

# **COURSE STRUCTURE AND DETAILED SYLLABUS**

for

**M.Tech**

in

**ELECTRICAL POWER ENGINEERING**

**(EPE)**

(Applicable from the Academic Year 2012-2013)



**SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(An Autonomous Institution approved by UGC and affiliated to JNTUH)**

**Yamnampet, Ghatkesar, R.R.District-501 301.**

**M.Tech (Electrical Power Engineering)**  
**Course Structure and Syllabus**  
**Academic Year: 2012-2013**

**I YEAR - I Semester**

Code	Subject	L	T	P	Credits	Marks	
						Int.	Ext.
122EP01	Power System Dynamics	3	1	--	3	40	60
122EP02	Optimization & Control	3	1	--	3	40	60
122EP03	Advanced Power Electronics	3	1	--	3	40	60
122EP04	Computer Methods in Power Systems	3	1	--	3	40	60
	<b>Elective – I</b>	3	1	--	3	40	60
	<b>Elective – II</b>	3	1	--	3	40	60
122EP71	Power System Simulation Lab – I	--	--	6	3	40	60
122EP72	Technical Paper Writing and Seminar	--	--	3	2	50	--
<b>Total Credits</b>		<b>18</b>	<b>6</b>	<b>9</b>	<b>23</b>	<b>330</b>	<b>420</b>

**I YEAR - II Semester**

Code	Subject	L	T	P	Credits	Marks	
						Int.	Ext.
122EP11	Power System Stability	3	1	--	3	40	60
122EP12	Advanced Power System Protection	3	1	--	3	40	60
122EP13	Flexible AC Transmission Systems	3	1	--	3	40	60
122EP14	Power Quality	3	1	--	3	40	60
	<b>Elective – III</b>	3	1	--	3	40	60
	<b>Open Elective</b>	3	1	--	3	40	60
122EP73	Power System Simulation Lab – II	--	--	6	3	40	60
122EP74	Technical Seminar (Independent Review Paper)	--	--	3	2	50	--
<b>Total Credits</b>		<b>18</b>	<b>6</b>	<b>9</b>	<b>23</b>	<b>330</b>	<b>420</b>

**Elective – I:** Any one subject to be selected**Elective – II:** Any one subject to be selected

Code	Subject
122EP05	High Voltage DC Transmission
122EP06	Distribution Planning & Automation
122EP07	Microprocessors & Microcontroller Systems

Code	Subject
122EP08	High Voltage Engineering
122EP09	Energy Conversion Systems
122EP10	Advanced Operation and Control

**Elective – III:** Any one subject to be selected

Code	Subject
122EP15	Soft Computing Techniques
122EP16	Restructuring in Electrical Power Systems
122EP17	Power System Harmonics

**Open Elective:** Any one subject to be selected

Code	Subject
122MB56	Banking Operations, Insurance and Risk Management
122BT 37	Indian Values, Ethics, Culture and Intellectual Property Rights
122VE16	Embedded and Real time control

**II Year - I Semester**

Code	Subject	L	T	P	Credits	Marks	
						Int.	Ext.
122EP75	Comprehensive Viva	--	--	--	2	--	50
122EP76	Project Seminar-I	--	--	--	2	50	--
122EP77	Project work (Part – I) (Project Status Report) ( Excellent/ Good/ Satisfactory/ Un-Satisfactory	--	--	--	18	Grading	--
<b>Total Credits</b>		--	--	--	<b>22</b>	<b>50</b>	<b>50</b>

**II Year - II Semester**

Code	Subject	L	T	P	Credits	Marks	
						Int.	Ext.
122EP78	Project Seminar-II	--	--	--	2	50	--
122EP79	Project work and Dissertation ( Excellent/ Good/ Satisfactory/ Un-Satisfactory )	--	--	--	20	--	Grading
<b>Total Credits</b>		--	--	--	<b>22</b>	<b>50</b>	--

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

**I Year – I Sem. M.Tech (EPE)****Code: 122EP01 POWER SYSTEM DYNAMICS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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 Modeling, 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 3<sup>rd</sup> 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: 122EP02 OPTIMIZATION AND CONTROL**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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:**

Unimodal 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: 122EP03 ADVANCED POWER ELECTRONICS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT – I - OVERVIEW OF SWITCHING POWER DEVICES:**

State and dynamic characteristics of switching devices: SCR BJT, MOSFET, IGBT, GTO, MCT, Design of drive and Snubber circuits.

**UNIT – II - PHASE CONTROLLED RECTIFIERS:**

Principle of phase controlled converter operation, single phase full converters, dual converters, three phase full and semi converters, reactive power, power factor improvements – extinction angle control, symmetrical angle control and PWM control.

**UNIT – III - DC-DC CONVERTERS:**

Study of class – A, B, C, and D choppers, non – isolated DC-DC converters, buck boost, buck-boost converters under continuous and discontinuous conduction operation.

**UNIT – IV – ISOLATED DC-DC CONVERTERS:**

Isolated DC-DC converters forward, fly-back, push-pull, half-bridge and full –bridge converters Relationship between I / P and O/P voltages. Expression for filter inductor and capacitors.

**UNIT – V - INVERTERS:**

Single phase and three – phase inverters,  $120^0$  and  $180^0$  modes of operation, PWM techniques: single, multiple and sinusoidal PWM techniques, selective harmonic elimination, space vector modulation, current source inverter, multi- Current source inverter, multi – level inverters, techniques for reduction of harmonics.

**UNIT –VI – MULTILEVEL INVERTERS:**

Diode clamped multi level inverters, capacitors clamped multilevel inverters, cascaded H bridge inverter, SPWM, SVPWM and other modulation techniques, applications of multilevel inverters, techniques for reduction for harmonics.

**TEXT BOOKS:**

1. Power Electronics – Circuits, Devices & Applications: M.H.Rashid, PHI
2. Power Electronics: Converters, Applications: Ned Mohan, T.M. Undeland, William P.Robbins, John Wiley & Sons.

**REFERENCES:**

1. Switch Mode Power Supply Handbook: Keith H.Billing, MC Graw Hill International Edition 1996.
2. Switching Power supply Design: Abrahan L.Pressman, Mc.Graw Hill International Second Edition, 1996.

**I Year – I Sem. M.Tech (EPE)****Code: 122EP04 COMPUTER METHODS IN POWER SYSTEMS**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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:**

Introduction, power system equations, solution techniques, Acceleration of convergence, examples of load flow calculations, Voltage controlled buses, representation of transformer. Sparsity, Sparsity techniques, optimal ordering, tap changing transformers.

**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:**

Single area, two area systems, uncontrolled and controlled cases, PID controllers, State space model, application of optimal control theory.

**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, Revised edition.

**I Year – I Sem. M.Tech (EPE)****Code: 122EP05 HIGH VOLTAGE D.C. TRANSMISSION  
(ELECTIVE-I)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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: 122EP06 DISTRIBUTION PLANNING & AUTOMATION  
(ELECTIVE – I)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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: 122EP07 MICROPROCESSORS & MICROCONTROLLERS SYSTEMS  
(ELECTIVE – I)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT I- 8086/8088 PROCESSORS:**

Introduction to 8086 Microprocessors, Architecture, Addressing modes, Instruction set, Register Organization, Assembler directives.

**UNIT II - HARD WARE DESCRIPTION:**

Pin diagram signal description min & max modes, bus timing, ready & wait states, 8086 based micro computing system.

**Special features & Related Programming:** Stack structure of 8086, Memory segmentation, Interrupts, ISR, NMI and MI and interrupt Programming, Macros.

**UNIT III - ADVANCED MICROPROCESSORS:**

Intel 80386 programming model, memory paging, Introduction to 80486, Introduction to Pentium Microprocessors and special Pentium pro features.

**UNIT IV - BASIC PERIPHERALS & THEIR INTERFACING:**

Memory Interfacing (DRAM) PPI- Modes of operation of 8255, interfacing to ADC & DAC.

**UNIT V - SPECIAL PURPOSE OF PROGRAMMABLE PERIPHERAL DEVICES AND THEIR INTERFACING:**

Programmable interval timer, 8253, PIC 8259A, serial data communication standards, Programmable communication Interface 8251, USART and Exercises.

**UNIT VI - MICROCONTROLLERS:**

Introduction to Intel 8 bit & 16 bit Microcontrollers, 8051- Architecture, Memory organization, Addressing Modes and exercises.

**Hardware description of 8051:**

Instruction formats, Instruction sets, interrupt Structure & interrupt priorities, Port structures & Operation linear counter Functions, different Modes of Operation and Programming examples.

**TEXT BOOKS:**

1. The Intel Microprocessors Architecture Programming & Interfacing- Barry b Brey.
2. Advanced Microprocessor- Kenrith J Ayala, Thomson publishers.
3. Microcontrollers - Kenrith J Ayala, Thomson publishers.

**REFERENCES:**

1. Microprocessors & Interfacing Programming & Hardware- DOUGLAS V.Hall.
2. Microprocessors & Microcontrollers - Prof. C.R.Sarma.

**I Year – I Sem. M.Tech (EPE)****Code: 122EP08 HIGH VOLTAGE ENGINEERING  
(ELECTIVE – II)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT I - CONDUCTION AND BREAKDOWN IN GASES:**

Ionization process, Townsend's current growth equation, current growth in the secondary processes, Townsend's criterion for breakdown, streamer theory of breakdown in gases, Paschen's law, breakdown in non uniform fields and corona discharge.

**UNIT II - CONDUCTION, BREAKDOWN IN LIQUIDS AND SOLIDS:**

Pure liquids and commercial liquids, conduction and breakdown in pure liquids, breakdown in solids dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown.

**UNIT – III - GENERATION OF HIGH VOLTAGE AND CURRENTS:**

Generation of high D.C. generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

**UNIT IV - MEASUREMENT OF HIGH VOLTAGE AND CURRENTS:**

Measurement of high d.c.voltages, Measurement of high a.c. and impulse voltages, Measurement of high d.c., a.c. and impulse currents. Cathode Ray Oscilloscope for impulse voltage and current measurements.

**UNIT – V - TESTING OF MATERIALS AND APPARATUS:**

Measurement of D.C. resistivity, measurement of dielectric constant and loss factor, partial discharge measurements, testing of insulators, bushing, circuit breakers, transformers and surge diverters.

**UNIT VI: OVER VOLTAGE PHENOMENON INSULATION COORDINATION:**

Causes of over voltage, lightning phenomenon, switching over voltages and power frequency over voltages in power systems.

**Gas insulated substations:**

Advantages of Gas Insulated Substations, Comparison of Gas Insulated substations and Air Insulated Substations, Design and Layout of Gas Insulated Substations, Description of Various components in GIS.

**TEXT BOOKS:**

1. High Voltage Engineering- M.S.Naidu and V.Kamaraju – TMH.
2. High Voltage Engineering fundamentals- Kuffel and Zungel, Elsevier Publications
3. Switchgear - BHEL, TMH

**REFERENCES:**

1. Fundamentals of Gaseous Ionization and plasma Electronics - Essam Nasser – Wiley - Inter Science.
2. High Voltage Technology - ALSTOM
3. Gaseous Dielectrics - Arora, TMH

**I Year – I Sem. M.Tech (EPE)****Code: 122EP09 ENERGY COVNERSION SYSTEMS  
(ELECTIVE - II)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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, H<sub>2</sub>-O<sub>2</sub> 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, Fspn & Co

**I Year – I Sem. M.Tech (EPE)****Code: 122EP10 ADVANCED OPERATION & CONTROL  
(ELECTIVE – II)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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 Megra Hill edition.

**I Year – I Sem. M.Tech (EPE)****Code: 122EP71 POWER SYSTEM SIMULATION LAB - I**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>-</b>	<b>-</b>	<b>6</b>	<b>3</b>

1. Y-bus and Z-bus Formation method and Y bus formation using Sparsity technique.
2. Conduct a power flow study on a given power system network using Gauss-Seidal iterative method for 5bus, IEEE 14bus and IEEE 30bus system.
3. Develop a SIMULINK model for a single area load frequency problem and simulate with and with out controller.
4. Develop a program to solve swing equation.
5. Symmetrical fault analysis
6. Determine stability of a given dynamical system using following methods.
  - a) Root locus
  - b) Bode Plot
  - c) Nyquist Plot
  - d) Liapunov's stability criteria
7. Obtain model matrix of a given system, obtain it's diagonalize form if exists or obtain Jordon Canonical form of system.
8. PSPICE Simulation of three Phases full converter using RL & E loads PSPICE Simulation of Single Phase full converter using RL & E loads.
9. PSPICE Simulation of Single Phase AC voltage controller using RL load.
10. AC / DC load flow study.
11. General a clock pulse of time duration T at port1-0th pin?
  - a)5 microsecond
  - b)10microsec
  - c)5 millisecond
  - d)15 millisecond
12. Write ALP to send a character 'A', continuously to serial window at baud rate 4800?
13. Write an ALP to send "Embedded system" to a serial window using timer0, mode1?
14. Write a program to generate square wave, triangular wave using ADC interfacing

**I Year – II Sem. M.Tech (EPE)****Code: 122EP11 POWER SYSTEM STABILITY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT I:**

Concepts of steady state, dynamic and transient stabilities.

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

**UNIT II:**

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 III - TRANSIENT STABILITY CONTROLLERS:**

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.

**UNIT – IV - 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 V - VOLTAGE STABILITY INDICES:**

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

**UNIT VI- VOLTAGE STABILITY MARGIN:**

**Stability Margin:** Compensated and un-compensated systems.

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

**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: 122EP12 ADVANCED POWER SYSTEM PROTECTION**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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: 122EP13 FLEXIBLE A.C. TRANSMISSION SYSTEM**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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.

**UNIT 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.

**UNIT 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.

**UNIT 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.H.Ingorani & Laszlo 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: 122EP14 POWER QUALITY**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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 INTERRUPTONS:**

Interruptions – Definition – Difference between failure, 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: 122EP15 SOFT COMPUTING TECHNIQUES  
(ELECTIVE – III)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**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 Chaturvedi, Springer.

**I Year – II Sem. M.Tech (EPE)****Code: 122EP16 RESTRUCTURING IN ELECTRICAL POWER SYSTEMS  
(ELECTIVE – III)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT – I – DEREGULATION OF THE ELECTRICITY SUPPLY INDUSTRY:**

What is Delegation?, Background to Deregulation and the Current Situation around the world, Benefits from Competitive Electricity 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 OPERATION 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, Congestion management in Deregulation

**UNIT – V – ANCILLARY SERVICES MANAGEMENT :**

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, Kluwer 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.,

**I Year – II Sem. M.Tech (EPE)****Code: 122EP17 POWER SYSTEM HARMONICS  
(ELECTIVE – III)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT I:**

Mechanism of harmonic generator, definitions and standards. General harmonic indices. Harmonic Analysis: Fourier series and coefficients, effect of symmetry. Complex form of Fourier series, convolution of harmonic phasors.

**UNIT II - THE FOURIER TRANSFORM:**

Sampled time functions, discrete Fourier transform, The Nyquist Frequency and Aliasing. Fast Fourier Transform window functions. Efficiency of FFT algorithm. The wavelet transforms, Automation of disturbance recognition.

**UNIT III:**

Harmonic sources – Transformer magnetization non linearities, Rotating machine harmonics, Distortion caused by arcing devices, Single phase rectification, 3-Phase current source conversion, 3-phase voltage source conversion, Inverter fed A.C. Drives – Thyristor controlled reactors, Modulated phase control A.C regulators.

**UNIT IV:**

Effects of harmonic distortion, Resonance effects of harmonics on rotation machines, effect of harmonics on static power plant, Power assessment with distorted waveforms, Harmonic interference with ripple control systems, Harmonic interference with Power System Protection, Effect of harmonics on consumer equipment – interference with communications.

**UNIT V: HARMONIC MONITORING AND ELIMINATION:**

Measurement requirements, Transducers, Harmonic instrumentation, Data transmission, Presentation of harmonic information, Examples of applications.

**UNIT VI – HARMONIC ELIMINATION:**

Passive filters, Filter design, Network impedance for performance calculations, Tuned Filters, Damped Filters, Conventional filters, Band pass filters, Distribution systems filter planning, Filter components, Costs, DC side filters – Active filters.

**TEXT BOOKS:**

1. Power System Harmonics- J .Arillaga and N.R.Wadson, John Wiley, 2<sup>nd</sup> Edition.

**REFERENCES:**

1. Power System Harmonics - Wakileh – Springer verilag.

**I Year – II Sem. M.Tech (EPE)**

**Code: 122MB56 BANKING OPERATIONS, INSURANCE AND  
RISK MANAGEMENT  
(OPEN ELECTIVE)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT I : INTRODUCTION TO BANKING BUSINESS:**

Banking Sectors- Retail, Corporate, Rural, and International; Non-banking financial intermediaries; Types of advances and deposits in a bank, New Dimensions and Products. - Credit, Debit and Smart Cards, and e-Banking Structure of the Indian Banking System's. Commercial Banks – Public and Private Sector and Foreign Banks. Cooperative Banks.

**UNIT II : BANKING REFORMS AND REGULATION:** Banking Regulation Act, 1949, Reserve Bank of India Act 1934, and Reserve Bank's Instruments of Credit Control. Deficiencies in Indian Banking including Problems Accounts and Non-Performing Assets, Banking Sector Reforms.

**UNIT III : INSURANCE:** Need for and importance of insurance, branches of insurance (life and general insurance) policy and procedure.

**UNIT IV : INSURANCE BUSINESS ENVIRONMENT:**

Mathematical basis of life insurance, reinsurance coverage, regulatory and legal framework governing the insurance, business and economics of insurance, need for changing mindset; Latest trends.

**UNIT V : INTRODUCTION TO RISK**

Types of Risks facing Business and Individuals, Risk Management Process, Risk Management Methods, Risk Identification and Measurement, Risk Management Techniques: Non Insurance Methods.

**UNIT VI: INSURANCE AS A RISK MANAGEMENT**

Techniques Principles: Principle of Indemnity, Principle of Insurable Interest, Principle of Subrogation, Principle of utmost good Faith, Requisites of Insurable Risks, Requirements of an Insurance Contract, Distinguishes Characteristics of Insurance Contracts, Role of Agents and Brokers.

**TEXT BOOKS**

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



**REFERENCES:**

- Scott E. Harringam Gregory R. Nichaus: Risk Management & Insurance, , TMH, 2009.
- George E. Rejda: Principles of risk Management & Insurance, , 9/e, Pearson Education, 2009.
- G.Koteshwar: Risk Management Insurance and Derivatives, Himalaya, 2008
- Gulati: Principles of Insurance Management, Excel, 2009
- James S Trieschmann, Robert E. Hoyt & David N. Sommer: Risk Management & Insurance, Cengage, 2009.
- Dorfman: Introduction to Risk Management and Insurance, 8/e,Pearson, 2009.
- P.K.Gupta: Insurance and Risk Management, Himalaya ,2009.
- Vivek & P.N. Asthana: Financial Risk Management, Himalaya,2009.

**I Year – II Sem. M.Tech (EPE)****Indian Values, Ethics, Culture and Intellectual Property Rights  
(OPEN ELECTIVE- I)****Code: 122BT37**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT-1 Indian Culture**

A Introduction to Culture Values and Ethics, Bharata, The Indian Concept of Human Life, Indian Civilization, Sanskrit and Indian Languages, Festivals, Sculpture, Music, Dance, Drama, Ayurveda, Family and its Importance, Indian Marriage System, Status of Women in Indian Society, Education, Purpose, Ancient System, Value Education, Interfaith Understanding, Happiness, Modernism and its Effect on Lifestyle, Mind and its Operation, Control of Mind, Yoga, Exemplary Life Sketches-Albert Einstein, Abraham Lincoln

**UNIT-II Value System**

Human Value System, Truthfulness, Righteousness, Peace, Non-Violence, Love, Kindness and Compassion, Humility, Faith, Courage, Optimism, Forgiveness, Ceiling on Desires (Control of Sense organs), Exemplary Life Sketches-M K Gandhi, Abdul Kalam

**UNIT-III Ethics**

Ethics in Ancient India, Ethics, Morals, Ethics and Human Life, Core Areas for Ethics, Values, Morality, Integrity, Honesty, Character, Loyalty, Trustworthiness, Courage and Confidence, Confidentiality, Secrecy and Transparency, Justification, Contracts and Spirit Promises and Schedules, Quarrels, Selfishness, Obstacles, Supporting Measures, Reputation and its sale, Decision Making in Ethics, Exemplary Life Sketches-Vishveshwaraiah, Jagadeesh Chandra Bose, Meghanad Saha

**UNIT- IV Professional Ethics**

Occupation, Profession, Professional, Professional Organization, Obligations Of a Professional, Temptations, Aptitude, Importance of Professional Ethics for Engineers, Code of Ethics, Need for a Code, Impact of Ethical Behaviour, The Code of Ethics for Engineers, Fundamental Principles and Cannons, Commerce and Ethics, Marketing Ethics, Finance and Ethics, Science, Religion and Ethics, Medical Ethics, Genetics and Ethics, Politics and Ethics, Genders and Ethics, Media and Ethics, Computer Ethics  
Exemplary Life Sketches- Narayan Murthy, Homi Jahangir Bhabha

**UNIT –V Intellectual Property Rights (IPR)**

Invention and Creativity, Basic Types of Property, Need for Protection of IPR, IP Types Industrial Property (Patents, Trade Marks, Trade Secrets, Industrial Designs and Integrated Circuits), Copyrights and Related Rights, Geographical Indications.

**UNIT-VI** WIPO Mission and Activities, GATT & Trips, Indian Position on WTO and strategies, Indian IPR legislations-commitments to WTO-Patent Ordinance and the Bill, Draft of a National Intellectual Property Policy, Case Studies on IP

**REFERENCE BOOKS:**

1. The ABCs of Ethics by Michael. L. Buckner, Universe. Inc, New York Lincoln, Shanghai
2. Science, Faith and Ethics by Denis Alexander and Robert.S.White, Hendrickson Publishers, Massachusetts, USA, March 2006
3. Vedic Science Primer by PSR Murthy, BS Publications, Hyderabad
4. Medical Ethics-Global View Points, Edited by Diane Andrews, Hennig Feld, Green Haven Press
5. Divine Stories, Human Value Stories, Volume I and II, Sri Satya Sai Books and Publications.

**I Year – II Sem. M.Tech (EPE)****Code: 122VE16 EMBEDDED AND REAL TIME CONTROL  
(OPEN ELECTIVE)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>

**UNIT – I – INTRODUCTON:**

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 (ASIPs) – 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.

**UNIT – 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, Brooks / 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 Iyer, Pankaj Gupta, TMH, 2004.

**I Year – II Sem. M.Tech (EPE)****Code: 122EP73 POWER SYSTEM SIMULATION LAB – II  
(Minimum of ten of the following to be conducted)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>-</b>	<b>-</b>	<b>6</b>	<b>3</b>

1. Conduct a power flow study on a given power system network using Newton Rapson Method for 5bus, IEEE 14bus and IEEE 30bus system.
2. Develop a SIMULINK model for a two area load frequency problem and simulate with and with out controller.
3. Solution of simultaneous differential equations by RK and modified Euler's method.
4. Design excitation systems for voltage control.
5. Unsymmetrical fault analysis.
6. Design a compensator for a given systems for required specifications.
7. Design a PID controller and Write a program and implement linear quadratic regulator.
8. PSPICE Simulation of Three phase inverter with PWM controller
9. PSPICE Simulation of resonant pulse commutation circuit and impulse commutation circuit.
10. NR load flow study with FACTS.
11. Write a program using embedded c to blink pins of port-1?
12. Write a program using embedded c to print given string in the output?
13. Display the status of port1 in the microcontroller on LEDS?
14. Reading from PSBs and writing in to LEDS?

**I Year – II Sem. M.Tech (EPE)****Code: 122EP74 TECHNICAL SEMINAR  
(Independent Review Paper)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
-	-	3	2

**Max. Marks: 50**

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 50 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:**

- Day to day evaluation by the Supervisor : 10 marks
- Final Report : 10 marks
- Presentation : 30 marks

**II Year – I Sem. M.Tech (EPE)****Code: 122EP75 COMPREHENSIVE VIVA-VOCE**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
-	-	-	2

**Max. Marks: 50**

There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the students' understanding in various subjects he/she studied during the M.Tech course of study. The Comprehensive Viva-Voce is valued for 50 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce. A candidate has to secure a minimum of 50% to be declared successful.



**II Year – I Sem. M.Tech (EPE)****Code: 122EP76 PROJECT SEMINAR - I**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
-	-	-	<b>2</b>

**Max. Marks: 50**

In II year I semester and II semester, a project seminar shall be conducted for 50 marks and for 2 credits (there is no external evaluation) in each of the semester. The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 25 marks and the end semester seminar evaluation shall carry 25 marks. The report for the project seminar will carry 10 marks and the remaining marks (15) shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

**II Year – I Sem. M.Tech (EPE)****Code: 122EP77 PROJECT WORK (PART I)  
PROJECT STATUS REPORT**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
-	-	-	<b>18</b>

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Project Review Committee.

A Project Review Committee (PRC) shall be constituted comprising of Heads of all the Departments which are offering the M.Tech programs and three other senior faculty members concerned with the M.Tech. Programme.

Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the previous semesters and after obtaining the approval of the PRC.

After satisfying attendance requirement, 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 its approval. Only after obtaining the approval of PRC the student can initiate the Project work. This process is to be completed within four weeks of commencement of II year I semester.

The student shall submit a project report at the end of II year I semester, and the same shall be evaluated at the end of that semester by the PRC as Excellent/Good/Satisfactory/Unsatisfactory. In the case of unsatisfactory declaration, the student shall re-submit the Project report after carrying out the necessary modifications / additions in the Project work, within the specified time as suggested by the PRC.

**II Year – II Sem. M.Tech (EPE)****Code: 122EP78 PROJECT SEMINAR - II**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
-	-	-	<b>2</b>

**Max. Marks: 50**

In II year I semester and II semester, a project seminar shall be conducted for 50 marks and for 2 credits (there is no external evaluation) in each of the semester. The evaluation for the project seminar shall be done in two stages, i.e. in the middle of the semester and at the end of the semester. The mid-semester seminar evaluation shall carry 25 marks and the end semester seminar evaluation shall carry 25 marks. The report for the project seminar will carry 10 marks and the remaining marks (15) shall be for presentation and discussion. A candidate shall secure a minimum of 50% to be declared successful.

**II Year – II Sem. M.Tech (EPE)****Code: 122EP79 PROJECT WORK AND DISSERTATION**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
-	-	-	<b>20</b>

A candidate is permitted to submit Project Dissertation only after successful completion of PG subjects (theory and practical), seminars, Comprehensive viva-voce, PG Project Part-I, and after 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 shall make an oral presentation before the PRC. Along with the draft thesis the candidate shall submit draft copy of a paper in standard format fit for publication in Journal / Conference, based on the project thesis, to the Head of the Department with due recommendation of the supervisor.

- Four copies of the Project Dissertation certified by the Supervisor and Head of the Department shall be submitted to the College.
- The dissertation shall be adjudicated by one examiner selected by the College. For this, Head of Department shall submit a panel of 3 examiners, who are eminent in that field, with the help of the PRC. The Chief Superintendent of the college in consultation with the college academic committee shall nominate the examiner.
- If the report of the examiner is not favorable, the candidate shall revise and resubmit the Dissertation, in the time frame as prescribed by PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M.Tech program is limited to four years.
- If the report of the examiner is favorable, viva-voce examination shall be conducted by a Board consisting of the Head of the Department, Supervisor and the Examiner who adjudicated the Dissertation. The Board shall jointly report the student's performance in the project work as – (a) Excellent, or (b) Good, or (c) Satisfactory, or (d) Unsatisfactory, as the case may be. In case, the student fails in the viva-voce examination, or gets the Unsatisfactory grade, he can re-appear only once for the viva-voce examination, as per the recommendations of the Board. If he fails at the second viva-voce examination, the candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M.Tech program is limited to four years.