrate the Power wheeling and congestion management in transmission networks.
- To annotate Ancillary services and regulatory issues in power sector deregulation.

Course Outcomes

By the end of the course, student will be able to:

- Annotate the fundamentals associated with electricity markets.
- Illustrate various electricity structure ownership/management models.
- Correlate the frame work and different methods to analyse bilateral and pool markets.
- Determine the power wheeling and congestion management of transmission networks.
- Infer various ancillary services and regulatory issues in power system deregulation.

SYLLABUS

Need and conditions for deregulation, Introduction of Market structure, Market Architecture, Spot Market, forward markets and settlements. Review of Concepts: marginal cost of generation, least-cost operation, incremental cost of generation, Power System Operation.

Electricity sector structures Ownership/management, forms of Ownership and management, Different structure model like Monopoly model, Purchasing agency model, wholesale competition model, Retail competition model.

Frame work and methods for the analysis of Bilateral and pool markets, LMP based markets, auction models and price formation, price based unit commitment, country practices.

Transmission network and market power, Power wheeling transactions and marginal costing, transmission costing, Congestion management methods-market splitting, counter-trading; Effect of congestion on LMPs-country practices.

Ancillary Services and System Security in Deregulation, Classifications and definitions, AS management in various markets- country practices. Technical, economic, & regulatory issues involved in the deregulation of the power industry.

Text Books:

1. Power System Economics: Designing markets for electricity–S.Stoft,wiley.
2. Operation of restructured power systems–K.Bhattacharya, M.H.J.BollenandJ.E.Daalder, Springer.

Reference Books:

1. Power generation, operation and control,-J.Wood and B.F.Wollenberg,Wiley.
2. Market operations in electric power systems–M.Shahidehpour, H.YaminandZ.Li,Wiley.
3. Fundamentals of power system economics–S.Kirschen and G.Strbac,Wiley.
4. Optimization principles: Practical Applications to the Operation and Markets of the Electric Power Industry–N.S.Rau, IEEE Press series on Power Engineering.
5. Competition and Choice in Electricity–Sally Hunt and Graham Shuttle worth.

EEPS 3.1(b): POWER SYSTEM RELIABILITY

Course Objectives

To enable the student to:

- To understand the concept of probability theory, Bernoulli trials, density and distribution functions.
- To understand the network modelling, bathtub curves, – reliability measures MTTF, MTTR, MTBF
- To understand Markov chains, frequency of encountering state, evaluate cumulative probability.
- To understand the reliability of a generation system, evaluation of transition rates, cumulative probability.
- To understand composite system reliability analysis, decomposition method, and evaluation of load and energy indices.

Course Outcomes

By the end of the course, student will be able to:

- The student would understand the concept of probability theory, Bernoulli trials, density and distribution functions.
- The student would understand the network modelling, bathtub curves, – reliability measures MTTF, MTTR, MTBF
- The student would understand Markov chains, frequency of encountering state, evaluate cumulative probability.
- The student would understand the reliability of a generation system, evaluation of transition rates, cumulative probability.
- The student would understand composite system reliability analysis, decomposition method, and evaluation of load and energy indices.

SYLLABUS

Basic probability theory–rules for combining probabilities of events–Bernoulli'strails–probability density and distribution functions – binomial – distributions – expected value and standard deviation of binomial distribution.

Network Modelling and Reliability Analysis of Series, Parallel, Series-Parallel networks – complex networks–decomposition method. Reliability functions F(t), R(t), h(t) and their relationship – exponential distributions – Expectedvalue and standard deviation of exponential distribution – Bath tub curve – reliability analysis of series parallel networks using exponential distribution–reliability measures MTTF,MTTR,MTBF

Markov chains – concept of stochastic transitional probability Matrix, Evaluation of limiting state probabilities–Markov processes one component repairable system–time dependent probability evaluation using Laplace transform approach–evaluation of limiting state probabilities using STPM–two component repairable models–Frequency and duration concept -Evaluation of frequency of encountering state, mean cycle time, for one, two component repairable models–evaluationofcumulativeprobabilityandcumulativefrequencyofencountering merged states.

Generation system reliability analysis – reliability model of a generation system – recursive relation for unit addition and removal – load modelling – merging of generation load model – evaluation of transition rates for merged state model–cumulative Probability, cumulative frequency of failure evaluation–LOLP, LOLE.

Composite system reliability analysis, decomposition method – distribution system reliability analysis –radial networks –weathereffects ontransmissionlines – Evaluation of load and energy indices.

Reference Books:

1. Reliability Evaluation of Engg.System–R.Billinton, R.N.Allan, PlenumPress, NewYork.
2. Reliability Modelling in Electric Power Systems–J.Engrenyi,John Wiley,1978,Newyork.
3. An Introduction to Reliability and Maintainability Engineering. Sharies EE beling, TATA Mc Graw Hill–Edition.

EEPS 3.1(c): SMART GRID TECHNOLOGIES

Course Objectives

To enable the student to:

- To understand concept of smart grid and developments on smart grid.
- To understand smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
- To have knowledge on smart substations, feeder automation and application for monitoring and protection.
- To have knowledge on micro grids and distributed energy systems.
- To know power quality aspects in smart grid.

Course Outcomes

By the end of the course, student will be able to:

- Understand smart grids and analyse the smart grid policies and developments in smart grids.
- Develop concepts of smart grid technologies in hybrid electrical vehicles etc.
- Understand smart substations, feeder automation, GIS etc.
- Analyse micro grids and distributed generation systems.
- Analyse the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.

SYLLABUS

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & Smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

Smart Grid Technologies :Part1: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

Smart Grid Technologies: Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage, like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS),Phase Measurement Unit (PMU).

Micro grids and Distributed Energy Resources: Concept of micro grid, need & applications of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources.

Power Quality Management in Smart Grid: Power Quality &EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, SmartGrid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network(WAN).

Text Books:

1. Ali Keyhani, Mohammed N.Marwali,MinDai"Integration of Green and Renewable Energy in Electric Power Systems", Wiley.
2. Clark W.Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. JankaEkanayake, Nick Jenkins, KithsiriLiyanage, LianzhongWu, AkihikoYokoyama, "Smart Grid: Technology and Applications", Wiley
4. Jean Claude Sabonnadiere,NouredinHadjsaid,"Smart Grids",Wiley Blackwell19
5. Peter S.Fox Penner,"Smart Power:Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press;Iedition8Jun2010
6. S.Chowdhury,S.P.Chowdhury,P.Crossley,"Micro grids and Active Distribution Networks. "Institution of Engineering and Technology,30Jun2009
7. Stuart Borlase,"Smart Grids(Power Engineering)",CRCPress
8. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: I", Artech House Publishers July2011.

EEPS 3.2(a): BUSINESS ANALYTICS
(Open Elective)

Course Objectives

To enable the student to:

- Enable all participants to recognise, understand and apply the language, theory and models of the field of business analytics
- Foster an ability to critically analyse, synthesis and solve complex unstructured business problems
- Encourage an aptitude for business improvement, innovation and entrepreneurial action
- Encourage the sharing of experiences to enhance the benefits of collaborative learning
- Instil a sense of ethical decision-making and a commitment to the long-run welfare of both organizations and the communities they serve

Course Outcomes

Upon completion of the subject students will be able to:

- Understand and critically apply the concepts and methods of business analytics.
- Identify, model and solve decision problems in different settings.
- Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity.
- Create viable solutions to decision making problems.

SYLLABUS

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

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

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

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

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.

Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Story telling and Data journalism.

Reference Books:

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

EEPS 3.2(b): INDUSTRIAL SAFETY
(Open Elective)

Course Objectives

To enable the student to:

- Recognize and evaluate occupational safety and health hazards in the workplace.
- Determine appropriate hazard controls following the hierarchy of controls.
- Furthermore be able to analyze the effects of workplace exposures, injuries and illnesses, fatalities.
- The methods to prevent incidents using the hierarchy of controls, effective safety and health management systems and task oriented training.

Course Outcomes

Upon completion of the subject students will be able to:

- Evaluate workplace to determine the existence of occupational safety and health hazards.
- Identify relevant regulatory and national consensus standards along with best practices that are applicable.
- Select appropriate control methodologies based on the hierarchy of controls. Analyze injury and illness data for trends.

SYLLABUS

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

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

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

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

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its

use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Text Books:

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

EEPS 3.2(c): COST MANAGEMENT OF ENGINEERING PROJECTS
(Open Elective)

Course Objectives

To enable the student to:

- Establish systems to help streamline the transactions between corporate support departments and the operating units.
- Devise transfer pricing systems to coordinate the buyer-supplier interactions between decentralized organizational operating units.
- Use pseudo profit centers to create profit maximizing behavior in what were formerly cost centers.

Course Outcomes

Upon completion of the subject students will be able to:

- Understand the concept of strategic cost management, strategic cost analysis – target costing, life cycle costing and Kaizen costing and the cost drive concept.
- Describe the decision-making; relevant cost, differential cost, incremental cost and opportunity cost, objectives of a costing system.
- Understand the meaning and different types of project management and project execution, detailed engineering activities.
- Understand the project contracts, cost behaviour and profit planning types and contents, Bar charts and Network diagram.
- Analyse by using quantitative techniques for cost management like PERT/CPM.

SYLLABUS

Cost: Cost Elements, Pricing, Materials, Labour; Engineering, Equipment, Parts, and Tool; Economic Costs, Activity-Based Cost Management.

Cost Estimating & Planning: Estimating, Process Product Manufacturing, Discrete Product Manufacturing. Planning and Scheduling.

Progress & Cost Control: Progress Measurement and Earned Values, Earned Value for Variable Budgets, Tracking Cost and Schedule Performance, Performance and Productivity Management.

Project Management: Project Management Fundamentals, Project Organization Structure, Project Planning, Project Labour Cost Control, Leadership and Management of Project People, Quality Management, Value Analysis, Contracting for Capital Projects, Strategic Asset Management.

Economic Analysis, Statistics & Probability: Basic Engineering Economics, Applied Engineering Economics, Statistics & Probability, Basic Concepts in Descriptive Statistics, Risk Management.

Reference Books:

1.Charles J.Austin Industrial Engineering & Technology Building,(AG/IT216)

EEPS 3.2(d): COMPOSITE MATERIALS
(Open Elective)

Course Objectives

To enable the student to:

- Explain the mechanical behavior of layered composites compared to isotropic materials.
- Apply constitutive equations of composite materials and understand mechanical behavior at micro and macro levels.
- Determine stresses and strains relation in composites materials.

Course Outcomes

Upon completion of the subject students will be able to:

- Explain the behavior of constituents in the composite materials
- Enlighten the students in different types of reinforcement
- Develop the student's skills in understanding the different manufacturing methods available for composite material.
- Illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.

SYLLABUS

Introduction: Definition of composite 2 material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites.

Performance of structural composites: Basic analytical concepts(Qualitative black box approach and Quantitative analytical approach), Performance analysis by various models (Law of Mixtures, Shear lag model, Laminated plate model, Eshelby's models and Other models, - thermo elasticity, plasticity and creep), Strengthening mechanisms, Stress distribution in fibre and the matrix (shear stress and axial tensile stress in the fibre along its length), critical length of fibre for full strengthening, Analysis of uni axial tensile stress-strain curve of unidirectional continuous and short fibre composites, Estimation of the required minimum amount of fibre and critical amount of fibre to gain a composite strength, Analysis of strength of a composite during loading at an angle to the fibres, Nano-structured composites.

Performance of Composite in Non structural Applications: Composites in Electrical, Super conducting and Magnetic Applications, Nano-composite devices.

Industrial Application of Composite Materials: Civil constructions of structures/pannels, Aerospace industries, Automobile and other surface transport industries, Packaging industries, Household and sports components etc.

Fracture & amp; Safety of Composite: Fracture behavior of composites, Mechanics and Weakest link statistics, Griffith theory of brittle fracture and modification for structural materials, Basic fracture mechanics of composite (Fracture toughness, COD and J-integral approaches, Fatigue crack growth rate), Fracture Mechanics of brittle matrix fibre composite, Fracture mechanics of metal matrix fibre composite, Experimental evaluation (composite), Elementary reliability analysis.

Reference Books:

1. Composite materials, K.K.Chawala, 2nded., (1987) Springer-Verlag, NewYork.Nano composite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003), Wiley-VCHVerlagGmbHCo. KGaA, Weinheim.
2. Mechanics and Analysis of Composite Materials,V.V.Vasilievand E.V.Morozov,(2001), Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5lGB,UK.
3. Ceramic matrix composites,K.K.Chawala,1sted.,(1993),Chapman&Hall,London.
4. Advances in composite materials,G.Piatti,(1978)Applied Science PublishersLtd.,London.

EEPS 3.2(e): WASTE TO ENERGY
(Open Elective)

Course Objectives

To enable the student to:

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

Course Outcomes

Upon completion of the subject students will be able to:

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

SYLLABUS

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

Biomass Pyrolysis: Pyrolysis–Types, slowfast–Manufacture of charcoal–Methods-Yields and application–Manufacture of pyrolytic oils andgases,yields and applications.

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

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

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

TEXTBOOKS:

1. Non-Conventional Energy,Desai,AshokV.,WileyEasternLtd.,1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I&II, Tata McGraw Hill Publishing Co.Ltd.,1983.
3. Food, Feed and Fuel from Biomass, Challal,D.S., IBH Publishing Co.Pvt.Ltd.,1991.
4. Biomass Conversion and Technology, C.Y.WereKo-Brobby and E. B.Hagan, John Wiley & Sons, 1996.

EEPS 3.3: Major Project (Phase-I Dissertation)

EEPS 4.1: Major Project (Phase-II Dissertation)