COURSE STRUCTURE

AND

DETAILED SYLLABUS

For

M. Tech (ELECTRICAL POWER ENGINEERING)
(Model Curriculum)

Academic Year: 2019-20

DEAPRTMENT OF EEE
SREENIDHI INSTITUTE OF SCIENCE & TECHNOLOGY
(An Autonomous Institution approved by UGC and affiliated to JNTUH)
Yamnampet, Ghatkesar Mandal,
Hyderabad - 501301.

SREENIDHI INSTITUTE OF SCIENCE & TECHNOLOGY
DEPT OF EEE

M.Tech (Electrical Power Engineering)
Course Structure and Syllabus - Academic Year: 2019 - 2020

I Year - I Semester

Code	Subject	L	T	P	Credits	Marks	
						CIE	SEE
7X101	Power System Dynamics	4	--	--	4	30	70
7X105	High Voltage DC Transmission	3	--	--	3	30	70
7X112	Advanced Power System Operation and Control	3	--	--	3	30	70
7X104	Computer Methods in Power Systems	3	--	--	3	30	70
	Program Elective – I	3	--	--	3	30	70
7HC18	English for Research paper Writing (Audit Course –I)	2	--	--	0	30	70
						Grade Evaluation	
7X135	Research Methodology	2	--	-	2	30	70
7X175	Power Systems Simulation Lab	--	--	4	2	30	70
7X172	Technical Seminar -I	--	--	2	1	100	-
Total Credits		**20**	**--**	**6**	**21**	**340**	**560**

Program Elective – I: Any one subject to be selected

Code	Subject
7X102	Optimization Techniques
7X106	Distribution Planning & Automation
7X111	Wind and Solar Energy
7X117	Advanced Control Systems
7X119	Electric and Hybrid Vehicles
7P140	Java Programming

I Year - II Semester

Code	Subject	L	T	P	Credits	Marks	
						CIE	SEE
7X211	Power System Stability	4	--	--	4	30	70
7X212	Advanced Power System Protection	3	--	--	3	30	70
7X213	Flexible AC Transmission Systems	3	--	--	3	30	70
7X214	Power Quality	3	--	--	3	30	70
	Program Elective – II	3	--	--	3	30	70
7HC19	Ethics, Morals, Gender Sensitization, and Yoga (Audit Course- II)	2	--	--	--	30	70
						Grade Evaluation	
7X277	Power Systems Lab	--	--	4	2	30	70
7X273	Comprehensive Viva Voce	--	--	--	1	30	70
7X274	Technical Seminar -II	--	--	2	1	100	-
	Mini Project with seminars (Evaluation in II –Year I –Sem)	Evaluation in II Year I Sem					
Total Credits		**18**	**--**	**6**	**20**	**340**	**560**

Program Elective – II: Any one subject to be selected

Code	Subject
7X108	SCADA System & Applications
7X109	Energy Conversion Systems
7X118	Reactive Power Compensation & Management
7X120	Digital Control Systems
7X121	Smart Electric Grid
7RC17	Database Management Systems

II Year - I Semester

Code	Subject	L	T	P	Credits	Marks	
						CIE	SEE
	Open Elective	3	--	--	3	30	70
	Program Elective – III	3	--	--	3	30	70
7X378	Main Project Phase-I with Seminars	--	--	10	5	30	70
7X375	Mini Project with seminars (Project conducted in summer)	--	--	6	3	30	70
Total Credits		**6**	**--**	**16**	**14**	**120**	**280**

Open Elective: Any one subject to be selected

Code	Subject
7ZC03	Banking Operations, Insurance and Risk Management
7T216	Embedded and Real time control
7ZC31	Business Analytics
7Z332	Cost management of Engineering Project
7WC18	Operations Research

Program Elective – III: Any one subject to be selected

Code	Subject
7X215	Soft Computing Techniques
7X216	Restructuring in Electrical Power Systems
7X217	Power System Transients
7X222	Real Time Control of Power Systems
7X223	Switched Mode Power Conversion
7P141	Computer Networks

II Year - II Semester

Code	Subject	L	T	P	Credits	Marks	
						Int.	Ext.
7X479	Main Project Phase- II with Seminars	-	-	12	6	30	70
7X480	Dissertation And Defense Viva	--	--	--	7	30	70
Total Credits		--	--	12	**13**	**60**	**140**

L - Lectures; T - Tutorial; P - Practical; C - Credits

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

VISION

To emerge as a leading Electrical & Electronics Engineering Department in Technical Education and Research with focus to produce professionally competent and socially sensitive engineers capable of working in multidisciplinary global environment.

MISSION

1. To empower the students and provide the academic environment to pursue and attain competencies in their studies at undergraduate, post graduate and doctoral levels in Electrical & Electronics Engineering.
2. To develop liaison with academia, R&D institutions and electrical industry for hands-on training which enable the students to design and produce novel products for better society.
3. To inculcate interpersonal skills, team work, leadership qualities and professional ethics in students.
4. To enable the students to pursue higher studies and conduct research which will help them in developing the qualities for life-long learning and for a successful professional career.

PROGRAMME EDUCATIONAL OBJECTIVES

Program Educational Objectives (PEOs) Of M.Tech Electrical Power Engineering Programme:

PEO-I: To empower the students by providing necessary knowledge, critical thinking and problem solving capabilities in the field of Electrical Power Engineering so that they can excel in their profession, in industry, higher studies and Research & Development.

PEO-II: To develop competencies in student community of Electrical Power Engineering and allied fields, so as to conduct experiments, comprehend, analyze, design and apply appropriate techniques / tools to provide optimal solutions for real time challenges.

PEO-III: To inculcate the sense of responsibility towards ethics, Intellectual Property rights, good communication skills and entrepreneurship with adequate knowledge of project / finance management skills for betterment of society at large.

PEO-IV: To motivate the students not only to be academically excellent but also to be sensitive to Professional ethics, to acquire leadership skills and to be life-long learners for a successful professional career.

PROGRAM OUTCOMES (POS)

Program Outcomes (POs) Of M.Tech Electrical Power Engineering Programme:

1. Postgraduates will demonstrate their abilities to acquire knowledge and state of the art knowledge and to expand the frontiers in the field of Electrical Power Engineering.
2. Postgraduate will demonstrate their abilities to analyze and evaluate complex engineering problems to make intellectual to create advances in the field of Electrical Power Engineering.
3. Postgraduate will demonstrate their abilities of problem solving skills to find optimal solution in the areas of Electrical Power Engineering including considerations of public health and safety, cultural, societal and environmental factors.
4. Postgraduate will demonstrate ability to carry out literature survey, design and conduct experiments and analyze results using appropriate research methodologies. They should also demonstrate to contribute scientific / technical knowledge in their domain areas either individually or in groups.
5. Postgraduate will demonstrate ability to develop appropriate techniques and tools for prediction and modeling of various engineering systems.
6. Postgraduate will demonstrate ability to collaborate and engage in multidisciplinary group tasks in scientific research.
7. Postgraduate will demonstrate ability manage projects efficiently including consideration of economical and financial factors.
8. Postgraduate will demonstrate abilities in both oral and written technical communications.
9. Postgraduate will demonstrate ability to learn latest developments independent and continuously in his field.
10. Postgraduate shall acquire professional ethics and intellectual integrity in the consideration of impact of research outcomes for sustainable development of society.
11. Postgraduate shall learn from mistakes and make corrective measures on their own.

I Year – I Sem. M.Tech (EPE)

Code: 7X101 POWER SYSTEM DYNAMICS

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of system security, system dynamics problems, Synchronous machine Park's Transformation, per unit quantities, Excitation System Modelling, synchronous machine model with field circuit and basic concepts in applying PSS.

Course Outcomes:

Students will able to

1. Explain model and analysis Power System stability, system security and system dynamics problems solution.
2. Describe ability to study different models of Synchronous machine.
3. Explain design Excitation System Modelling and Systems block diagram.
4. Derive Stator equations, rotor equations, Synchronous machine model with field circuit.
5. Analysis of small signal analysis with block diagram representation with and without PSS.
6. Study of concept of PSS and its analysis.

UNIT I – BASIC CONCEPTS:

Power System stability status of operation and system security, system dynamics problems, system model analysis of steady State Stability and transient stability, simplified representation of Excitation control.

UNIT II – MODELING OF SYNCHRONOUS MACHINE:

Synchronous machine Park's Transformation, Transformation of flux linkages, Transformation of stator voltage equations and rotor equations. Analysis of steady state performance, per unit quantities, Equivalent circuits of synchronous machine, determination of parameters of equivalent circuits.

UNIT III- EXCITATION SYSTEM:

Excitation System Modelling, excitation Systems block Diagram system representation by state equations.

UNIT IV: DYNAMICS OF A SYNCHRONOUS GENERATOR CONNECTED TO INFINITE BUS:

System model synchronous machine model, stator equations, rotor equations, synchronous machine model with field circuit and with field circuit and one equivalent damper winding on q axis (model 1.1), and calculation of Initial conditions.

UNIT V – ANALYSIS OF SINGLE MACHINE SYSTEM:

Small signal analysis with block diagram representation, characteristic equation and application of Routh – Hurwitz compensator analysis of single machine infinite bus system with and without PSS.

UNIT VI – APPLICATION OF POWER SYSTEM STABILIZERS:

Basic concepts in applying PSS, Control signals, structure and turning of PSS washout circuit, dynamic compensator analysis of single machine infinite bus system with and without PSS.

TEXT BOOKS:

1. Power system dynamics - K.R. Padiyar, B.S. Publications 3rd edition, Hyderabad

REFERENCES:

1. Power System Control and Stability - P.M. Anderson and A.A. Fouad, John Wiley sons.

I Year – I Sem. M.Tech (EPE)

Code: 7X105 HIGH VOLTAGE D.C TRANSMISSION

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of Types of HVDC Links, Comparison of AC &DC Transmission, analysis of Graetz circuit, Effect of source inductance on the system, Modelling of DC Links-DC Network, surge arresters and Characteristics harmonics.

Course Outcomes:

Students will able to

1. Compare HVDC transmission and AC transmission, Block diagram and operation of HVDC systems. Different HVDC configurations.
2. Describe how to choose pulse number, Evaluate valve rating and converter transformer rating, Operation of converter under rectifier and inverter modes.
3. Explain control of converter stations and HVDC links, Characteristics of converter control, Control hierarchy, starting and stopping of HVDC link it introduces reactive power requirements in steady state, conventional control strategies, alternate control strategies, sources of reactive power, AC filters.
4. Describe power flow analysis in AC/ DC systems, modeling of DC links, mathematical formulation, and solution of load flow, P.U. systems, Simultaneous and segmental methods. Converter faults, protection against over current, over voltage, corona effects, DC breakers, Surge arresters.
5. Explain different types of converter faults, protection against different faults, DC circuit breaker, corona & radio interference in DC lines, Multi-terminal DC systems.
6. Explain effects of harmonics, Characteristic harmonics, Non characteristic harmonics, AC current harmonics , DC voltage harmonics Classification of filters, AC filters, DC filters characteristics, Design of filters , Locus diagrams

UNIT – I -BASIC CONCEPTS:

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C. Transmission.

UNIT – II -ANALYSIS OF HVDC CONVERTERS:

Choice of Converter configuration – analysis of Graetz circuit – characteristics of 6 Pulse & 12 Pulse converters –Cases of two 3 phase converters in star –star mode – their performance.

UNIT – III -CONVERTER & HVDC SYSTEM CONTROL:

Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the system; Starting and stopping of DC link; Power Control.

UNIT-IV -POWER FLOW ANALYSIS IN AC/DC SYSTEMS, REACTIVE POWER CONTROL IN HVDC:

Modeling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow – P.U. System for d.c. quantities-solution of AC-DC Power flow-Simultaneous method-Sequential method

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies-sources of reactive power-AC Filters – shunt capacitors-synchronous condensers.

UNIT-V - CONVERTER FAULT & PROTECTION:

Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines- Radio interference. Multi terminal DC system, series and parallel operations, advantages.

UNIT – VI -HARMONICS- FILTERS:

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

TEXT BOOKS:

1. HVDC Power Transmission Systems: Technology and system Interactions – K.R.Padiyar, New Age International (P) Limited.
2. EHVAC and HVDC Transmission Engineering and Practice – S.Rao.

REFERENCES:

1. HVDC Transmission – J.Arrillaga.
2. Direct Current Transmission – E.W.Kimbark, John Wiley & Sons.
3. Power Transmission by Direct Current – E.Uhlmann, B.S.Publications

I Year – I Sem. M.Tech (EPE)

Code: 7X112 ADVANCED POWER SYSTEM OPERATION & CONTROL

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of concepts of economic dispatch of thermal units, B-matrix loss formula, hydro-thermal coordination problem, AC power flow methods and application of maximum likelihood weighted least squares technique.

Course Outcomes:

Students will able to

1. Explain concepts of economic dispatch of thermal units with and without losses.
2. Describe effects of transmission losses, B-matrix loss formula and exact method of calculating penalty factors.
3. Explain hydro-thermal coordination problem and Long range and short range hydro-thermal scheduling problem is differentiated.
4. Explain the necessity of economic interchange between inter-connected utilities.
5. Explain importance of power system security and the factors affecting the security. Contingency analysis procedure and algorithms are discussed. Use of linear sensitivity factors and AC power flow methods are discussed along with contingency selection.
6. Describe state estimation and the application of maximum likelihood weighted least squares technique to power system state estimation is explained.

UNIT I: ECONOMIC DISPATCH OF THERMAL UNITS AND METHODS OF SOLUTION:

The Economic dispatch problem, Thermal dispatching with network Losses are considered, The Lambda Iteration method, Economic dispatch by Gradient search method.

Dynamic programming of Economic Dispatch, Economic Dispatch using Dynamic programming, Dynamic programming examples.

UNIT II – TRANSMISSION SYSTEM EFFECTS:

Transmission losses – The B.Matrix formula – Exact – method of calculating penalty factors.

Unit commitment: Economic Dispatch vs Unit Commitment, Constraints, priority list method, dynamic programming solution.

UNIT III - HYDRO – THERMAL CO-ORDINATION:

Introduction, Long range and short range Hydro – thermal scheduling, short term Hydro- Thermal scheduling problem, A Gradient approach.

UNITS – IV - INTERCHANGE OF POWER AND ENERGY:

Economic interchange between interconnected utilities, Inter utility energy evaluation, Power pools, Transmission effects and Issues, Limitations, Wheeling.

UNIT V – POWER SYSTEM SECURITY:

Introduction, factors effecting power system security, Contingency analysis, Linear sensitivity factors, AC power flow methods, Contingency selection

UNIT – VI- STATE ESTIMATION:

Introduction, Maximum likelihood weighted least squares equation, Orthogonal Decomposition estimation method, Algorithm.

TEXT BOOKS:

1. Power Generation, Operation and Control - Allen J.Wood and Bruce F.Wollenberg,John wiley & sons (Asia) Pvt. Ltd.,

REFERENCES:

1. Power System Optimization - D.P.Kothari J.S.Dhillon, PHI, 2004.
2. Power System analysis – John Grainger & William D. Stevenson Jr – Tata Mc Graw Hill edition.

I Year – I Sem. M.Tech (EPE)

Code: 7X104 COMPUTER METHODS IN POWER SYTEMS

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of Algorithm for formation of network matrices, Short circuit calculations using Z_{Bus},, Differential equations, Swing equation and tie line bias control.

Course Outcomes:

Students will able to

1. Ability to understand the formation of network matrices for single phase and three phase power systems.
2. Ability to learn the fault analysis for three phase systems using Z_{bus} method.
3. Learn about requirement and different methods of load flow analysis.
4. Describe solution of differential equations.
5. Ability to learn analysis of transient stability in power systems.
6. Ability to study single area and two area control of power systems.

UNIT – I - INCIDENCE AND NETWORK MATRICES:

Algorithm for formation of network matrices. Three phase networks, balanced networks, Algorithm for formation for 3-phase bus impedance matrix. Modifications for changes in network.

UNIT – II - SHORT CIRCUIT STUDIES:

Short circuit calculations using Z_{Bus}, balanced 3-phase network with Z_{Bus}, Calculation of fault currents 3-phase to ground fault, line to ground fault, line to line fault.

UNIT – III - LOAD FLOW STUDIES:

N-R method in polar and rectangular coordinate system, convergence characteristics, decoupled and fast decoupled load flow, load flow using $Z_{Bus.}$

UNIT – IV:

Differential equations, numerical solutions, Euler Method, R.K. Method

UNIT – V - TRANSIENT STABILITY STUDIES:

Introduction, Swing equation, Machine equations, Power Systems equations, solution techniques. Example of Transient stability calculations.

UNIT – VI – LOAD FREQUENCY CONTROL:

Two area systems, uncontrolled and controlled cases, PID controllers, State space model, application of optimal control theory, tie line bias control.

TEXT BOOKS:

1. Computer methods in power system analysis- Glenn Stagg and A. El-Abiad.
2. Modern Power System Analysis- D.P. Kothari, I.J.Nagrath, Tata Mc.Graw Hill

REFERENCES:

1. Operation Control in Power Systems- P.S.R.Murty, B.S. Publications, 2nd edition.

I Year – I Sem. M.Tech (EPE)

Code: 7X102 **OPTIMIZATION TECHNIQUES**
(ELECTIVE – I)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of single variable optimization, multi variable optimization with no constraints, motivation of the simplex method, Direct Search Method, Liapunov's stability, Fixed end Point problem and Pontryagin's theorem.

Course Outcomes:

Students will able to

1. Identify and decide upon the various constraints of both equality and inequality type along with the objective function especially in relation to electrical power system operation.
2. Describe simplex method and two phase methods enable the student grasp the philosophy and logic in developing algorithms for solution.
3. Should be well conversed with the solution methodology to formulate and solve for unconstrained minimization (maximization) for objective functions by direct search, gradient search and in case of necessity conjugate gradient search.
4. Understand the concept of system energy and its increase or decrease and its effect on stability, especially in power system operation.
5. Calculus of variations with Euler Lagrange equation and its solution under varying boundary conditions is essential for study for optimal control applied to power systems.
6. Design of state regulators with feasible mathematical assumptions that will provide practical and implementable algorithms so as to synthesize power system controllers is provided in this unit.

UNIT I - CLASSICAL OPTIMIZATION TECHNIQUES :
Introduction, single variable optimization, multi variable optimization with no constraints, multi variable with equality constraints, multi variable optimization with inequality constraints.

UNIT II - LINEAR PROGRAMMING (SIMPLEX METHOD):
Introduction, Application of linear programming, standard form of a linear programming problem, Geometry of linear programming problems, definitions and theorems, solutions of a system of linear simultaneous equations, Pivotal reduction of a general system of equations, motivation of the simplex method, Simplex algorithm, Introduction to two phases of the simplex method.

UNIT – III - NON-LINEAR PROGRAMMING:
Unimodel function, Elimination methods, Fibonacci Method, Golden Section Method, Direct Search Method, Univariate Method, Powell's method of conjugate directions, steepest decent method, Davidon and Fletcher Powell method.

UNIT IV - NON-LINEAR SYSTEMS:
Types of non – linearities, limit cycle, jump phenomenon, singular points.
Phase plane analysis – Method of Isoclines, Stability analysis – Liapunov's stability and Instability theorems. Stability analysis of linear continuous time invariant systems. Liapunov's second method, Generation of Liapunov's functions.

UNIT V – CALCULUS OF VARIATION:
Functional, Variations, Fixed end Point problem, variable end point problem.

UNIT – VI – OPTIMAL CONTROL:
Pontryagin's theorem, Hamiltonian theorem, Linear Quadratic Regulator, Matrix Ricatti Equation, Algebraic Ricatti Equation.

TEXT BOOKS:

1. Engineering Optimization - S.S.Rao, Publications: New Age International (P) Ltd. Publishers.
2. Modern Control Engineering - Ogata. K. Prentice Hall
3. Modern Control Systems Theory - M.Gopal, New Age International

REFERENCES:

1. Modern control Engineering – D.Roy Chowdary, PHI publications.

I Year – I Sem. M.Tech (EPE)

Code: 7X106 DISTRIBUTION PLANNING & AUTOMATION

(ELECTIVE – I)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of distribution automation, communication systems for distribution automation, technical benefits of distribution automation and economic evaluation methods in distribution automation.

Course Outcomes:

Students will able to

1. Explain concept of distribution automation and components of distribution automation.
2. Describe functions of distribution automation.
3. Describe communication systems for distribution automation.
4. Learn about communication systems used in distribution automation
5. Learn the technical benefits of distribution automation
6. Explain economic evaluation methods in distribution automation.

UNIT I - DISTRIBUTION AUTOMATION AND THE UTILITY SYSTEM:

Introduction to Distribution Automation (DA), control system interfaces, control and data requirements, centralized (Vs) decentralized control, DA System (DAS), DA Hardware, DAS Software.

UNIT II - DISTRIBUTION AUTOMATION FUNCTIONS:

DA capabilities, Automation system computer facilities, management processes, Information management, system reliability management, system efficiency management, voltage management, Load management.

UNIT III - COMMUNICATION SYSTEMS FOR DA:

DA communication requirements, Communication reliability, Cost effectiveness, Data rate requirements, Two way capability, Ability to communicate during outages and faults, Ease of operation and maintenance, Conforming to the architecture of data flow

UNIT – IV - COMMUNICATION SYSTEMS USED IN DA:

Distribution line carrier (Power line carrier), Ripple control, Zero crossing technique, telephone, cable TV, Radio, AM broadcast, FM SCA, VHF Radio, UHF Radio, Microwave satellite. Fiber optics, Hybrid Communication systems, Communication systems used in field tests.

UNIT V - TECHNICAL BENEFITS:

DA benefit categories, Capital deferred savings, Operation and Maintenance savings, Interruption related savings, Customer related savings, Operational savings, Improved operation, Function benefits, Potential benefits for functions, function shared benefits, Guide lines for formulation of estimating equations parameters required, economic impact areas, Resources for determining benefits impact on distribution system, integration of benefits into economic evaluation.

UNIT VI: ECONOMIC EVALUATION METHODS:

Development and evaluation of alternate plans, Select study area, Select study period, Project load growth, Develop Alternatives, Calculate operating and maintenance costs, Evaluate alternatives.

Economic comparison of alternate plans, Classification of expenses and capital expenditures, Comparison of revenue requirements of alternative plans, Book Life and Continuing plant analysis, Year by year revenue requirement analysis, short term analysis, end of study adjustment, Break even analysis, Sensitivity analysis computational aids.

TEXT BOOK:

1. IEEE Tutorial Course "Distribution Automation" IEEE Working Group on "Distribution Automation"

I Year – I Sem. M.Tech (EPE)

Code: 7X111 **WIND AND SOLAR SYSTEMS**

(PROFESSIONAL ELECTIVE-I)

L	T	P	C
3	1		3

Course Objectives:-Students will be able to:
1. To get exposure to wind and solar systems
2. To understand the factors involved in installation and commissioning of a Solar or Wind plant.
3. Learning the dynamics involved when interconnected with power system grid

Course Outcomes:-
Students will be able to:
1. Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems
3. Demonstrate the knowledge of physics of solar power generation and the associated issues
4. Identify, formulate and solve the problems of energy crises using wind and solar energy

UNIT – I: Historical development and current status, characteristics of wind power generation and network integration issues

UNIT -II: Generators and power electronics for wind turbines, power quality standards for wind turbines and Technical regulations for interconnections of wind farm with power systems.

UNIT – III: Isolated wind systems, reactive power and voltage control and economic aspects.
UNIT – IV: Impacts on power system dynamics, power system interconnection
UNIT -V: Introduction of solar systems, merits and demerits, concentrators, various applications.
UNIT – VI: Solar thermal power generation, PV power generation, Energy Storage device and Designing the solar system for small installations.

SUGGESTED READING:

1. Thomas Ackermann, Editor, "Wind power in Power Systems", John Willy and sons ltd.2005
2. Siegfried Heier, "Grid integration of wind energy conversion systems", John Willy and sons ltd., 2006
3. K. Sukhatme and S.P. Sukhatme, "Solar Energy". Tata MacGraw Hill, Second Edition, 1996

I Year – I Sem. M.Tech (EPE)

Code: 7X117 **ADVANCED CONTROL SYSTEMS**
(PROFESSIONAL ELECTIVE-I)

L	T	P	C
3	1		3

Course Objective:

This subject deals with state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

Course Outcomes:

Students will able to

1. Explain State Space Representation, Solution of State Equation and State Transition Matrix.
2. Describe Tests for controllability and observability for continuous time systems.
3. Study of Lyapunov's stability and Lypanov's instability theorems.
4. Analysis of Effect of state feedback on controllability and observability.
5. Describe Minimization of functional of single function and constrained minimization.
6. Derive Formulation of optimal control problem, Minimum time, Minimum energy and minimum fuel problems.

UNIT – I STATE SPACE ANALYSIS

State Space Representation, Solution of State Equation, State Transition Matrix, Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form.

CONTROLLABILITY AND OBSERVABILITY

Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and observability form Jordan canonical form and other canonical forms.

UNIT – II DESCRIBING FUNCTION ANALYSIS

Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems.

PHASE-PLANE ANALYSIS

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

UNIT-III STABILITY ANALYSIS

Stability in the sense of Lyapunovs, Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems.

UNIT – IV MODAL CONTROL

Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.

UNIT-V CALCULUS OF VARIATIONS

Minimization of functional of single function, constrained minimization. Minimum principle, Control variable inequality constraints, Control and state variable inequality constraints, Euler Lagrangine Equation.

UNIT-VI OPTIMAL CONTROL

Formulation of optimal control problem. Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Output regulator problem. Tracking problem, Continuous-Time Linear Regulators.

TEXT BOOKS:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996.

REFERENCE BOOKS:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata Mc Graw-Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.

I Year – I Sem. M.Tech (EPE)

Code: 7X119 ELECTRIC AND HYBRID VECHILES

(PROFESSIONAL ELECTIVE – I)

L	T	P	C
3	1	-	3

Course Objectives:-Students will be able to:
1. To understand upcoming technology of hybrid system
2. To understand different aspects of drives application
3. Learning the electric Traction

Course Outcomes:-
Students will be able to:
1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To learn electric drive in vehicles / traction.

UNIT- I: History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source, characterization Transmission characteristics and Mathematical models to describe vehicle performance

UNIT – II: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies and Fuel efficiency analysis.

UNIT – III: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies and Fuel efficiency analysis.

UNIT – IV: Introduction to electric components used in hybrid and electric Vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives, configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

UNIT –V: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology and Communications, supporting subsystems

UNIT – VI: Introduction to energy management and their strategies used in hybrid and electric vehicle Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

SUGGESTED READING:

1.Sira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

I Year – I Sem. M.Tech (EPE)

Code: 7P140 **JAVA PROGRAMMING**

(PROFESSIONAL ELECTIVE-I)

L	T	P	C
3	1	0	3

Course Objective :

Understand the concepts of Object oriented programming principles of Java. Write the programs and execute using OOP principles such as garbage collection, overloading methods, constructors, recursion, string handling, String Tokenizer, inheritance and its types, packages, multithreading and threads.

Course Outcomes:

Students will able to

- Understand the concept of OOP as well as the purpose and usage of principles of inheritance, Identify classes, objects, members of a class and the relationships among them needed for a specific problem.
- Understand and implement concepts of polymorphism, encapsulation and method overloading.
- Create Java application programs using sound OOP practices (e.g., interfaces and APIs) and proper program structuring (e.g., by using access control identifiers, automatic documentation through comments)
- Students understand and implement error exception handling and multi-threading.
- Students learn to create GUI and write programs for event-handling using various user interface components on applets.

UNIT-I

History of Java, Java buzzwords, data types, variables, simple java program, scope and life time of variables, operators, expressions, control statements, type conversion and costing, arrays,, classes and objects – concepts of classes, objects, constructors, methods, access control, this keyword, overloading methods and constructors, string handling, String Tokenizer.

Objective: On the completion of the unit, a student should be able to: i) Write ,compile and execute simple java programs ii) Understand the syntax of classes and objects creation in java iii) Explain the differences between classes and objects iv) differentiate methods and constructors v) Understand constructor and method overloading vi) Understand how to handle strings in java

UNIT-II

Inheritance –Definition, single inheritance, benefits of inheritance, Member access rules, super class, polymorphism- method overriding, Dynamic method dispatch, using final with inheritance, abstract class, Base class object.

Objective:

On the completion of the unit, a student should be able to: i) Explain the benefits of inheritance ii) Understand how to access members of super class from subclass iii) Differentiate static and dynamic polymorphism iv) Understand the usage of final keyword in inheritance v) Understand the use of abstract class

UNIT-III

Interfaces: definition, variables and methods in interfaces, differences between classes and interfaces, usage of implements and extends keyword, uses of interfaces.

Packages: Definition, types of packages, Creating and importing a user defined package.

Applications using interface

Applications using packages

Objective:

On the completion of the unit, a student should be able to: i) Understand uses of interfaces and packages ii) Understand how to implement multiple inheritance in java iii) Explain the difference between classes and interfaces iv) Create and import packages.

UNIT-IV
Exception handling -exception definition, benefits of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating user defined exceptions.

Multi-Threading:-Thread definition, types of multitasking, uses of multitasking, thread life cycle, creating threads using Thread class and Runnable interface, synchronizing threads, daemon thread.

Applications of multithreading.

Objective:
On the completion of the unit, a student should be able to: i) Understand benefits of exception handling ii) Handle built-in and user defined exceptions iii) Understand the uses of multi-threading iv) Create multi-threaded programs using either Thread class or Runnable interface v) Know how to synchronize threads

UNIT-V
Advantages of GUI over CUI ,The AWT class hierarchy, Component, Frame, user interface components- labels, button, scrollbars, text components, check box, check box groups, choices, lists panels – scrollpane, menubar, graphics, layout, managers –boarder, grid, flow and card layouts.

Applications: developing calculator, developing feedback form, developing biodata.

Objective:
On the completion of the unit, a student should be able to: i) understand the advantages of GUI over CUI ii) Write GUI programs

UNIT-VI
Event handling: Delegation event model, closing a Frame, mouse and keyboard events, Adapter classes.

Applets – Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets, passing parameters to applets.

Applications: Developing of simple advertisements.

Objective:
On the completion of the unit, a student should be able to: i) Able to handle events using delegation event model ii) Write applet programs

TEXT BOOKS
1. Java; the complete reference, 6th editon, Herbert schildt, TMH.
2. Introduction to Java programming 6th edition, Y. Daniel Liang, pearson education.

REFERENCES
1. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, 7th Edition, Pearson Education.
2. Core Java 2, Vol 2, Advanced Features, Cay. S. Horstmann and Gary Cornell, 7th Edition, Pearson Education

I Year – I Sem. M.Tech (EPE)
ENGLISH FOR RESEARCH PAPER WRITING
(AUDIT COURSE – I)

Code: 7HC18

L-T-P-C
2 -0 -0- 0

Course objectives: Students will be able to:

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

UNIT 1: Planning and Preparation

a. Word Order and Breaking up long sentences

b. Structuring Paragraphs and Sentences

c. Being Concise and Removing Redundancy

d. Avoiding Ambiguity and Vaguencess

UNIT 2: Clarifying who did what

a. Highlighting your Findings

b. Hedging and Criticizing

c. Paraphrasing and Plagiarism

d. Sections of a Paper

e. Abstracts Introduction

UNIT 3: Review of Literature

a. Methods

b. Results

c. Discussion

d. Conclusions

e. The Final Check

UNIT 4: Key skills needed when writing a Title

a. Key skills needed when writing an Abstract

b. Key skills needed when writing an Introduction

c. Skills needed when writing a Review of Literature

UNIT 5: Skills needed when writing the Methods

a. Skills needed when writing the Results

b. Skills needed when writing the Discussion

c. Skills needed when writing the Conclusion

UNIT 6: Useful phrases

a. How to ensure paper as good as it could possibly be for the first – time submission

SUGGESTED STUDIES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Writeand 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, 2011

I Year – I Sem. M.Tech (EPE)

Code: 7X135 **RESEARCH METHODOLOGY**

L	T	P	C
2	-	-	2

Course Objective:

Understand the concepts of Various Steps in Research process, Surveying, synthesizing, Statistical Modelling and Analysis, Relation between frequency distributions and other graphs, Fundamentals of Genetic algorithms, Types of Report and Mechanism of writing a research report.

Course Outcomes:

Students will able to

1. Explain Definition and objectives of Research, critical evaluation, interpretation, Research Purposes and Ethics in research.
2. Explain Statistical Modelling and Analysis, Fundamentals of Time Series Analysis and Spectral Analysis.
3. Describe Tables and graphs that show the relationship between two variables, Relation between frequency distributions and other graphs.
4. Explain Neural Network based optimization, Optimization of fuzzy systems.
5. Understand Types of Report and Layout of Research Report.
6. Understand Mechanism of writing a research report, referencing in academic writing.

UNIT I: INTRODUCTION:

Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.

UNIT II: QUANTITATIVE METHODS FOR PROBLEM SOLVING:

Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.

UNIT III: TABULAR AND GRAPHICAL DESCRIPTION OF DATA:

Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, Relation between frequency distributions and other graphs, preparing data for analysis

UNIT IV: SOFT COMPUTING:

Computer and its role in research, Use of statistical soft ware SPSS, GRETL etc in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

UNIT V

Structure and Components of Research Report, Types of Report, Layout of Research Report.

UNIT VI

Mechanism of writing a research report, referencing in academic writing.

TEXT BOOKS:

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006
2. Donald H.McBurney, Research Methods, 5th Edition, Thomson Learning, ISBN: 81-315-0047- 0, 2006.

REFERENCE BOOKS:

1. Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006.
2. Fuzzy Logic with Engg Applications, Timothy J.Ross, Wiley Publications, 2nd Ed.
3. Simulated Annealing: Theory and Applications (Mathematics and Its Applications, by P.J. van Laarhoven & E.H. Aarts.
4. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg

I Year – I Sem. M.Tech (EPE)

Code: 7X175 POWER SYSTEMS SIMULATION LAB

L	T	P	C
-	-	4	2

Course Objective:

Understand the concepts and develop of formation of Y-bus and Z-bus, Guass Seidal method, SIMULINK model for a single area load frequency problem, three phase inverter, automatic voltage regulator, Lag compensator and Machine language program using 8255- PPI.

Course Outcomes:

Students will able to

1. Ability to write a program for formation of Y-bus and Z-bus.
2. Ability to write a program for a power flow study on a given power system network using Guass Seidal method.
3. Ability to Develop a SIMULINK model for a single area load frequency problem.
4. Ability to develop a program to solve swing equation.
5. Ability to simulate single phase and three phase full converter.
6. Ability to Develop a SIMULINK model for a two area load frequency problem
7. Ability to simulate a three phase inverter
8. Ability to develop a program for PID controller.
9. Ability to Develop a SIMULINK model for a automatic voltage regulator.
10. Ability to Design a Lag compensator through SIMULINK.
11. Ability to write a program for Machine language program using 8255- PPI

Conduct any 10 Experiments

1. Formation of Y-bus, Z-bus and Y bus formation using Sparsity technique.
2. Power flow study on a given power system network using Guass-Seidal method for 5bus system, IEEE 14bus system and IEEE 30bus system.
3. A SIMULINK model for a single area load frequency problem and simulate with and without controller.
4. Develop a program to solve swing equation.
5. a) Simulation of three Phases full converter using RL & E loads.
   b) Simulation of Single Phase full converter using RL & E loads.
6. A simulink model for a two area load frequency problem and
   Simulate with and without controller.
7. Simulation of 3-phase inverter with PWM controller.
8. Program for PID controller.
9. A simulink model for automatic voltage regulator with and without Controller.
10. Design a Lag compensator through SIMULINK.
11. Write a Machine language program for
    i) to initialize port A as an input port in mode-0
    ii) to initialize port A as an input port and port B as an output port in mode-0
    iii) to initialize port C as output port in mode-0
    iv) to initialize port C as an input port in mode-0 using 8255- PPI

I Year – I Sem. M.Tech (EPE)

Code: 7X172 **TECHNICAL SEMINAR – I**

L	T	P	C
-	-	2	1

Max. Marks: 100

Course Objective:

To give sufficient technical lifelong skills to learn impact various engineering solutions in global products and process industries.

Course out comes: after studying this course, the students will be able to

1. Identify a research topic
2. Collect literature
3. Present seminar
4. Discuss the queries

There shall be two seminar presentations during I year I semester and I year II Semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee, which shall consist of the Head of the Department, a senior Faculty Member and the Supervisor and will jointly evaluate the report and presentation. For each Seminar there will be only internal evaluation of **100 marks**. A candidate has to secure a minimum of 50% to be declared successful.

In the First semester the report must be in the form of the review paper with a format used by IEEE / ASME etc. In the Second semester Technical Seminar in the form of Independent Review Paper must be of high quality fit for publication in a reputed conference / journal.

The evaluation format for seminar is as follows:

Selection of topic, literature survey Review by the guide	10 marks
Final report and viva	10 marks
Level of content	15 marks
Presentation	20 marks
Discussion & Involvement	15 marks
Class notes	15 marks
Attendance	15 marks
Total	**100 Marks**

Contents:

- Identification of specific topic
- Analysis
- Organization of modules
- Naming Conventions
- Writing style
- Figures
- Feedback
- Miscellaneous

I Year – II Sem. M.Tech (EPE)

Code: 7X211 POWER SYSTEM STABILITY

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of steady state, dynamic & transient and modeling of synchronous machine, multi machine system transient stability analysis, voltage collapse proximity indicator and voltage stability margin of compensated and un-compensated systems.

Course Outcomes:

Students will able to

1. Explain concepts of various power system stabilities such as steady state, dynamic & transient and modeling of synchronous machine, excitation system, governing system and induction machine for stability studies.
2. Explain solution of non-linear swing equation & phase plane trajectory from potential energy curve and analysis in phase plane multi machine system modeling and multi machine system transient stability analysis.
3. Explain power system design w.r.t. transient stability and various transient stability controllers.
4. Describe terms voltage stability, voltage collapse and voltage security and Physical relationship indicating the dependency of voltage on reactive power flow.
5. Explain need for voltage collapse proximity indicator and types of indicators and the effectiveness of determinant of power flow Jacobian matrix as voltage collapse proximity indicator.
6. Explain voltage stability margin of compensated and un-compensated systems and methods to improve voltage stability and the practical considerations.

UNIT – I - INTRODUCTION TO VOLTAGE STABILITY:

Definitions: Voltage Stability, Voltage Collapse, Voltage Security, Physical relation indicating dependency of voltage on reactive power flow, Factors affecting Voltage collapse and instability, previous cases of voltage collapse incidences.

UNIT II - VOLTAGE STABILITY INDICES:

Voltage collapse proximity indicator, Determinant of Jacobin as proximity indicators, Voltage Stability margin.

UNIT III– VOLTAGE STABILITY MARGIN:

Stability Margin: Compensated and un-compensated systems.

Voltage Security: Definition, Voltage Security, Methods to improve voltage stability and its practical aspects.

UNIT IV:

Concepts of steady state, dynamic and transient stabilities.

Models for stability, synchronous machine, excitation system, governing system induction machine modeling.

UNIT V:

Generator connected to infinite bus Energy balance, Solution to non-linear swing equation, Phase- plane trajectory from potential energy curve, Analysis in phase plane multi Machine system modeling and Multi Machine system transient stability analysis.

UNIT VI - TRANSIENT STABILITY CONTOLLERS:

System Design for Transient Stability, Discrete Supplementary Controls, Dynamic Braking, Discrete control of Excitation Systems, Momentary and Sustained Fast Valving, Discrete Control of HVDC Links, Series capacitor Insertion, Emergency control Measures.

TEXT BOOKS:

1. "Performance, Operation and Control of EHV power transmission system" A.Chakrabarthy, D.P. Kotari and A.K. Mukopadyay, A.H.Wheeler Publishing, 1 Edition, 1995
2. "Power System Dynamics Stability and Control" – K.R.Padiyar, II Edition, B.S. Publications.

REFERENCES:

1. "Power System Voltage Stability" - C.W. Taylor, Mc Graw Hill Publications, 1994.

I Year – II Sem. M.Tech (EPE)

Code: 7X212 ADVANCED POWER SYSTEM PROTECTION

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of primary and backup protection, effect or arc resistance, fundamental frequency components using DFT, WHT, RHT techniques, interface A/D converter and MHO and angle impedance relays using microprocessor.

Course Outcomes:

Students will able to

1. Explain primary and backup protection, C.T and P.T required for protection and electromagnetic and static relays
2. Explain principle operation of impedance, reactance, mho and angle impedance relays and restricted, analyze the effect or arc resistance, to select proper distance relay.
3. Able to select minimum number of distance relays, differentiate between types of pilot relaying schemes and explain the importance of carrier aided distance protection
4. Able to calculate fundamental frequency components using DFT, WHT, RHT techniques, explain about removal of D.C offset.
5. Explain about single chip computers, interface A/D converter, use Programmable interval timer to create time delay.
6. Able to realize impedance, reactance, MHO and angle impedance relays using microprocessor, derive generalized mathematical expression for distance relays and implement digital distance relaying algorithms.

UNIT I:

Primary and back up protection, current transformers for protection, potential transformer, review of electromagnetic relays static relays.

Over current relays time current characteristic, current setting time setting, directional relay, static over current relays.

UNIT II- DISTANCE PROTECTION:

Impedance, reactance, mho, angle impedance relays. Input quantities for various types of distance relays, effect of arc resistance on the performance of distance relays, selection of distance relays. MHO relay with blinders, quadrilateral relay, elliptical relay. Restricted mho, impedance directional, reactance relays. Swiveling characteristics.

UNIT III:

Compensation for correct distance measurement, reduction of measuring units switched schemes. Pilot relaying schemes. Wire pilot protection, circulating current scheme, balanced voltage scheme, transley scheme, carrier current protection, phase comparison carrier current protection, carrier aided distance protection.

UNIT IV:

Digital relaying algorithms, differential equation technique, discrete Fourier transform technique, walsh-hadamard transform technique, rationalized harr transform technique, removal of dc offset

UNIT V:

Introduction to Microprocessors: review of microprocessors and interfacing. Single chip microcomputers programmable interval timer, A/D converter.

UNIT VI - MICROPROCESSOR BASED PROTECTIVE RELAYS:

Over current, directional, impedance, reactance relays. Generalized mathematical expressions for distance relays, mho and offset mho relays, quadrilateral relay.

Microprocessor implementation of digital distance relaying algorithms.

TEXT BOOKS:

1. Power system protection & switchgear - Badri Ram & Vishwakarma, TMH Publication New Delhi, 1995.
2. Power System Protection - Madhava Rao TMH.

REFERENCES:

1. Power System - Ravindra Nath and Chandar, PHI.

I Year – II Sem. M.Tech (EPE)

Code: 7X213 FLEXIBLE A.C. TRANSMISSION SYSTEM

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of Basic types of FACTS controllers, various converters such as VSC & CSC used in FACTS devices; various shunt compensation methods, concept of transient stability in a power system and operating principle of UPSC.

Course Outcomes:

Students will able to

1. Understand Basic types of FACTS controllers and its importance in power systems.
2. Describe the operation of various converters such as VSC & CSC used in FACTS devices and comparison between them.
3. Explain the objectives of various shunt compensation methods of controllable VAR generation.
4. Explain objectives of various series compensation methods for improving voltage profile of power system.
5. Describe the concept of transient stability in a power system and its improvement using FACTS devices.
6. Demonstrate the knowledge of operating principle of UPSC.

UNIT I - FACTS CONCEPT:

Transmission inter connection – Power flow in AC system – What limits the loading capability – Power flow and dynamics stability consideration of a transmission inter – connection – importance of controllable parameters – Basic types of FACTS controllers – Brief description of FACTS controllers. In perspective HVDC vs FACTS.

UNTI II- VOLTAGE SOURCED CONVERTERS:

Basic concept of VSC – Single phase full wave bridge converter operation – Single phase leg operation – Three phase full wave bridge converter – Sequence of valve conduction in each phase leg- Transformer connection for 12 pulse operation – Current sourced converters.

Basic concept of C.S.C. – Thyristor based converter – Rectifier & inverter operation – Valve voltage – communication failure – A.C. Current & D.C. voltage harmonics – Current sourced converter with turn off devices, CSC vs VSC.

UNIT III - STATIC SHUNT COMPENSATORS:

Objectives of shunt compensation methods of controllable VAR generation – Variable impedance type – switching converter type – VAR generators – SVC & STATCOM.

UNTI VI - STATIC SERIES COMPENSATORS:

Objectives of series compensation – Variable impedance types series compensation – GCSC – ISSC – TCSC – Switching converter type series compensation – Static synchronous series compensator (SSSC) – Transmitted power Vs. transmission angle characteristics – Control range & VA rating – Capability to provide real power compensation.

UNTI V - STATIC VOLTAGE & PHASE ANGLE REGULATORS:

Objectives, Voltage and Power angle regulation – Power flow control by PAR – Real and Reactive loop power flow control – Improvement of transient stability with PAR.

UNIT – VI- UNIFIED POWER FLOW CONTROLLER:

Basic operating principle – conventional transmission control capabilities, Independent real and reactive power flow control, Control structure Control Scheme for P & Q control.

TEXT BOOKS:

1. Narain G.HIngorani & Laszio Gyugyi, Understanding FACTS – Concepts & Technology of Flexible AC transmission Systems, 2001, Standard Publication Distribution, Delhi, 2001.
2. Flexible AC transmission Systems, Edited - Yong Hau Song & Allah T.Johns, Published by IEE, London, 1999.

I Year – II Sem. M.Tech (EPE)

Code: 7X214 **POWER QUALITY**

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of Power Quality phenomenon, concepts of long interruptions in the Power System, concepts of short interruptions, three phase voltage sags with phase angle jumps, synchronous motors and adjustable speed AC and DC drives and concepts of different litigation methods of interrupts and voltage sags.

Course Outcomes:

Students will able to

1. Explain overview of Power Quality phenomenon, classification of different Power Quality events along with duration.
2. Describe the concepts of long interruptions in the Power System and reliability of power system.
3. Describe the concepts of short interruptions, multiply events and the behaviour of voltage and current during fault and post fault period.
4. Explain the concepts of Sag and their causes, classification and important methods, three phase voltage sags with phase angle jumps.
5. Explain the concepts of the effect on Power Electronics loads, induction motors, synchronous motors and adjustable speed AC and DC drives.
6. Explain the concepts of different litigation methods of interrupts and voltage sags, IEC and European Power Quality standards.

UNIT I: INTRODUCTION:

Introduction of the Power Quality (PQ) problems. Terms used in PQ Voltage, Sag, Swell, Surges, Harmonics, over voltages, Spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.

UNIT II: LONG INTERRUPITONS:

Interruptions – Definition – Difference between failures, outage, Interruptions – causes of Long Interruptions Origin of Interruptions – Limits for the Interruption frequency

Limits for the interruption duration – Costs of interruption – Over view of Reliability evaluation to power quality, comparison of observations and reliability evaluation.

UNIT – III - SHORT INTERRUPTIONS:

Short interruptions – definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping, voltage and current during faulty period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT IV – VOLTAGE SAG – CHARACTERIZATION – SINGLE PHASE:

Voltage sag definition, causes of voltage sag, voltage saga magnitude, monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, voltage sag duration.

VOLTAGE SAG – CHARACTERIZATION – THREE PHASE:

Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT V – PQ CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS:

Voltage sag, equipment behavior of Power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT VI – MITIGATION OF INTERRUPTIONS AND VOLTAGE SAGS:

Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

POWER QUALITY AND EMC STANDARDS:

Introduction to standardization, IEC Electromagnetic compatibility standards, European Voltage characteristics standards, PQ surveys.

TEXT BOOKS:

1. "Understanding Power Quality Problems" - Math H J Bollen, IEEE Press.
2. Power Quality- C. Sankaran.

I Year – II Sem. M.Tech (EPE)

Code: 7X208 **SCADA SYSTEM AND APPLICATIONS**

(ELECTIVE – II)

L	T	P	C
3	1	-	3

Course Objectives:-Students will be able to:
1. To understand what is meant by SCADA and its functions
2. To know SCADA communication
3. To get an insight into its application

Course Outcomes:-
Students will be able to:
1Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications
2Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system
3 Knowledge about single unified standard architecture IEC 61850
4: To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server
6: Learn and understand about SCADA applications in transmission and distribution sector, industries etc

UNIT – I: Introduction to SCADA, Data acquisition systems, Evolution of SCADA and Communication technologies

UNIT – II: Monitoring and supervisory functions, SCADA applications in Utility Automation and Industries SCADA

UNIT – III: Industries SCADA System Components, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC) and Communication Network, SCADA Server, SCADA/HMI Systems

UNIT – IV: SCADA Architecture, Various SCADA architectures, advantages and disadvantages of each system and single unified standard architecture -IEC 61850.

UNIT –V: SCADA Communication, various industrial communication technologies, wired and wireless methods and fiber optics and Open standard communication protocols

UNIT – VI: SCADA Applications: Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Industries - oil, gas and water and Case studies, Implementation, Simulation Exercises

SUGGESTED READING:
1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999

I Year – II Sem. M.Tech (EPE)

Code: 7X209 ENERGY COVNERSION SYSTEMS

(ELECTIVE - II)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of solar cell configurations, principles of MHD power generation, tidal power stations, application of OTEC systems, Co-generation and energy storage and applications of fuel cells.

Course Outcomes:

Students will able to

1. Explain about solar power generation, solar cell configurations and applications of super conducting materials in electrical equipment systems.
2. Describe principles of MHD power generation, practical MHD generator, properties of air and wind, types of wind turbines.
3. Explain about tides and tidal power stations, turbines and generators for tidal power generation, properties of waves and power content.
4. Describe ocean thermal energy conversion systems, application of OTEC systems and miscellaneous energy conversion systems.
5. Describe principles of EMF generation, Co-generation and energy storage, combined cycle co-generation, energy storage.
6. Explain about types of fuels, applications of fuel cells, environmental effects of energy conversion systems.

UNIT – I:

Photo voltaic power generation ,spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for pv systems, applications of super conducting materials in electrical equipment systems.

UNIT – II:

Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology, Wind Energy conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

UNIT – III:

Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation. Wave energy conversion: properties of waves and power content, vertex motion of Waves, device applications.

UNIT- IV:

Types of ocean thermal energy conversion systems Application of OTEC systems examples.
Miscellaneous energy conversion systems: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion.

UNIT – V:

Principles of EMF generation, description of fuel cells. Co-generation and energy storage, combined cycle co-generation, energy storage. Global energy position and environmental effects: energy units, global energy position.

UNIT – VI:

Types of fuel cells, H2-O2 Fuel cells, Application of fuel cells – Batteries, Description of batteries, Battery application for large power. Environmental effects of energy conversion systems, pollution from coal and preventive measures steam stations and pollution, pollution free energy systems.

TEXT BOOKS:

1. “Energy conversion systems” - Rakosh das Begamudre, New age international Publishers, New Delhi - 2000.
2. “Renewable Energy Resources” - John Twidell and Tony Weir, 2nd edition, Fspon & Co

I Year – II Sem. M.Tech (EPE)

Code: 7X218 REACTIVE POWER COMPENSATION & MANAGEMENT (ELECTIVE – II)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of reactive power characteristics, types of compensation, static compensations, Basic concepts of quality of power supply, basic methods load shaping and Typical layout of traction systems.

Course Outcomes:

Students will able to

1. Explain model and analysis Power System stability, system security and system dynamics problems solution.
2. Describe ability to study different models of Synchronous machine.
3. Explain design Excitation System Modelling and Systems block diagram.
4. Derive Stator equations, rotor equations, Synchronous machine model with field circuit.
5. Analysis of small signal analysis with block diagram representation with and without PSS.
6. Study of concept of PSS and its analysis.

UNIT-I: LOAD COMPENSATION

Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads-examples.

UNIT-II: STEADY – STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM

Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples.

Transient state reactive power compensation in transmission systems:

Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation –compensation using synchronous condensers – examples

UNIT-III: REACTIVE POWER COORDINATION

Objective – Mathematical modelling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences.

UNIT-IV: DEMAND SIDE MANAGEMENT

Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

Distribution side Reactive power Management:

System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks.

UNIT-V: USER SIDE REACTIVE POWER MANAGEMENT

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations.

UNIT-VI: REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES:

Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace.

REFERENCE BOOKS:

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

I Year – II Sem. M.Tech (EPE)

Code: 7X220 **DIGITAL CONTROL SYSTEMS**

(ELECTIVE – II)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of Examples of Data control systems, Linear difference equations, Z-Transform method for solving difference equations, State Space Representation of discrete time systems, Mapping between the S-Plane and the Z-Plane and Ackerman's formula.

Course Outcomes:

Students will able to

1. Describe Digital to Analog conversion and Analog to Digital conversion.
2. Explain linear difference equations, pulse response, Z – transforms.
3. Understand State Space Representation of discrete time systems, Pulse Transfer Function Matrix.
4. Explain Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips.
5. Describe Transient and steady – State response Analysis – Design based on the frequency response method.
6. Explain Design of state feedback controller through pole placement.

UNIT – I SAMPLING AND RECONSTRUCTION

Introduction, Examples of Data control systems – Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

UNIT-II THE Z – TRANSFORMS

Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms.

Z-PLANE ANALYSIS OF DISCRETE-TIME CONTROL SYSTEM

Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane.

UNIT – III STATE SPACE ANALYSIS

State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations.

CONTROLLABILITY AND OBSERVABILITY

Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function

UNIT – IV STABILITY ANALYSIS

Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci, Constant damping ratio loci, Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.

UNIT– V DESIGN OF DISCRETE TIME CONTROL SYSTEM BY CONVENTIONAL METHODS

Transient and steady – State response Analysis – Design based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.

UNIT – VI STATE FEEDBACK CONTROLLERS AND OBSERVERS

Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula.State Observers – Full order and Reduced order observers.

TEXT BOOKS:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition

REFERENCE BOOKS:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control and State Variable Methods by M. Gopal, TMH.

I Year – II Sem. M.Tech (EPE)

Code: 7X221 **SMART ELECTRIC GRID**

(ELECTIVE-II)

L	T	P	C
3	1		3

Course Objective:

Understand the concepts of Smart Grid, Architecture of Smart Grid Design, Intelligence Techniques, Electric Vehicles and plug –in hybrids, Phasor Measurement Units (PMUs) and Reactive Power Control in Smart Grid.

Course Outcomes:

Students will able to

1. Describe Working definitions of Smart Grid and Associated Concepts.
2. Understand Components and Architecture of Smart Grid Design.
3. Explain Computational Techniques –Static and Dynamic Optimization Techniques.
4. Describe Electric Vehicles and plug –in hybrids, Environmental impact and Climate Change –Economic Issues.
5. Understand Wide Area Measurement Systems (WAMS).
6. Explain Load Frequency Control (LFC) in Micro Grid System.

UNIT – I INTRODUCTION TO SMART GRID:

What is Smart Grid, Working definitions of Smart Grid and Associated Concepts –Smart Grid Functions-Traditional Power Grid and Smart Grid –New Technologies for Smart Grid – Advantages –Indian Smart Grid – Key Challenges for Smart Grid.

UNIT – II SMART GRID ARCHITECTURE:

Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs –Transmission Automation – Distribution Automation – Renewable Integration

UNIT – III TOOLS AND TECHNIQUES FOR SMART GRID:

Computational Techniques –Static and Dynamic Optimization Techniques –Computational Intelligence Techniques –Evolutionary Algorithms –Artificial Intelligence techniques.

UNIT – IV DISTRIBUTION GENERATION TECHNOLOGIES:

Introduction to Renewable Energy Technologies –Micro grids –Storage Technologies –Electric Vehicles and plug –in hybrids –Environmental impact and Climate Change –Economic Issues.

UNIT – V COMMUNICATION TECHNOLOGIES AND SMART GRID:

Introduction to Communication Technology –Synchro Phasor Measurement Units (PMUs) –Wide Area Measurement Systems (WAMS).

UNIT – VI CONTROL OF SMART POWER GRID SYSTEM:

Load Frequency Control (LFC) in Micro Grid System –Voltage Control in Micro Grid System – Reactive Power Control in Smart Grid. Case Studies and Test beds for the Smart Grids.

TEXT BOOKS:

1. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley-IEEE Press, 2004.
3. A.G. Phadke and J.S. Thorp, ―Synchronized Phasor Measurements and their Applications, Springer Edition, 2010.
4. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2005.

I Year – II Sem. M.Tech (EPE)

Code: 7RC17 **DATA BASE MANAGEMENT SYSTEMS**

(ELECTIVE – II)

L	T	P	C
3	-	-	3

Course Objective:

Understand the concepts of Database Languages, Relational Model, Complex Integrity Constraints in SQL Triggers, Multi valued Dependencies, Hash Based Indexing and Indexed Sequential Access Methods (ISAM).

Course Outcomes:

Students will able to

1. Understand Data base System Applications, data base System VS file System and Data Abstraction.
2. Explain Relational Model, Integrity Constraint Over relations and Enforcing Integrity constraints.
3. Understand Nested Queries, Correlated Nested Queries Set, Comparison Operators and Aggregative Operators – NULL values.
4. Describe Schema refinement in Data base Design; Multi valued Dependencies and FORTH Normal Form.
5. Understand implementation of Atomicity, Durability, Concurrent and Executions.
6. Explain File Organization, Indexing and Cluster Indexes

UNIT I:

Data base System Applications, data base System VS file System – View of Data – Data Abstraction –Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor, History of Data base Systems. Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model – Conceptual Design for Large enterprises.

UNIT II:

Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views.

Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.

UNIT III:

Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries – Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases.

UNIT IV:

Schema refinement – Problems Caused by redundancy – Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.

UNIT V:

Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock – Based Protocols – Timestamp Based Protocols- Validation- Based Protocols – Multiple Granularity, Recovery and Atomicity – Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems.

UNIT VI:

Data on External Storage – File Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing – Comparison of File Organizations – Indexes and Performance Tuning- Intuitions for tree Indexes – Indexed Sequential Access Methods (ISAM) – B+ Trees: A Dynamic Index Structure.

TEXT BOOKS:

1. Data base Management Systems- Raghurama Krishnan, Johannes Gehrke, Tata Mc-Graw Hill 3rd Edition
2. Data base System Concepts- Silberschatz, Korth, McGraw hill, V edition.

REFERENCES:

1. Data base Systems design, Implementation, and Management- Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems- Elmasri Navrate Pearson Education
3. Introduction to Database Systems- C.J.Date Pearson Education

I Year – II Sem. M.Tech (EPE)
Ethics, Morals, Gender Sensitization, and Yoga
(Audit Course – II)

Code: 7HC19

L	T	P	C
2	-	-	-

a	b	c	d	e	f	g	h	i	j	k	l	m
				x	x					x	x	

COURSE OBJECTIVES

Students will be able to

- develop students' sensibility with regards to issues of gender in contemporary

India and to help the students appreciate between 'values and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

- Provide a critical perspective on the socialization of men, women and transgender and to have a wider understanding of Ethics.
- Acknowledge women's role at home and at work.
- Help students reflect critically on gender violence, understand engineering ethics and an engineer's responsibility for safety.
- Perceive gender literacy and understand the importance of gender perspective.
- Understand rules and principles set by the society in a customary way.
- Understand and appreciate the importance of personality development through yoga for a holistic life.

UNIT I: UNDERSTANDING GENDER AND VALUES

Importance of gender sensitization
Socialization: Being modern in thought, yet rooted in one's culture
Just Relationships: Healthy relationship between men and women
Importance of Value Education, Understanding Social Factors, Morals, Values ,Family Values-Harmony, Respect, Caring; Sharing; Integrity; Honesty; Courage; Cooperation; Commitment; Empathy; Self Confidence; Character; Accountability; Loyalty; Confidentiality; and Attitude

UNIT II: GENDER SPECTRUM, LABOUR AND ETHICS

Beyond the Binary, Gender Imbalance and its Consequences
Decline in Women population (Medico-legal concerns- PC and PNDT Act 1994)
Social consequences of skewed gender ratio, Demographic Consequences
Housework: the invisible Labour
Women's Work: Its Politics and Economic
Unrecognized and Unaccounted Work. Wages and Conditions of Work
Ethics and Ethical Principles, Ethical Theories, and their uses

UNIT III: ISSUES OF VIOLENCE AND ENGINEERING ETHICS

Domestic Violence: Physical abuse, Mental abuse and Emotional disturbance
Consequences of domestic violence and legal Implications (Domestic Violence Act 2005- 498A)
Professional Ethics, Engineering Ethics, Code of Ethics, Moral Autonomy of Engineers, Engineer's Responsibility for safety and Risk

UNIT IV: GENDER STUDIES

Knowledge: Through the Lens of Gender
Unacknowledged Women and Men in Indian History- Women Scientist (Rupabai Furdoonji), Early Aviators (Babur Mirza and Pingle Madhusudhan Reddy), and Women Leader (T N Sadalakshmi)
Life Sketches: Mary Kom, Chanda Kochar, Mother Tesera, and Durga Bai Deshmukh

UNIT V: GLOBAL PERSPECTIVE

Distinguish between Bribes and Gifts; Occupational Crimes; Globalization- Cross-Cultural Issues; Environmental Ethics; Internet and Computer Codes of Ethics
Case Study: Ethics in Military and Weapons Development-Ethics in Research work

UNIT VI: PERSONALITY DEVELOPMENT

Spirituality, Personality and Our Identity, Understanding Self, Happiness, Positive Thinking, Understanding responsibility towards Society.

Introduction to Yoga in India; Origin and Development; Theoretical understanding of yoga; Stress Management : Modern and Yogic perspectives; Tackling ill-effects of Frustration, Anxiety and Conflict through modern and Yogic methods; Meditation Techniques; Suryanamaskar; Pranayama.

TEXT BOOKS:

1. Indian Culture Values and Professional Ethics (For Professional Students) by Prof.P.S. R. Murthy; B.S. Publications.
2. Professional Ethics and Human Values by M. Jayakumar, Published by University Science Press.
3. Telugu Academy, Hyderabad, 2015, Towards A World of Equals, A Bilingual Text Book on Gender.

REFERENCE BOOKS:

1. The Yoga Sutras of Patanjali by Swami Satchitananda
2. The Secret Power of Yoga by Nischala Joy Devi
3. Light on Pranayama by B.K.S. Iyengar
4. Books on the Art of Living by Poojya Sri Sri Ravi Shanker
5. Making It Relevant: Mapping the meaning of women's studies in Tamilnadu by Anandi S and Swamynathan P
6. Feminism is for Everybody; Passionate Politics by Bell Hooks
7. Gender by Geetha V
8. "Growing up Male" in what is worth teaching by K Kumar
9. The Lenses of Gender: Transforming the Debate on Sexual Inequality - Sandra Lipsitz Bem
   The Lenses of Gender - by ANNE MURPHY

I Year – II Sem. M.Tech (EPE)

Code: 6X277 POWER SYSTEMS LAB

(Minimum of ten of the following to be conducted)

L	T	P	C
-	-	4	2

Course Objective:

Understand the concepts and determination of Equivalent circuit of a 3-windingtransformer., determination of sequence impedances of a cylindrical rotor synchronous machine, determination of Sub-transient reactance`s of Salient Pole Synchronous Machine, determination of Positive, Negative and zero sequence reactance of 3 ph Transformers. Understand Fault Analysis of a 3phaseAlternator, IDMT Characteristics, Testing of Generator/Transformer and Differential Protection.

Course Outcomes:

Students will able to

1. Ability to determination of Equivalent circuit of a 3-windingtransformer.
2. Ability to determination of sequence impedances of a cylindrical rotor synchronous machine.
3. Ability to Fault Analysis of a 3phaseAlternator.
4. Ability to determination of Sub-transient reactance`s of Salient Pole Synchronous Machine.
5. Ability to determination of Positive, Negative and zero sequence reactance of 3 ph Transformers.
6. Ability to determination of IDMT Characteristics of Over Current Relay
7. Ability to determination of Characteristics of Percentage biased of Static/Electro Magnetic differential Relay
8. Ability to determination of Characteristics of Static Relay UV/OV 7052B/7053B.
9. Ability to determination of Characteristics of Static Negative Sequence Relay 7055B.
10. Ability to Performance and Testing of Generator/Transformer Protection System.
11. Ability to Performance and Testing of Transmission line Model 220KV/ 400Km.
12. Ability to determination of Differential Protection on Single Phase Transformer.

LIST OF EXPERIMENTS

1. Determination of Equivalent circuit of a 3-windingtransformer.
2. Determination of sequence impedances of a cylindrical rotor synchronous machine.
3. Fault Analysis of a 3phaseAlternator, (LG, LL, LLG, LLLG faults).
4. Determination of Sub-transient reactance`s of Salient Pole Synchronous Machine.
5. Determination of Positive, Negative and zero sequence reactance of 3 ph Transformers.
6. IDMT Characteristics of Over Current Relay
7. Characteristics of Percentage biased of Static/Electro Magnetic differential Relay
8. Characteristics of Static Relay UV/OV 7052B/7053B.
9. Characteristics of Static Negative Sequence Relay 7055B.
10. Performance and Testing of Generator/Transformer Protection System.
11. Performance and Testing of Transmission line Model 220KV/ 400Km.
12. Differential Protection on Single Phase Transformer.

M.Tech (EPE) I Year – II Sem
TECHNICAL SEMINAR - II

L	T	P	C
-	-	4	2

CODE: 7X274

Max. Marks: 100

In I year II semester, a mini project work review shall be done by PRC for 100 marks. The evaluation for the project reviews shall be done in 4 stages (not less than 4 weeks between two consecutive stages) including end semester evaluation.
Each stage project review shall carry 20 marks and the end semester Project Seminar shall carry 40 marks (50% by PRC and 50% by supervisor). The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey and design in Mini Project Review. A candidate shall secure a minimum of 50% to be declared successful in Project Seminar I. If candidate fails to fulfill minimum marks, he has to reappear during the supplementary examination.

II Year – I Sem. M.Tech (EPE)

Code: 7ZC03 BANKING OPERATIONS, INSURANCE AND RISK MANAGEMENT (OPEN ELECTIVE)

T	P	C
3	-	3

Course Objective: The objective of the course is to provide to students an understanding of Banking Operations, Insurance Market, and Risk Management Principles and techniques to control the risk & the major Institutions involved and the Services offered within this framework.

Course Outcomes: Students will able to

1. Describe the global, environmental, political, economic, legal and regulatory context of banking industry.
2. Explain individual ethical behavior and community responsibilities in organization and society.
3. Explain capacity to apply knowledge in new and unfamiliar circumstances through a conceptual understanding of relevant disciplines & able to manage diversity, contemporary societal and global issues
4. To demonstrate leadership and team work capabilities
5. To analyze and manage the financial risk in the real life situations.
6. To demonstrate the significance and methodology of using derivative contracts for managing investments

UNIT I: INTRODUCTION TO BANKING BUSINESS:

Introduction to Banking sectors-History of banking business in India, Structure of Indian banking system: Types of accounts, advances and deposits in a bank New Dimensions and products- E-Banking, Mobile-Banking, Net Banking, CRM, cheque system and KYC system.

UNIT II: BANKING REFORMS AND REGULATIONS:

Banking regulation Act-1949, Reserve Bank of India Act-1934, Establishment of RBI, Functions and credit control system; Role of commercial banks and its functions. Banking sector reforms in India and deficiencies in Indian banking including problems accounts and Non-Performing Assets.

UNIT III: INTRODUCTION TO INSURANCE:

Introduction to insurance, Need and importance of Insurance, principles of Insurance, characteristics of insurance contract, branches of insurance and types of insurance; life insurance and its products: Role of Agents and brokers.

UNIT IV: INSURANCE BUSINESS ENVIRONMENT:

Regulatory and legal frame work governing the insurance sector, history of IRDA and its functions: Business and economics of insurance, need for changing mindset and latest trends.

UNIT V: INTRODUCTION TO RISK MANAGEMENT:

Introduction to Risk, meaning and types of risk in business and individual, Risk management process, methods: Risk identification and measurement, Risk management techniques; Non insurance methods

UNIT VI: FINANCIAL RISK MANAGEMENT:

Introduction to Financial markets. Financial risk management techniques –Derivatives, Hedging and Portfolio management techniques: Derivatives and types of Derivatives-Futures, options and swaps: Shares, Commodity and Currency trading in India.

TEXT BOOKS:

1. Varshney, P.N., Banking Law and Practice, Sultan Chand & Sons, New Delhi.
2. General Principles of Insurance Harding and Evantly
3. Mark S. Dorfman: Risk Management and Insurance, Pearson, 2009.

REFERENCES:

1. Scott E. Harringam Gregory R. Nichanus: Risk Management & Insurance, TMH, 2009.
2. Geroge E. Rejda: Principles of risk Management & Insurance, 9/e, pearson Education. 2009.
3. G. Koteshwar: Risk Management Insurance and Derivatives, Himalaya, 2008.
4. Gulati: Principles of Insurance Management, Excel, 2009.
5. James S Trieschmann, Robert E. Hoyt & David N. Sommer: Risk Mgt. & Insurance, Cengage, 2009.
6. Dorfman: Introduction to Risk Management and Insurance, 8/e, Pearson, 2009.
7. P.K. Gupta: Insurance and Risk Management, Himalaya, 2009.
8. Vivek & P.N. Asthana: Financial Risk Management, Himalaya, 2009.
9. Jyotsna Sethi & Nishwan Bhatia : Elements of Banking and Insurance, 2/e,PHI, 2012.

II Year – I Sem. M.Tech (EPE)

Code: 7T216 EMBEDDED AND REAL TIME CONTROL
(OPEN ELECTIVE)

L	T	P	C
3	-	-	3

Course Objective:

Understand the concepts of overview of embedded systems, pipelining processing, Kernel architecture, task scheduler, embedded Linux, RT Linux and Parallel evolution of compilation and synthesis.

Course Outcomes:

Students will able to

1. Explain overview of embedded systems, design challenges, various technologies available for embedded system design.
2. Explain the general purpose processors architecture, operation, pipelining processing, development, instruction set of application specific processors.
3. Describe the state machine and concurrent processor models and also communication and synchronization among processors and their implementation with data follow model.
4. Explain the need for communication interfaces for various technologies and it introduces the embedded/RTOS concepts with Kernel architecture, task scheduler.
5. Explain the embedded concepts of mail box queues, event registers, pipe, signals and different embedded operating systems like embedded Linux, RT Linux, and Windows CE.
6. Explain the concepts of Automation, Synthesis, Parallel evolution of compilation and synthesis. It also gives the logic synthesis, RT synthesis, Behavioral Synthesis, Systems Synthesis.

UNIT – I – INTRODUCITON:
Embedded systems overview, design challenge, processor technology, IC technology, Design Technology, Trade-offs, Single purpose processors RT – level combinational logic, sequential logic (RT-level), custom single purpose processor design (RT-level), optimizing custom single purpose processors.

UNIT – II – GENERAL PURPOSE PROCESSORS :
Basic architecture, operation, Pipelining, Programmer's view, development environment, Application Specific Instruction-set Processors (ASIPs0 – Micro controllers and Digital Signal Processors.

UNIT – III – STATE MACHINE AND CONCURRENT PROCESS MODELS:
Introduction, models Vs. languages, finite state machines with data path model (FSMS), using state machines, program state machine model (PSM), concurrent process model, concurrent processes, communication among processes, synchronization among processes, implementation, data flow model, real time systems.

UNIT – IV – COMMUNICATION INTERFACE:
Need for communication interfaces, RS232/UART/RS422/RS485, USB, infrared, IEEE 1394 Fire wire, Ethernet, IEEE 802.11, Blue tooth.
Embedded / RTOS concepts – I:
Architecture of the Kernel, Tasks and Task scheduler, Interrupt service routines, Semaphores, Mutex.

UNTI – V – EMBEDDED CONCEPTS – II:
Mailboxes, Message Queues, Event Registers, Pipes, Signals.
Embedded /RTOS Concepts –III: Timers, Memory Management, Priority inversion problem, Embedded operating systems Embedded Linux, Real-time operating systems, RT Linux, Handheld operating systems, Windows CE.

UNIT – VI - DESIGN TECHNOLOGY:
Introduction, Automation, Synthesis, Parallel evolution of compilation and synthesis, Logic Synthesis, RT synthesis, Behavioral Synthesis, Systems Synthesis and Hardware / Software Co-Design, Verification, Hardware / Software co-simulation, Reuse of intellectual property codes.

TEXT BOOKS:
1. Embedded System Design – A Unified Hardware / Software Introduction –Frank Vahid, tony D.Gavargis, John Wiley, 2002.
2. Embedded / Real Time Systems – KVKK Prasad Dreamtech Press, 2005.

REFERENCES:

1. Embedded Microcomputer Systems – Jonathan W.Valvano, Broooks / Cole, Thommson, Learning.
2. An Embedded Software Primer – David E.Simon, Pearson, Ed. 2005
3. Introduction to Embedded Systems – Raj Kamal, TMS, 2002.
4. Embedded Real Time Systems Programming – Sri Ram V lyer, Pankaj Gupta, TMH, 2004.

II Year – I Sem. M.Tech (EPE)

Code: 7ZC11 LOGISTICS AND SUPPLY CHAIN MANAGEMENT (Open Elective)

Course Objective: The objective of the course is to give the student an overview of Supply Chain management principles and practices

***The students need Statistical Table to solve numerical problems.**

Prerequisites: Knowledge of Production and Operations Management, Marketing Management and QABD taught in second semester of the programme.

Course Outcomes:

Students will able to

1. Explain Logistics and Competitive strategy Understanding the Supply Chain.
2. Describe Drivers for Supply Chain Performance, Framework for Structuring drivers.
3. Explain Demand Forecasting in Supply Chain Components of forecast and forecasting methods.
4. Understand Benchmarking the logistics process and SCM operations.
5. Explain Business process of warehouse management.
6. Understand Performance of Logistics and Supply chain in India, Logistics in a global economy.

UNIT I: INTRODUCTION TO LSCM:

Logistics and Competitive strategy Understanding the Supply Chain. Objective and Importance of Supply Chain Process View of Supply Chain. Competitive and Supply Chain Strategies, Achieving Strategic Fit, Challenges of SCM

UNIT II: SUPPLY CHAIN DRIVERS AND METRICS:

Drivers for Supply Chain Performance, Framework for Structuring drivers. Facilities, inventory, transportation, information, sourcing and pricing. Obstacles to Achieving fit. Designing the Supply Chain Network. Role of distribution in the Supply Chain, Factors influencing network design, the role of network in the Supply Chain.

UNIT III: DEMAND FORECASTING & AGGREGATE PLANNING IN SUPPLY CHAIN:

Demand Forecasting in Supply Chain Components of forecast and forecasting methods. Role of IT in forecasting. Aggregate Planning in Supply Chain Planning Supply and Demand in A Supply Chain, Managing Predictable Variability.

UNIT IV: LOGISTICS AND SUPPLY CHAIN RELATIONSHIPS:

Benchmarking the logistics process and SCM operations –Mapping the supply chain processes – SCOR model – Supplier and distributor benchmarking –setting benchmarking priorities –identifying logistics performance indicators –Channel structure – channel relationships – Transportation, Inventory Planning & Managing - logistics service alliances.

UNIT V: WAREHOUSE MANAGEMENT:

Importance, Structure, Business process of warehouse management, product unit used for packaging and shipping, supply chain relevant for warehouse management, Goods receipt, Issue & Transfer within the warehouse, Warehouse management automation & IT integration, RFID.

UNIT VI: MANAGING GLOBAL LOGISTICS AND GLOBAL SUPPLY CHAINS:

Performance of Logistics and Supply chain in India, Logistics in a global economy – views of global logistics-global operating levels – interlinked global economy – The global supply chains -Global supply chain business processes.

TEXT BOOKS:

1. Sunil Chopra and Peter Meindl: *Supply chain Management: Strategy, Planning and Operation,3/e,* Pearson Education, New Delhi 2007.
2. Donald J.Bowersox and David J.Closs, Logistical Management: The Integrated Supply Chain Process, Tata McGraw Hill, 2006.

REFERENCES:

1. Martin Christopher, *Logistics and Supply Chain Management,* Pitman, London.
2. B.S.Sahay, *Supply Chain Management for Global Competitiveness*, Macmillan, New Delhi.2003.
3. Philip B.Schary, Tage Skjott-Larsen: Managing the Global Supply Chain, Viva, Mumbai, 2006.

4. Monczka: Purchasing and Supply Chain Management Thomson, 2006.
5. Ballou, Business Logistics/Supply chain Management5/e Pearson Education.
6. David Simchi-Levi, Philip Kaminsky,Edith Simchi-Levi, Designing and Managing The Supply Chain 2nd ed. Tata McGraw Hill Publishing Company Ltd.,2006
7. Amit Sinha, Herbert Kotzab , Supply Chain Management A managerial Approach, Tata McGraw Hill Education Private Ltd, 2012.

II Year – I Sem. M.Tech (EPE)

Code: 7XC30 **WASTE TO ENERGY**

(Open Elective)

UNIT-I: INTRODUCTION TO ENERGY FROM WASTE:
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II: BIOMASS PYROLYSIS:
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III: 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 gasifier operation.

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

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

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

II Year – I Sem. M.Tech (EPE)

Code: 7X215 **SOFT COMPUTING TECHNIQUES**

(ELECTIVE – III)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of Biological Neuron, Continuous Perceptron models, Multi-Category Perceptron model, Matrix Memories, classical sets, Membership, Uncertainty and Defuzzification methods.

Course Outcomes:

Students will able to

1. Describe Biological Neuron, differences between biological neuron and artificial neuron models.
2. Explain discrete, Continuous Perceptron models and Multi-Category Perceptron model and the training algorithms.
3. Explain Hebbian Learning, Hamming Distance, the Linear Associate, Matrix Memories, and Content Addressable Memory.
4. Explain classical sets, properties, Operations and relations classical sets ,Introduction to fuzzy sets, Membership, Uncertainty, Operations Properties, fuzzy relations, cardinalities, membership functions, Membership value assignment, development of rule base and decision making system and Defuzzification to crisp sets, Defuzzification methods.
5. Explain neural networks application deals with Process identification, control, Fault diagnosis, Load forecasting.
6. Explain Load frequency control, reactive power control, speed control of DC, AC motors

UNIT –I: ARTIFICIAL NEURAL NETWORKS:

Introduction, neural network models, architectures, knowledge representation, learning process, learning tasks, ANN paradigms

UNIT – II:

Mc Cullochs-Pitts model, Back propagation, RBF algorithms, Hopfield networks

UNIT – III:

Fuzzy logic, fuzzy sets, membership function, fuzzy interference, Defuzzification methods

UNIT – IV: Genetic algorithms, encoding, fitness function, reproduction operators, genetic modeling, genetic operators cross over and mutation, generation cycle, convergence of GA

UNIT V - APPLICATION OF SOFT COMPUTING TECHNIQUES:

Load forecasting, load flow studies, economic load dispatch,

UNIT – VI:

Load frequency control, reactive power control, speed control of DC, AC motors

TEXT BOOKS:

1. Principles of soft computing- S.N.Sivandan, S.N.Deepa, Wiley India, 2007.
2. Neural Networks and Fuzzy Logic, Genetic Algorithms, Synthesis, Applications- S.Raja Sekharan, G.A.Vijayalakshmi, PHI, 2005.

REFERENCES:

1. Studies in computational intelligence – Devendra K Chaturuvedi, Springer.

II Year – I Sem. M.Tech (EPE)

Code: 7X216 RESTRUCTURING IN ELECTRICAL POWER SYSTEMS (ELECTIVE – III)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of importance of deregulation around the contemporary world, Economic Load Dispatch (ELD), Independent System Operator (ISO), concept of Power Wheeling, importance of Ancillary Services and Reliability Costs and Hierarchical Levels of different power systems.

Course Outcomes:

Students will able to

1. Explain importance of deregulation around the contemporary world.
2. Explain Economic Load Dispatch (ELD), Optimal Power Flow as a Basic Tool and Unit Commitment (UC) methods enable the student grasp logic in developing Formation of Power Pools.
3. Explain role of the Independent System Operator (ISO), Operational Planning Activities of ISO, and Operatinal Planning Activities of a Genco around the economic market can be analysed.
4. Explain concept of Power Wheeling, Transmission Open Access, cost Components in Transmission, Pricing of Power Transactions, transmission Open Access and pricing Mechanisms in Various Countries.
5. Explain the importance of Ancillary Services, Ancillary Services Management in Various Countries.
6. Explain concepts of Reliability Analysis, Reliability Costs and Hierarchical Levels of different power systems.

UNIT – I – DEREGULAION OF THE ELECTRICITY SUPPLY INDUSTRY:

What is Delegulation, Background to Deregulation and the Current Situation around the world, Benefits from Competetive Eelctricity Market, After – Effects of Deregulation?

UNIT – II – POWER SYSTEM ECONOMIC OPERATION OVERVIEW:

Economic Load Dispatch (ELD), Optimal Power Flow as a Basic Tool, Unit Commitment (UC), Formation of Power Pools.

UNIT – III – POWER SYSTEM OPERAITON IN COMPETITIVE ENVIRONMENT:

Role of the Independent System Operator (ISO), Operational Planning Activities of ISO, Operational Planning Activities of a Genco.

UNIT – IV – TRANSMISSION OPEN ACCESS AND PRICING ISSUES:

What is Power Wheeling, Transmission Open Access, Cost Components in Transmission, Pricing of Power Transactions, Transmission Open Access and pricing Mechanisms in Various Countries, Security Management in Deregulated Environment, Cogestion management in Deregulation?

UNIT – V – ANCILLARY SERVICES MANAGMENT:

What do we mean by Ancillary Services, Ancillary Services Management in Various Countries, Reactive Power as an Ancillary Service.

UNIT – VI- RELIABILITY AND DEREGULATION:

Reliability Analysis, The network Model, Reliability Costs, Hierarchical Levels, Reliability and Deregulation, Performance Indicators

TEXT BOOKS:

1. Operation of restructured power systems, Kankar Bhattacharya, Math H.J. Bollen, Japp E.Daalder, Kluwar Academic Publishers, 2001.

REFERENCES:

1. Restructured Electrical Power Systems - Mohd.Shahidehpour and Alomoush – Marcel Deccan, Inc, 2001.
2. Power System restructuring and deregulation – trading, performance and information Technology by Loi Lei Lai, John Willey & Sons Ltd.,

II Year – I Sem. M.Tech (EPE)

Code: 7X217 **POWER SYSTEM TRANSIENTS**

(ELECTIVE – III)

L	T	P	C
3	1	-	3

Course Objectives: -Students will be able to:
1. Learn the reasons for occurrence of transients in a power system
2. Understand the change in parameters like voltage & frequency during transients
3. To know about the lightning phenomenon and its effect on power system

Course Outcomes: -
Students will be able to:
1: Knowledge of various transients that could occur in power system and their mathematical formulation
2: Ability to design various protective devices in power system for protecting equipment and personnel
3: Coordinating the insulation of various equipments in power system
4: Modeling the power system for transient analysis

UNIT- I: Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, damping circuits -Abnormal switching transients, Three-phase circuits and transients and Computation of power system transients

UNIT – II: Principle of digital computation – Matrix method of solution, Modal analysis- Z transform-Computation using EMTP, Lightning, switching and temporary over voltages, Lightning and Physical phenomena of lightning.

UNIT – III: Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometric fault, Energizing transients - closing and re-closing of lines, line dropping, load rejection – over voltages induced by faults

UNIT- IV: Switching HVDC line travelling waves on transmission line, Circuits with distributed Parameters Wave Equation, Reflection, Refraction, Behavior of Travelling waves at the line terminations, Lattice Diagrams – Attenuation and Distortion, Multi-conductor system and Velocity wave

UNIT – V: Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Coordination between insulation and protection level, Statistical approach

UNIT – VI: Protective devices, Protection of system against over voltages, lightning arresters, substation earthling

SUGGESTED READING:
1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991

II Year – I Sem. M.Tech (EPE)

Code: 7X222 REAL TIME CONTROL OF POWER SYSTEMS (ELECTIVE-III)

L	T	P	C
3	1		3

Course Objective:

Understand the concepts of Sub Station/ Generating Station, SCADA:, Types Of Communications, Function of FEPS (Front End Processors), Structure of Real time Programs and Functions & Responsibilities of SLDC.

Course Outcomes:

Students will able to

1. Describe the Lay out of substation / Generating Station, Transducers & their connectivity.
2. Explain SCADA, VDU Display and its use, Operator Dialogs, Mimic Diagram Functions, and Printing Facilities.
3. Explain RTU Panel, Interface Panel, Types of Network Elements in LAN & WAN.
4. Explain Functionality and responsibilities of Sub LDC
5. Understand Modbus, Distributed Network Protocol (DNP), IEC 870-5 and 60870 series.
6. Understand Hierarchy of Data Transfer, Functions & Responsibilities of SLDC, Real Time Operation carried at SLDC.

UNIT – I: SUBSTATION/ GENERATING STATION:

Lay out of substation / Generating Station, Main Equipment in Sub Station/ Generating Station, Instrument Transformers and their importance in measurements and protection, important parameters necessary for Grid operation: Analog Points (MW, MVar, Tap Position, Voltage, Frequency), Status Points (CB Status, Isolator Status, SOE Points), Alarms. Hardware required getting these parameters to RTU: Transducers & their connectivity.

UNIT – II: SCADA FUNCTIONS:

Introduction to SCADA: Grid Operation & Control, Difficulties in operating the large power systems manually, need for going to SCADA operation, advantages of SCADA operation. Data Acquisition, Monitoring and Event Processing, Control Functions, Time tagged data, Disturbance data collection and analysis, Reports and Calculations. Man –Machine Communication: Operator‘s Console, VDU Display and its use, Operator Dialogs, Mimic Diagram Functions, and Printing Facilities.

UNIT – III: REMOTE TERMINAL UNIT (RTU) & COMMUNICATION PRACTICES:

Major Components: RTU Panel, Interface Panel. D20M Main Processor, Analog Card, Status Card, Control Card, Modems. Types Of Communications: Power Line Carrier Communications, Microwave, Optical fibre, VSAT Communications. Types of Network Elements in LAN & WAN. Process of Data Communication.

UNIT – IV: SUB-LOAD DISPATCH CENTER (SUB-LDC):

Various Equipment in Sub LDC: (a) Work Stations: details (b) FEPS: Function of FEPS (Front End Processors). (c) Routers: function of routers, interconnectivity of the equipment by LAN, Functionality and responsibilities of Sub LDC

UNIT – V: INTRODUCTION TO SCADA PROTOCOLS AND COMMUNICATION STANDARDS FOR ELECTRICAL POWER SYSTEMS:

Power System Control requirements and evolution of Protocol for Communication, Protocols -Modbus, Distributed Network Protocol (DNP), IEC 870-5 and 60870 series, Benefits from the IEC (International Electro technical Commission) communication Standards. (Ref: www.dnp.org,www.modbus.org, www.kema.nl)

Real Time Software:

Classification of Programs, Structure of Real time Programs, Construction Techniques & Tools, Programming Language Requirements for Process Control.

UNIT – VI: COMPUTER CONTROL OF ELECTRICAL POWER SYSTEMS:

Evolution of System Control, time scale of system control, online computer control, and Software Elements: State Estimation, Monitoring & Prediction, Generation & Load Control, Security Analysis; Software Coordination & Systems Simulation. State Load Dispatch Center (SLDC): Inter Connectivity of Sub-LDCs & SLDCs, Hierarchy of Data Transfer, Functions & Responsibilities of SLDC, Real Time Operation carried at SLDC.

Southern Regional Load Dispatch Centre (SRLDC):
Functions & Responsibilities of SRLDC, Operations carried at SRLDC, Overview of SCADA, Real Time Operation in detail.

TEXT BOOKS:

1. Hassan Bevrani: Robust Power System Frequency Control, Power Electronics and Power Systems, Edition illustrated Publisher Springer, 2009.
2. Michael John Howard Sterling: Power system control, Volume 6 of IEE control engineering series, Edition illustrated Publisher Peregrinus [for] the Institution of Electrical Engineers, 1978.
3. TorstenCegrell, ―Power System control –Technology‖, Prentice –Hall International seriesin Systems and control Engineering, Prentice Hall International Ltd., 1986.
4. S. Bennett and D.A. Linkens (Editors): Real –Time Computer Control, IEE Control Engineering series (24), peter Peregrinus Ltd., 1984.
5. Real –Time Systems –by C.M. Krishna and Kangg. Shin, McGraw-Hill international companies, 1997.

II Year – I Sem. M.Tech (EPE)

CODE: 7X223 SWITCHED MODE POWER CONVERSION

(ELECTIVE – III)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of buck, boost converters, voltage, current fed converters, phase modulation technique, buck, boost, design of drive circuits for switching devices and mechanisms of loop stabilization.

Course Outcomes:

Students will able to

1. Describe Basic topologies of buck, boost converters, buck-boost converters, and cuk converter.
2. Explain Voltage mode and current mode control of converters.
3. Explain types of resonant converters, methods of control and phase modulation technique.
4. Explain Application of state-space averaging to switching converters.
5. Understand Design of filter inductor & capacitor, and power transformer.
6. Understand mechanisms of loop stabilization.

UNIT- I: DC/DC CONVERTERS:

Basic topologies of buck, boost converters, buck-boost converters, and cuk converter, isolated DC/DC converter topologies—forward, and fly-back converters, half and full bridge topologies, modeling of switching converters.

UNIT –II: CURRENT MODE AND CURRENT FED TOPOLOGIES:

Voltage mode and current mode control of converters, peak and average current mode control, its advantages and limitations, voltage and current fed converters.

UNIT – III: RESONANT CONVERTERS:

Need for resonant converters, types of resonant converters, methods of control, phase modulation technique with ZVS in full-bridge topology, series resonant converter and resonant transition converter.

UNIT – IV: CONVERTER TRANSFER FUNCTIONS:

Application of state-space averaging to switching converters, derivation of converter transfer functions for buck, boost, and fly-back topologies.

UNIT – V: POWER CONVERTER DESIGN:

Design of filter inductor & capacitor, and power transformer, Ratings for switching devices, current transformer for current sensing, design of drive circuits for switching devices, considerations for PCB layout.

UNIT –VI: CONTROLLER DESIGN:

Introduction, mechanisms of loop stabilization, shaping E/A gain vs. frequency characteristic, conditional stability in feedback loops, stabilizing a continuous mode forward converter and discontinuous mode fly-back converter, feed-back loop stabilization with current mode control, the right-half plane zero.

TEXT BOOKS:

1. Ned Mohan Tore M. Undeland: Power Electronics: Converters, Applications, and Design, Edition3, John Wiley & Sons, 2007.
2. Abraham I. Pressman, ―Switching Power Supply Design‖, Mc Graw Hill International, Second Edition, 1999.
3. P.C. Sen: Modern Power Electronics, S. Chand-2004.
4. Andrzej M. Trzynadlowski Introduction to Modern Power Electronics, 2nd Edition, illustrated Publisher John Wiley & Sons, 2010.
5. Muhammad H. Rashid, Power electronics hand book, ISBN: 81 8147 367 1.

II Year – I Sem. M.Tech (EPE)

CODE: 7P141 COMPUTER NETWORKS

(ELECTIVE – III)

L	T	P	C
3	1	-	3

Course Objective:

Understand the concepts of TCP/IP, WAN, LAN, MAN, Logical link control, MAC addresses, Hierarchical routing, TCP and UDP protocols, DES and RSA algorithms.

Course Outcomes:

Students will able to

1. Describe the TCP/IP and other networks models, Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN.
2. Explain design issues in data link layer, Protocol-stop and wait and error detection and correction.
3. Explain ALOHA, MAC addresses, Carrier sense multiple access, ISDN and IEEE 802.X Standard Ethernet.
4. Explain Virtual circuit, Datagram subnets-Routing algorithm shortest path routing and distance vector routing.
5. Understand Congestion, Control Algorithms – General Principles – of Congestion prevension policies.
6. Understand Transport Services, Connection management, TCP and UDP protocols.

UNIT – I: INTRODUCTION:

OSI, TCP/IP and other networks models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN.

PHYSICAL LAYER: Transmission media copper, twisted pair wireless, switching and encoding asynchronous communications;

UNIT – II: DATA LINK LAYER:

Design issues in data link layer, Logical link control, framing, flow control, Protocol-stop and wait, Sliding Window, error detection and correction, CRC, HDLC, ATM.

UNIT – III: MEDIUM ACCESS SUB LAYER:

ALOHA, MAC addresses, Carrier sense multiple access, ISDN, IEEE 802.X Standard Ethernet, wireless LANS. Bridges

UNIT – IV: NETWORK LAYER:

Virtual circuit and Datagram subnets-Routing algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast, distance vector routing.

UNIT – V: Congestion, Control Algorithms – General Principles – of Congestion prevension policies. Internetworking: The Network layer in the internet and in the ATM Networks.

UNIT –VI: TRANSPORT LAYER:

Transport Services, Connection management, TCP and UDP protocols; ATM AAL Layer Protocol.

APPLICATION LAYER – network threats, confidentiality, authenticity, DES and RSA algorithms, Domain name system, Electronic Mail, WWW, Multi Media.

TEXT BOOKS

1. Computer Networks — Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI
2. Data Communications and Networking – Behrouz A. Forouzan.Third Edition TMH.

REFERENCES

1. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education
2. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson

M.Tech(EPE) II Year – I Sem.
PROJECT PHASE –I AND SEMINAR

L	T	P	C
-	-	20	10

Code: 7X378 **Max Marks: 100**

Guide Lines:

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.
7.1 A Project Review Committee (PRC) shall be constituted with Head of the Department as Chairperson, Project Supervisor and one senior faculty member of the Departments offering the M. Tech. programme.
7.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical up I year II Sem.
7.3 After satisfying 7.2, a candidate has to submit, in consultation with his Project Supervisor, the title, objective and plan of action of his project work to the PRC for approval. Only after obtaining the approval of the PRC the student can initiate the Project work.
7.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.
7.5 A candidate shall submit his project status report in four stages at least with a gap of 4 weeks between two consecutive stages.

Evaluation:
In II year I semester, a project work review shall be done by PRC for 100 marks and for 10 credits (there is no external evaluation). The evaluation for the project reviews shall be done in 4 stages (not less than 4 weeks between two consecutive stages) including end semester evaluation.
Each stage project review shall carry 20 marks and the end semester review shall carry 40 marks (50% by PRC and 50% by supervisor). The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey and design in Project Review I. A candidate shall secure a minimum of 50% to be declared successful in Project review I. If candidate fails to fulfill minimum marks, he has to reappear during the supplementary examination

M.Tech II Year –II Sem.
PROJECT PHASE – II and SEMINAR

L	T	P	C
-	-	20	10

CODE : 7X479

Max Marks:100

In II year II semester, a project work review II shall be done by PRC for 100 marks and for 10 credits (there is no external evaluation). The evaluation for the project reviews shall be done in 4 stages (not less than 4 weeks between two consecutive stages) including end semester evaluation. In the case of Project Review II, the Supervisor and PRC will examine implementation, testing and final execution of the project. A candidate shall secure a minimum of 50% to be declared successful in Project II. If candidate fails to fulfill minimum marks, he has to reappear during the supplementary examination.

M.Tech II Year – II Sem.
DISSERTATION (VIVA VOCE)

L	T	P	C
-	-	12	6

Max Marks:200

CODE: 6X480

Course Objective:

A student, who wants to complete a project, should have the following knowledge and competences:

- To make the links between the components of a technical problem.
- Capacity to analyze and define a complex and open problem, put it into its broader context and make a plan for its solution.
- Have a specialized discipline and current international research, for new ideas and novel work.

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

1. Critically and theoretically analyze the systems/products they are going to design or develop.
2. Apply the theoretical knowledge gained to bring out innovative products.
3. Effectively communicate in a variety of forms including written, visual, verbal, online and technical literacy.
4. Work and participate as effective members in a group within a professional environment.
5. Develop an ongoing critical awareness of learning needs in the application of appropriate technologies.
6. Gain as much knowledge and experience in areas of the area of Electrical Power Engineering.

Guide Lines:

7.6 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of all theory and practical courses (no backlogs) with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the PRC.

7.7 After approval from the PRC, the soft copy of the thesis should be submitted to the College for ANTI-PLAGIARISM for the quality check and the plagiarism report should be included in the final thesis. If the copied information is less than 24%, then only thesis will be accepted for submission.

7.8 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College.

Evaluation:

7.10 For Project Evaluation (Viva Voce) in II Year II Sem. there are external marks of 200 for 24 credits. HoD shall submit a panel of 3 examiners, eminent in that field. Principal will appoint one of them as examiner.

7.11 The thesis shall be adjudicated by examiner selected by the College. If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected.

7.12 If the report of the examiner is favorable, Project Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis. Candidate has to secure minimum of 50% marks in Project Evaluation (Viva-Voce) examination.

7.13 If he fails to fulfill as specified in 7.12, he will reappear for the Viva-Voce examination only after three months. In the reappeared examination also, fails to fulfill, he will not be eligible for the award of the degree.