THREE YEAR COURSE STRUCTURE

FOR

PART TIME M.TECH – ELECTRICAL & ELECTRONICS ENGINEERING (EPS)

w.e.f.

2014-2015 ADMITTED BATCH

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

COLLEGE OF ENGINEERING (AUTONOMOUS):: PULIVENDULA

Y.S.R. (DIST), ANDHRA PRADESH, INDIA -516390.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
COLLEGE OF ENGINEERING (Autonomous), PULIVENDULA
Academic Regulations 2014 for M. Tech (PTPG)
(Applicable for the students admitted during the Academic Year 2014 -15 and onwards)

1. ELIGIBILITY FOR ADMISSION:

Admission to the above program shall be made subject to the eligibility, qualification and specialization prescribed by the University for each Program from time to time.

i. Admission shall be made either on the basis of merit/rank obtained by the qualifying candidates in written exam conducted by the University or otherwise specified, whichever is relevant.
ii. The candidates **must be employed** in and around Pulivendula Town.
iii. **COURSES OFFERED**

S.No.	Department	Specialization
01.	Electrical & Electronics Engineering (EEE)	Electrical Power Systems (EPS)
02.	Mechanical Engineering (ME)	Computer Aided Design & Computer Aided Manufacturing (CAD&CAM)
03.	Electronics & Communication Engineering (ECE)	Digital Electronics & Communication Systems (DECS)
04.	Computer Science & Engineering (CSE)	Computer Science & Engineering (CSE)

And any other course as approved by the competent authorities from time to time

2. AWARD OF M.TECH. DEGREE:

A student will be declared eligible for the award of the M.Tech degree if he/she fulfills the following academic regulations:

i. He/she has pursued a course of study for not less than six semesters and not more than twelve semesters.
ii. Students who fail to fulfill all the academic requirements for the award of the degree within twelve semesters from the year of their admission, shall forfeit their seat in the course and their seat shall stand cancelled.
iii. Register for 68 credits and secure all 68 credits

3. COURSE WORK:

The programs are offered on a semester basis consisting of six semesters.

i. The candidates undergo three theories and one laboratory course during the first and Third semesters and two theory and one laboratory courses during the second and fourth semesters. During the fifth and sixth semesters the candidates shall pursue the dissertation in the concerned specialization only. The theme of dissertation should conform to the specialization.
ii. There shall be **two seminars** (seminar-I, and seminar -II) related to thesis/dissertation. Out of two seminars related to thesis/dissertation, seminar-I shall be conducted in the V^{th} semester and the seminar-II will be in VI^{th} semester.

iii. A candidate has to either present a paper in any national or international conference organized by AICTE recognized college/institution, or, publish/get acceptance for publication of a paper in peer-reviewed journals before the submission of thesis.

iv. Only on successful completion of all the prescribed courses, the candidate will be permitted to submit the thesis/dissertation. Three copies of the thesis / dissertation certified by the supervisor in the prescribed form shall be submitted to the College. Once a student fails to submit the thesis within the stipulated period of six semesters, extension of time up to twelve semesters may be permitted by the Principal with recommendation of the College Academic Committee.

v. The Thesis/Dissertation will be adjudicated by one external examiner appointed by the Principal.

vi. If the report of the external examiner is favorable, a viva-voce examination shall be conducted by a board consisting of Head of the department, the supervisor and the external examiner who adjudicated the thesis / dissertation. The board shall jointly report the candidate's work as :

A - Excellent B - Good
C - Satisfactory D - Unsatisfactory

vii. If the report of the viva-voce is not satisfactory, the candidate will re-register for the viva-voce examination after three months by paying prescribed fee. If he/she fails to get a satisfactory report at the second viva-voce examination, he/she will not be eligible for the award of the degree unless the candidate is asked to revise and resubmit the thesis / dissertation.

4. EVALUATION:

The performance of the candidate in each semester program shall be evaluated subject wise, with a maximum of 100 marks for theory and 50 marks for practical examination, on the basis of Internal Evaluation and End external examination.

i. For the theory subjects 60% of the marks will be for the End external Examination and 40% of the marks will be for Internal Evaluation.

ii. There shall be five units in each of the theory subjects.

iii. Two Midterm Examinations shall be held during the semester. First midterm examination shall be conducted for I & II unit syllabus and second midterm examination shall be conducted for the III, IV & V Unit syllabus. In each midterm exam, a student shall answer all three questions in 2 hours of time without any choice. Final Internal marks for a total of 40 marks shall be arrived at by considering the marks secured by the student in both the mid examinations with 80% weightage to the better mid exam and 20% to the other.

iv. The following pattern shall be followed in the End Examination.
   a. Five questions shall be set from each of the five units with either/or type for 12 marks each.
   b. All the questions have to be answered compulsorily.
   c. Each question may consist of one, two or more bits.

v. For practical subjects, 60% marks shall be for the End Examinations and 40% marks will be for internal evaluation. The end examination shall be conducted by the concerned laboratory teacher and another examiner from the same department nominated by the Principal. The internal marks will be awarded by the concerned laboratory teacher based on the performance.

vi. For Seminar, there will be an internal evaluation for 100 marks, with 50 marks in each semester**.** The student shall give a seminar in each semester on the progress of his

M.Tech. thesis. He/she has to secure a minimum of 50% to be declared successful. The assessment will be made by a Board consisting of Head of the Department, Thesis supervisor, and one senior faculty member.

vii. A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

viii. In case the candidate does not secure the minimum aggregate marks as specified in 5 (vii) he has to reappear for the semester examination, either in supplementary or in regular, in that subject.

5. **RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS**

Following are the conditions to avail the benefit of improvement of internal evaluation marks.

i. The candidate should have completed the course work and obtained examinations results for I & II semesters.

ii. He should have passed all the subjects for which the Internal evaluation marks secured are more than 50%.

iii. Out of the theory subjects, if the candidate has failed to obtain 50% of total marks in any subject due to Internal evaluation marks secured being less than 20 marks (50%), then the candidate shall be given one chance for registration of that subject for Improvement of Internal evaluation marks. However, a candidate shall not be permitted for re-registration of more than three such theory subjects.

iv. For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee.

vi. In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects shall stand cancelled.

6. ATTENDANCE:

The candidate shall put in a minimum of 75% attendance in aggregate of all subjects in a semester.

i. Condonation of shortage of attendance up to 10% in any subject i.e. from 65% and above and less than 75% may be given by the College Academic Committee.

ii. Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

iii. If the candidate has not satisfied the attendance requirements in a semester he/she will have to repeat that semester.

7. AWARD OF DEGREE AND CLASS:

A candidate shall be eligible for the award of M.Tech degree if he/she satisfies the minimum academic requirements in every subject and secures at least satisfactory report on his thesis/dissertation viva-voce examination.

First Class with Distinction	70% or more
First Class	Below 70% but not less than 60%
Second Class	Below 60% but not less than 50%

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

Further, percentage to the extent of 0.5% will be rounded off to next higher digit, to effect change of class from pass class to Second class, Second class to First class, First class to First class with distinction for all the courses being offered, without adding any marks to the original marks secured by the students.

8. WITHHOLDING OF RESULTS:

If the candidate has any dues not paid to the college or if any case of indiscipline or malpractice is pending against him, the result of the candidate shall be withheld and he will not be allowed /promoted into the next higher semester. The issue of awarding degree is liable to be withheld in such cases.

9. TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 4(viii) and 2(ii) and they will be in the academic regulations into which the candidate is presently readmitted.

10. GENERAL:

The academic regulations should be read as a whole for purpose of any interpretation.

i. The college reserves the right of altering the regulations as and when necessary. The regulations altered may be applicable to all the candidates on rolls.

ii. Wherever the word he, him or his occur, it will also includes she, her.

iii. There shall be no place transfer within the constituent colleges of Jawaharlal Nehru Technological University Anantapur during the entire course of the programme..

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
COLLEGE OF ENGINEERING, PULIVENDULA (AUTONOMUS)

Course structure for M.Tech (PTPG) ELECTRICAL POWER SYSTEMS with effective from 2014-15

M.Tech (PTPG) I- SEMESTER:

S.No.	COURSE CODE	SUBJECT	T	L	C
1.	13PT07101	Modern Control Theory	4	-	4
2.	13PT07102	Power System Stability & Control	4	-	4
3.		**Elective -I**	4	-	4
	13PT07103	System Reliability Concepts			
	13PT07104	Reactive power compensation & Management			
	13PT07105	HVDC Transmission			
4.	13PT07106	Machines & Power systems lab	-	3	2
		TOTAL	**12**	**3**	**14**

M.Tech (PTPG) II-SEMESTER:

S.No.	COURSE CODE	SUBJECT	T	P	C
1.	13PT07201	Renewable Energy systems	4	-	4
2.		**Elective –II**	4	-	4
	13PT07202	Distribution Automation			
	13PT07203	Power quality			
	13PT07204	Power Electronic Converters			
3.	13PT07205	Power systems simulation Lab -I	-	3	2
		TOTAL	**8**	**3**	**10**

M.Tech (PTPG) III - SEMESTER:

S.No.	COURSE CODE	SUBJECT	T	P	C
1.	13PT07301	Advanced Power System Protection	4	-	4
2.	13PT07302	Restructured Power systems	4	-	4
3.		**Elective- III**	4	-	4
	13PT07303	Power System Reliability			
	13PT07304	Energy auditing and management			
	13PT07305	Electric Smart grid			
4.	13PT07306	Renewable Energy Systems Lab	-	3	2
		TOTAL	**12**	**3**	**14**

M.Tech (PTPG) IV - SEMESTER:

S.No.	COURSE CODE	SUBJECT	T	P	C
1.	13PT07401	Operation and Control of Power Systems	4	-	4
2.		**Elective -IV**	4	-	4
	13PT07402	Soft computing techniques to power Systems			
	13PT07403	EHVAC Transmission			
	13PT07404	FACTS Controllers			
3.	13PT07405	Power System Simulation Lab –II		3	2
TOTAL			**8**	**3**	**10**

M.Tech (PTPG) - V SEMESTER:

S.No	COURSE CODE	Subject	Maximum Marks		Total	Credits
			Internal	External		
1.	13PT07501	Thesis Seminar – I	50		50	-

M.Tech (PTPG) - VI SEMESTER:

S.No	COURSE CODE	Subject	Maximum Marks		Total	Credits
			Internal	External		
1.	13PT07601	Thesis Seminar – II	50		50	-
2.	13PT07602	Project Work Grades: A, B, C, D A – Excellent B – Good C – Satisfactory D – Unsatisfactory	---	---	---	20

M.TECH (PTPG) I- SEMESTER

MODERN CONTROL THEORY

L	T	P	C
4	0	0	4

Unit I

Introductory matrix algebra and linear vector space. State space representation of systems. Linearization of a non-linear System. Solution of state equations. Evaluation of State Transition Matrix (STM) - Simulation of state equation using MATLAB/ SIMULINK program.

Unit II

Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO, MISO transfer functions. Discretization of a continuous time state space model. Conversion of state space model to transfer function model using Fadeeva algorithm. Fundamental theorem of feedback control - Controllability and Controllable canonical form - Pole assignment by state feedback using Ackermann's formula – Eigen structure assignment problem.

Unit III

Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using Eigen value and Eigen vector methods, iterative method. Controller design using output feedback.

Unit IV

Observability and observable canonical form - Design of full order observer using Ackermann's formula - Bass Gura algorithm. Duality between controllability and observability - Full order Observer based controller design. Reduced order observer design.

Unit V

Internal stability of a system. Stability in the sense of Lyapunov, asymptotic stability of linear time invariant continuous and discrete time systems. Solution of Lyapunov type equation. Model decomposition and decoupling by state feedback. Disturbance rejection, sensitivity and complementary sensitivity functions.

Text Books:

1. K. Ogata, Modern Control Engineering, Prentice Hall, India 1997
2. T. Kailath, T., Linear Systems, Perntice Hall, Englewood Cliffs, NJ, 1980.
3. N. K. Sinha , Control Systems, New Age International, 3rd edition, 2005.

References:

1. Panos J Antsaklis, and Anthony N. Michel, Linear Systems, New - age international (P) LTD. Publishers, 2009.
2. John J D'Azzo and C. H. Houpis , "Linear Control System Analysis and Design Conventional and Modern", McGraw - Hill Book Company, 1988.
3. B.N. Dutta, Numerical Methods for linear Control Systems - , Elsevier Publication, 2007.
4. C.T.Chen Linear System Theory and Design - PHI, India.
5. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 11th Edition, Pearson Edu., India, 2009.

M.TECH (PTPG)–I- SEMESTER

POWER SYSTEM STABILITY & CONTROL

L	T	P	C
4	0	0	4

UNIT- I: The Elementary Mathematical Model and System Sesponse to Small Disturbances

A Classical model of one machine connected to an infinite bus – Classical model of multi-machine system – Problems – Effect of the excitation system on Transient stability. The unregulated synchronous Machine – Effect of small changes of speed – Modes of oscillation of an unregulated multi-machine system – Regulated synchronous machine – Voltage regulator with one time lag – Governor with one time lag – Problems.

UNIT- II: Dynamic Stability & Transient Analysis

Concept of Dynamic stability – State space model of one machine system connected to infinite bus – Effect of excitation on Dynamic stability – Examination of dynamic stability by Routh's criterion - Transient Analysis of Three-Phase Power Systems Symmetrical Components in Three-Phase Systems - Sequence Components for Unbalanced Network Impedances - The Sequence Networks - The Analysis of Unsymmetrical Three-Phase Faults - The Single Line-to-Ground Fault - The Three-Phase-to-Ground Fault.

UNIT- III: Power System Stabilizers

Introduction to supplementary stabilizing signals - Block diagram of the linear system - Approximate model of the complete exciter – Generator system – Lead compensation – Stability aspect using Eigen value approach.

UNIT- IV: Excitation Systems

Excitation system response – Non-continuously regulated systems – Continuously regulated systems – Excitation system compensation – State space description of the excitation system - Simplified linear model – Effect of excitation on generator power limits. Type –2 system: Rotating rectifier system, Type-3 system: Static with terminal potential and current supplies - Type –4 system: Non – continuous acting - Block diagram representation – State space modeling equations of these types.

UNIT - V: Stability Analysis

Review of Lyapunov's stability theorems of non-liner systems using energy concept – Method based on first concept – Method based on first integrals – Quadratic forms – Variable gradient method – Zubov's method – Popov's method, Lyapunov function for single machine connected to infinite bus. What is voltage stability – Factors affecting voltage instability and collapse – Comparison of Angle and voltage stability – Analysis of voltage instability and collapse – Integrated analysis of voltage and Angle stability – Control of voltage instability.

TEXT BOOKS:

1. P.M.Anderson, A.A.Fouad, "Power System Control and Stability", IOWA State University Press, Galgotia Publications, Vol-I, 1st Edition.

2. Transients in Power System, Lou Van Der Sluis, John Wiley & Sons.

REFERENCE BOOKS:

1. M.A.Pai, Power System Stability-Analysis by the direct method of Lyapunov, North Holland Publishing Company, New York, 1981.

M.TECH (PTPG)–I- SEMESTER

SYSTEM RELIABILITY CONCEPTS

(Elective- I)

L	T	P	C
4	0	0	4

UNIT- I: Basic Probability Theory

Basic concepts – Rules for combining Probabilities of events – Failure Density and Distribution functions – Bernoulli's trials – Binomial distribution – Expected value and standard deviation for binomial distribution – Examples.

UNIT- II: Network Modeling and Reliability Evaluation

Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cut set based approach – complete event tree and reduced event tree methods - Examples.

UNIT- III: Time Dependent Probability

Basic concepts – Reliability functions f(t), F(t), R(t), h(t) – Relationship between these functions – Baths tubs curve – Exponential failure density and distribution functions - Expected value and standard deviation of Exponential distribution – Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel, Series-Parallel systems - Partially redundant systems - Evaluation of reliability measure – MTTF for series and parallel systems – Examples.

UNIT- IV: Discrete Markov Chains & Continuous Markov Processes

Basic concepts – Stochastic transitional Probability matrix – time dependent probability evaluation – Limiting State Probability evaluation – Absorbing states – Markov Processes-Modelling concepts – State space diagrams – time dependent reliability evaluation of single component repairable model – Evaluation of Limiting State Probabilities of one, two component repairable models – Frequency and duration concepts – Frequency balance approach - Examples.

UNIT- V: Multi Component & Approximate System Reliability Evaluation

Recursive relation for evaluation of equivalent transitional rates, cumulative probability and cumulative frequency and 'n' component repairable model - Series systems, Parallel systems, Basic reliability indices – Cut set approach – Examples.

REFERENCE BOOKS:

1. Reliability Evaluation of Engineering Systems by Roy Billinton and Ronald N. Allan Reprinted in India B. S. Publications, 2007.
2. Reliability Engineering by E. Balagurusamy, Tata McGraw Hill, 2003.
3. Reliability and Maintainability Engineering by Charles E. Ebeling, Tata McGraw Hill, 2000.
4. Probability concepts in Electric Power system – G.J.Anderson- 1st edition –1990 – John Wiley & sons.

M.TECH (PTPG)-I- SEMESTER

REACTIVE POWER COMPENSATION & MANAGEMENT

(Elective- I)

L	T	P	C
4	0	0	4

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 & Transient State Reactive Power Compensation in Transmission System

Uncompensated line – Types of compensation – Passive shunt and series and dynamic shunt compensation – Characteristic time periods – Passive shunt compensation – Static compensations - Series capacitor compensation – Compensation using synchronous condensers –Examples.

UNIT-III: Reactive Power Coordination & Demand Side Management

Objective – Mathematical modeling – 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. Load patterns – Basic methods load shaping – Power tariffs - KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

UNIT-IV: Distribution & User Side Reactive Power Management

System losses – Loss reduction methods – Examples – Reactive power planning – Objectives – Economics Planning capacitor placement – Retrofitting of capacitor banks - KVAR requirements for domestic appliances – Purpose of using capacitors – Selection of capacitors – Deciding factors – Types of available capacitor, characteristics and Limitations.

UNIT-V: 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.

TEXT BOOKS:

1. J.E.Miller, Reactive Power Control in Electric Power Systems, John Wiley and Sons, 1982 (Units I to IV).
2. D.M.Tagare, Reactive power Management, Tata McGraw Hill, 2004 (Units V to VIII).

M.TECH (PTPG) -I- SEMESTER

HVDC TRANSMISSION

(Elective-I)

L	T	P	C
4	0	0	4

UNIT-I: Introduction

General consideration, Power Handling Capabilities of HVDC Lines Basic Conversion principles, static converter configuration.

UNIT-II: Static Power Converters

3-pulse, 6-pulse, and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers. Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

UNIT-III: Control of HVDC Converters and Systems

Constant current, constant extinction angle and constant ignition angle control Individual phase control and equidistant firing angle control DC power flow control. Interaction between HV AC and DC systems – Voltage interaction Harmonic instability problems and DC power modulation.

UNIT-IV: MTDC Systems & Over Voltages

Series parallel and series parallel systems their operation and control.

Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults.

UNIT-V: Converter Faults & Protection

Converter faults, over current protection – valve group, and DC line protection over voltage protection of converters, surge arresters.

REFERENCE BOOKS:

1. E.W. Kimbark: Direct current Transmission, Wiely Inter Science – New York.
2. J. Arillaga HVDC Transmission Peter Peregrinus ltd. London UK 1983
3. KR Padiyar: High Voltage Direct current Transmission Wiely Eastern Ltd New Delhi – 1992.
4. E. Uhlman: Power Transmission by Direct Current , Springer Verlag, Berlin Helberg. 1985.

M.TECH (PTPG)–I- SEMESTER

MACHINES & POWER SYSTEMS LAB

L	T	P	C
0	0	3	2

1. Determination of Sub-transient Reactance of a Salient Pole Machine
2. Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine
3. Fault Analysis
   i) LG Fault
   ii) LL Fault
   iii) LLG Fault
   iv) LLLG Fault
4. Equivalent Circuit of a Three Winding Transformer
5. Separation of No Load losses of a Three Phase Squirrel Cage Induction Motor
6. Power Angle Characteristics of a Salient Pole Synchronous Machine
7. Scott Connection
8. Characteristics of IDMT Over Current Relay (Electro Magnetic Type)
9. Characteristics of Static Negative Sequence Relay
10. Characteristics of Over Voltage Relay
    i) Electromagnetic Type
    ii) Microprocessor Type
11. Characteristics of Percentage Biased Differential Relay
    i) Electromagnetic Type
    ii) Static Type

M.TECH (PTPG) II SEMESTER

RENEWABLE ENERGY SYSTEMS

L	T	P	C
4	0	0	4

UNIT –I: Introduction-

Energy Economics: Simple payback period, Internal (simple) rate of return, Net present valve, Internal rate of return (IRR), NPV and IRR with Fuel Escalation.

Solar resource-Solar spectrum, Altitude angle of sun at solar noon, solar position at any time of day, solar time, sun rise and sunset, solar radiation-direct beam, diffuse radiation, reflected radiation, and radiation measurements.

Semiconductor physics- Band gap energy, Solar spectrum, Band gap impact on Photo voltaic efficiency, P-n junction diode.

UNIT – II: Photo Voltaics:

Generic photo voltaic cell- Simple equivalent circuits, accurate equivalent circuit, Cells to modules to arrays, I-V curve under STC, Impacts of temperature & isolation on I-V curves, Shading impacts on i-V curves, Crystalline silicon technologies, thin film photovoltaic's.

Photovoltaic systems-Introduction to major Photovoltaic systems types, current-voltage curves for loads, Maximum power point trackers

Grid connected systems- Interfacing with utility, DC and AC rated power, Peaks hours approach to estimate PV performance, Grid connected system sizing

UNIT – III: Stand Alone PV Systmes

Stand alone PV systems- Load estimation, Batteries- storage capacity, Sizing, Coulomb efficiency instead of energy, Blocking diodes, Sizing of PV array, Stand alone system design

PV powered water pumping- Hydraulic system curves, Hydraulic curves, Hydraulic system curve and pump curve, a simple directly coupled PV-pump design approach- numerical

UNIT – IV: Wind and Tidal Power:

Wind power-Wind power- Historical development, types of wind turbines, power in wind, Temperature and altitude correction, Impact of tower height, Maximum rotor efficiency, wind turbine generators, Average power in the wind, wind turbine- Aerodynamics

Tidal power-Tides and tidal power stations, modes of operation, **Tidal power calculation**, Tidal project examples, turbines and generators for tidal power generation.

UNIT – V: Fuel Cells & Wave Energy

Fuel Cells – Historical Development, Basic Operation of Fuel cells, Fuel cell Thermodynamics: Enthalpy, Entropy and theoretical efficiency of Fuel Cells, Gibbs free Energy and Fuel cell efficiency, Electrical output of an ideal cell electrical characteristics.

Wave energy conversion: Wave power calculation, Properties of waves and power content, vertex motion of Waves, device applications. Types of ocean thermal energy conversion systems Application of OTEC systems examples

TEXT BOOKS:

1. Renewable and Efficient Electric Power systems: Gilbert M. Masters, John Wiley & Sons, Inc., Publication.

2. Renewable Energy Sources and Emerging Technologies, D.P. Kothari, K. C. Singal,Rakesh Ranjan, Kothari D.p., singal K. C., ranjan Rakesh

M.TECH (PTPG)-II SEMESTER

DISTRIBUTION AUTOMATION

(Elective-II)

L	T	P	C
4	0	0	4

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

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-IV: 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, and function shared benefits, Guidelines 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-V: 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.

REFERENCES:

1. IEEE Tutorial Course “Distribution Automation”
2. IEEE Working Group on “Distribution Automation”
3. Control and Automation of Electrical Distribution Systems, James. Northcote – Green Robert Wilson, CRC Press.
4. Electric Power Distribution Automation, Dr. M. K. Khedkar, Dr. G.M.Dhole, University Science press.

M.TECH (PTPG) - II SEMESTER

POWER QUALITY

(Elective II**)**

L	T	P	C
4	0	0	4

UNIT - I: Introduction to Power Quality

Definition of Power Quality - Power Quality Progression - Power Quality Terminology - Power Quality Issues - Susceptibility Criteria - Responsibilities of Power Suppliers and Users - Power Quality Standards.

UNIT -II: Power Frequency Disturbance & Transients

Introduction to Power Frequency Disturbance - Common Power Frequency Disturbances - Cures for Low Frequency Disturbances - Voltage Tolerance Criteria - ITIC Graph - Introduction to Transients - Transient System Model - Examples of Transient Models and Their Response - Power System Transient Modeling - Types and Causes of Transients - Examples of Transient Waveforms.

UNIT - III: Harmonics & Electromagnetic Interference (EMI)

Definition of Harmonics - Harmonic Number (h) - Odd and Even Order Harmonics - Harmonic Phase Rotation and Phase Angle - Voltage and Current Harmonics - Individual and Total Harmonic Distortion - Harmonic Signatures - Effect of Harmonics On Power System Devices - Guidelines For Harmonic Voltage and Current Limitation - Harmonic Current Mitigation - Introduction to EMI - Frequency Classification - Electrical Fields - Magnetic Fields - EMI Terminology - Power Frequency Fields - High Frequency Interference - EMI Susceptibility - EMI Mitigation - Cable Shielding - Health Concerns of EMI.

UNIT - IV: Grounding and Bonding

Introduction to Grounding and Bonding - Shock and Fire Hazards - NEC Grounding Requirements - Essentials of a Grounded System - Ground Electrodes - Earth Resistance Tests - Earth Ground Grid Systems - Power Ground System - Signal Reference Ground (SRG) - SRG Methods - Single and Multipoint Grounding - Ground Loops - Electrochemical Reaction - Examples of Grounding Anomalies.

UNIT - V: Measuring and Solving Power Quality Problems

Introduction to Power Quality Measurements - Power Quality Measurement Devices - Power Quality Measurements - Test Locations - Test Duration - Instrument Setup - Instrument Guidelines

TEXT BOOKS:

1. Power quality by C. Sankaran, CRC Press
2. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ptd.

REFERENCE BOOKS:

1. Understanding Power quality problems by Math H. J. Bollen IEEE Press
2. Power quality enhancement using custom power devices by Arindam Ghosh,Gerard Ledwich,Kluwer academic publishers

M.TECH (PTPG) II SEMESTER

POWER ELECTRONIC CONVERTERS

(Elective II)

L	T	P	C
4	0	0	4

Unit – I: Rectifiers

Single phase full converters with resistive load and inductive load – Three phase full converter with resistive load – principle and operation of dual converter -– Two quadrant operation –Four quadrant operation.

Unit –II: DC –Dc Converters

Analysis of step-down and step-up dc to dc converters with resistive and Resistive-inductive loads – Switched mode regulators -Analysis of Buck Regulators - Boost regulators - buck and boost regulators - Cuk regulators -Condition for continuous inductor current and capacitor voltage (Continuous Conduction & Discontinuous Conduction modes) - comparison Of regulators - Multiouput boost converters - advantages - applications - Numerical problems.

Unit – III: DC – Ac Converters

single phase bridge inverter- evaluation of output voltage and current with resistive, inductive loads - Voltage control of single phase inverters - single PWM – multi pulse PWM- Three phase inverters - analysis of 180 degree condition for output voltage and current - analysis of 120 degree Conduction - voltage control of three phase inverters - sinusoidal PWM - Third Harmonic PWM - 60 degree PWM - space vector modulation - advantages - applications - numerical problems.

Unit – IV: Multilevel Inverters

Concept of multilevel inverters – Classification of multilevel inverters – single phase to single phase cyclo converters – single phase voltage controller with R load and RL load- Comparison of multi level inverter topologies – Basics of matrix converters – Grid Synchronization- applications and advantages.

Unit – V: Utility applications of power electronics

Power Semiconductor Devices and their capabilities, Distributed Generation applications, Power electronic loads, power quality solutions, Transmission and distribution applications

TEXT BOOKS:

1. Power Electronics - Mohammed H. Rashid - Pearson Education -Third Edition - First Indian Reprint 2004.
2. Power Electronics - Ned Mohan, Tore M. Undeland and William P. Robbins -John Wiley and Sons Second Edition.
3. Modern Power electronics and AC drives – Bimal K. Bose – Prentice Hall india.

M.TECH (PTPG) II SEMESTER

POWER SYSTEM SIMULATION –I LAB

L	T	P	C
0	0	3	2

MATLAB

1. Y - Bus Formation Using MATLAB
2. Gauss – Seidel Load Flow Analysis using MATLAB
3. N-R Method for Load flow Analysis using MATLAB
4. Fast Decoupled Load Flow Analysis using MATLAB
5. Fast Decoupled Load Flow Analysis for Distribution Systems using MATLAB
6. Point by Point Method using MATLAB
7. Step Response of Two Area System with Integral Control and Estimation of Tie Line Power Deviation using SIMULINK
8. Step Response of Two Area System with Integral Control and Estimation of Tie Line Frequency Deviation using SIMULINK

MiPower

9. Load Flow Analysis using MiPower
   i) Gauss Seidel Method
   ii) Newton Raphson Method
10. Short Circuit Analysis using MiPower
11. Transient Stability Analysis using MiPower
12. Economic Load Dispatch Analysis using MiPower

M.TECH (PTPG) –III SEMESTER

ADVANCED POWER SYSTEM PROTECTION

L	T	P	C
4	0	0	4

UNIT-I: **Static Relays**

Advantages of static relays - Basic construction of static relays – Level detectors – Replica impedance-mixing circuits-general equation for two input phase and amplitude comparators – Duality between amplitude and phase comparator.

UNIT-II: Comparators

Amplitude: Circulating current type and opposed voltage type rectifier bridge comparators – Direct and Instantaneous comparators. Phase Comparators: Coincidence circuit type block spike phase comparator, techniques to measure the period of coincidence – Integrating type – Rectifier and vector product type phase comparators. Multi –Input Comparators: Conic section characteristics – Three input amplitude comparator – Hybrid comparator – Switched distance schemes – Polyphase distance schemes-Phase fault scheme – Three phase scheme – combined and ground fault scheme.

UNIT-III: Static Over Current, Differential And Distance Relays

Introduction-Instantaneous over current relay – Time over current relays - Basic principles-Definite time and Inverse definite time over current relays. Analysis of static differential relays – static relay schemes – Dual bias transformer differential protection – Harmonic restraint relay. Static Relays: Static impedance – reactance - MHO and angle impedance relay sampling comparator – realization of reactance and MHO relay using a sampling comparator.

UNIT-IV: Power Swings

Effect of power swings on the performance of Distance relays - Power swing analysis – Principle of out of step tripping and blocking relays – Effect of line length and source impedance on distance relays.

UNIT-V: Microprocessor Based Protective Relays

Over current relays – Impedance relays – Directional relay – Reactance relay (Block diagram and flow chart approach only). Generalized mathematical expression for distance relays - Measurement of resistance and reactance – MHO and offset MHO relays – Realization of MHO characteristics – Realization of Offset MHO characteristics (Block diagram and flow chart approach only) Basic principle of Digital computer relaying.

TEXT BOOKS:

1. T.S.Madhava Rao, Power system Protection static relay, Tata McGraw Hill, 2nd Edition, 1989.

REFERENCE BOOKS:

1. Badri Ram and D.N.Vishwakarma, Power system Protection and Switchgear, Tata McGraw Hill, First Edition -1995.

M.TECH (PTPG) –III SEMESTER

RESTRUCTURED POWER SYSTEM

L	T	P	C
4	0	0	4

UNIT - I: Key Issues In Electric Utilities

Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange - Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT-II: Open Access Same-Time Information System (Oasis) & Market Power

Structure of OASIS - Posting of Information – Transfer capability on OASIS. Market Power: Introduction - Different types of market Power – Mitigation of Market Power - Examples.

UNIT-III: Available Transfer Capability (Atc) & Electricity Pricing

Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow. Electricity Pricing: Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

UNIT - IV: Power System Operation In Competitive Environment

Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO.

UNIT- V: Transmission Cost Allocation Methods & Ancillary Services Management

Introduction - Transmission Cost Allocation Methods : Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods. Ancillary Services Management: Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

TEXT BOOKS :

1. Kankar Bhattacharya, Math H.J. Boller and Jaap E.Daalder, Operation of Restructured Power System, Kulwer Academic Publishers, 2001.
2. Mohammad Shahidehpour and Muwaffaq alomoush, Restructured Electrical Power Systems, Marcel Dekker, Inc., 2001.

REFERENCE BOOKS:

1. Loi Lei Lai, Power System Restructuring and Deregulation, John Wiley & Sons Ltd., England.

M.TECH (PTPG) –III SEMESTER

POWER SYSTEM RELIABILITY

(Elective III)

L	T	P	C
4	0	0	4

UNIT-I: Generating System Reliability Analysis – I

Generation system model – Capacity outage probability tables – Recursive relation for capacitive model building – Sequential addition method – Unit removal – Evaluation of loss of load and energy indices – Examples.

UNIT-II: Generating System Reliability Analysis – II

Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units – 2-level daily load representation - Merging generation and load models – Examples.

UNIT-III: Bulk Power System Reliability Evaluation

Basic configuration – Conditional probability approach – System and load point reliability indices – Weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

UNIT-IV: Distribution System Reliability Analysis – I (Radial Configuration)

Basic Techniques – Radial networks – Evaluation of Basic reliability indices, performance indices - Load point and system reliability indices – Customer oriented, loss and energy oriented indices – Examples.

UNIT-V: Distribution System Reliability Analysis - Ii (Parallel Configuration)

Basic techniques – Inclusion of bus bar failures, scheduled maintenance – Temporary and transient failures – Weather effects – Common mode failures – Evaluation of various indices – Examples.

TEXT BOOKS:

1. Roy Billinton and Ronald N. Allan, Reliability Evaluation of Power Systems, Plenum Press, New York and London, 2nd Edition, 1996.
2. J. Endrenyi , Reliability Modeling in Electric Power Systems, John Wiley & Sons, 1st Edition, 1978.

M.TECH (PTPG) –III SEMESTER

ENERGY AUDITING, CONSERVATION AND MANAGEMENT

(Elective-III)

L	T	P	C
4	0	0	4

UNIT-I: Basic Principles Of Energy Audit

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT-II: Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

UNIT-III: Energy Efficient Motors

Energy efficient motors , factors affecting efficiency, loss distribution , constructional details , characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

UNIT-IV: Power Factor Improvement, Lighting And Energy Instruments

Power factor – methods of improvement, location of capacitors, Pf with non linear loads, effect of harmonics on power factor, power factor motor controllers - Good lighting system design and practice, lighting control ,lighting energy audit - Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

UNIT-V: Economic Aspects And Analysis

Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting - Applications of life cycle costing analysis, return on investment .

REFERENCE BOOKS:

1. Energy management by W.R. Murphy AND G. McKay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995-
4. Energy management hand book by W.C. Turner, John wiley and sons
5. Energy management and good lighting practice : fuel efficiency- booklet12-EEO

M.TECH (PTPG) –III SEMESTER

ELECTRIC SMART GRID

(Elective **– III)**

L	T	P	C
4	0	0	4

UNIT–I: Introduction

Introduction to smart grid- Electricity network-Local energy networks- Electric transportation-Low carbon central generation-Attributes of the smart grid- Alternate views of a smart grid.

Smart Grid To Evolve A Perfect Power System: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power systems-Distributed power systems- Fully integrated power system-Nodes of innovation.

UNIT–II: DC Distribution And Smart Grid

AC vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centers and information technology loads-Future neighborhood-Potential future work and research.

Intelligrid Architecture For The Smartgrid: Introduction- Launching intelligrid-Intelligrid today- Smart grid vision based on the intelligrid architecture-Barriers and enabling technologies.

UNIT–III: Dynamic Energy Systems Concept

Smart energy efficient end use devices-Smart distributed energy resources-Advanced whole building control systems- Integrated communications architecture-Energy management-Role of technology in demand response- Current limitations to dynamic energy management-Distributed energy resources-Overview of a dynamic energy management-Key characteristics of smart devices- Key characteristics of advanced whole building control systems-Key characteristics of dynamic energy management system.

UNIT–IV: Energy Port As Part Of The Smart Grid:

Concept of energy -Port, generic features of the energy port.

Policies And Programs To Encourage End – Use Energy Efficiency: Policies and programs in action -multinational - national-state-city and corporate levels.

Market Implementation: Framework-factors influencing customer acceptance and response - program planning-monitoring and evaluation.

UNIT–V: Efficient Electric End – Use Technology Alternatives

Existing technologies – lighting - Space conditioning - Indoor air quality - Domestic water heating - hyper efficient appliances - Ductless residential heat pumps and air conditioners - Variable refrigerant flow air conditioning-Heat pump water heating - Hyper efficient residential appliances - Data center energy efficiency- LED street and area lighting - Industrial motors and drives - Equipment retrofit and replacement - Process heating - Cogeneration, Thermal energy storage - Industrial energy management programs - Manufacturing process-Electro-technologies, Residential, Commercial and industrial sectors.

TEXT BOOKS:

1. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.
2. Janaka Ekanayake, Kithsiri Liyanage,Jianzhong.Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
3. James Momoh, "Smart Grid :Fundamentals of Design and Analysis"- Wiley, IEEE Press, 2012.

M.TECH (PTPG) –III SEMESTER

RENEWABLE ENERGY SYSTEMS LAB

L	T	P	C
0	0	3	2

1. Demonstration of I-V and P-V characteristics of two modules in series and parallel.
2. Draw charging and discharging characteristics of battery.
3. Perform the experiment of manually finding the MPP by varying the resistive load across the PV panel.
4. Perform the experiment of finding the MPP by varying the duty cycle of DC-DC converter.
5. Observation of current for linear & nonlinear loads and voltage waveform at PCC.
6. Synchronization of grid tied inverter, observation of current waveform and calculations for distortion, displacement and power factor of grid tied inverter
7. Evaluation of the active, reactive power and net energy flow between grid tied inverter, artificial grid & load.
8. MPPT Algorithm for SOLAR PV Panel Testing.
9. P, V and F measurement of output of wind generator.
10. Impact of load and wind speed on power output and its quality.
11. Performance of Frequency drop characteristic of induction generator at different loading conditions.
12. Design of DC –DC Converter for different types of variable DC Loads trough SIMULINK.
13. Design of DC –AC Converter for different types of variable AC Loads trough SIMULINK.

M.TECH (PTPG) –IV SEMESTER

OPERATION AND CONTROL OF POWER SYSTEM

L	T	P	C
4	0	0	4

UNIT-I: Economic operation- Load forecasting - Unit commitment – Economic dispatch problem of thermal units – Gradient method- Newton's method –Base point and participation factor method. Unit Commitment and Solution Methods: Optimal Unit Commitment, Constraints in unit commitment, Spinning reserve, Thermal Unit Constraints, Other constraints, Hydro constraints, Must Run, Fuel constraints, Unit commitment Solution methods : Priority-List methods, Dynamic Programming solution. Backward DP Approach, Forward DP Approach, Restricted Search Ranges, Strategies- Reliability considerations.

UNIT-II: Hydrothermal co-ordination: Short-term hydrothermal scheduling problem -gradient approach – Hydro units in series - pumped storage hydro plants-hydro-scheduling using Dynamic programming and linear programming.

UNIT-III: Automatic generation control: Review of LFC and Economic Dispatch control (EDC) using the three modes of control viz. Flat frequency – tie-line control and tie-line bias control. AGC implementation – AGC features - static and dynamic responses of uncontrolled & controlled two-area system.

UNIT-IV: Interchange of Power & Energy: Economic interchange between interconnected utilities – Inter utility energy evaluation – Power pools – Transmission effects and Issues: Limitations – Wheeling.

UNIT-V: Power system security-Contingency analysis – linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow-Interior point algorithm-Bus incremental costs.– Maximum likelihood Weighted least squares equation – orthogonal Decomposition estimation method – Algorithm.

REFERENCES:

1. Allen J.Wood and Wollenberg B.F., 'Power Generation Operation and control', John Wiley & Sons, Second Edition.
2. Nagrath, I.J. and Kothari D.P., 'Modern Power System Analysis', TMH,N.Delhi,1980
3. D.P.Kothari & J.S.Dhillon, Power System Optimization , PHI,2004

M.TECH (PTPG) –IV SEMESTER

SOFT COMPUTING TECHNIQUES TO POWER SYSTEMS

(Elective IV)

L	T	P	C
4	0	0	4

UNIT – I: Artificial Neural Networks

Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligence and Neural networks–Learning process – Error correction learning – Hebbian learning –Competitive learning –Boltzman learning –Supervised learning – Unsupervised learning – Reinforcement learning- learning tasks.

UNIT- II: ANN Paradigms

Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network.

UNIT – III: Fuzzy Logic

Introduction – Fuzzy versus crisp – Fuzzy sets - Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy cartesion Product –Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers-Fuzzy Inference-Fuzzy Rule based system-Defuzzification methods.

UNIT – IV: Genetic Algorithms

Introduction-Encoding –Fitness Function-Reproduction operators-Genetic Modeling –Genetic operators-Crossover-Single – site crossover-Two point crossover –Multi point crossover-Uniform crossover – Matrix crossover-Crossover Rate-Inversion & Deletion –Mutation operator –Mutation –Mutation Rate-Bit-wise operators-Generational cycle-convergence of Genetic Algorithm.

UNIT–V: Applications Of Ai Techniques

Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control of DC and AC Motors.

TEXT BOOK:

1. S.Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms”- PHI, New Delhi, 2003.

REFERENCE BOOKS:

1. P.D.Wasserman,Van Nostrand Reinhold,”Neural Computing Theory & Practice”- New York,1989.
2. Bart Kosko,”Neural Network & Fuzzy System” Prentice Hall, 1992.
3. G.J.Klir and T.A.Folger,”Fuzzy sets,Uncertainty and Information”-PHI, Pvt.Ltd,1994.
4. D.E.Goldberg,” Genetic Algorithms”- Addison Wesley 1999.

M.TECH (PTPG) –IV SEMESTER

EHV AC TRANSMISSION

(Elective IV)

L	T	P	C
4	0	0	4

UNIT – I: Preliminaries

Necessity of EHV AC transmission – Advantages and problems – Power handling capacity and line losses- Mechanical considerations – Resistance of conductors – Properties of bundled conductors – Bundle spacing and bundle radius - Examples.

UNIT – II: Line And Ground Reactive Parameters

Line inductance and capacitances – Sequence inductances and capacitances – Modes of propagation – Ground return – Examples. Electrostatics – Field of sphere gap – Field of line changes and properties – Charge – potential relations for multi-conductors – Surface voltage gradient on conductors – Distribution of voltage gradient on sub-conductors of bundle – Examples.

UNIT – III: Corona Effects

Power loss and audible noise (AN) – corona loss formulae – Charge voltage diagram – Generation, characteristics - Limits and measurements of AN – Relation between 1-phase and 3 - phase AN levels – Radio interference (RI) - Corona pulses generation, properties, limits – Frequency spectrum – Modes of propagation – Excitation function – Measurement of RI, RIV and excitation functions - Examples.

UNIT – IV: Electro Static Field & Traveling Wave Theory

Electrostatic field: calculation of electrostatic field of EHV/AC lines – Effect on humans, animals and plants – Electrostatic induction in unenergised circuit of double - circuit line – Electromagnetic interference - Examples. Traveling wave expression and solution - Source of excitation - Terminal conditions - Open circuited and short circuited end - Reflection and refraction coefficients - Lumped parameters of distributed lines - Generalized constants - No load voltage conditions and charging current.

UNIT –V: Voltage Control

Power circle diagram and its use – Voltage control using synchronous condensers – Cascade connection of shunt and series compensation – Sub synchronous resonance in series capacitor – Compensated lines – Static VAR compensating system.

TEXT BOOKS:

1. R. D. Begamudre, EHVAC Transmission Engineering, New Age International (p) Ltd.
2. S. Rao, HVAC and DC Transmission.

M.TECH (PTPG) –IV SEMESTER

FACTS CONTROLLERS

(ELECTIVE IV)

L	T	P	C
4	0	0	4

UNIT-I: Facts Concepts

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT-II: Voltage Source & Current Source Converters

Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT – III: Shunt Compensation

Objectives of shunt compensation - Methods of controllable var generation - variable impedance type static var generators - switching converter type var generators - hybrid var generators – Comparison of SVC and STATCOM.

UNIT – IV: Series Compensation

Objectives of series compensation – GTO Thyristor Controlled Series Capacitor (GCSC) - Thyristor Switched Series Capacitor (TSSC) - Thyristor Controlled Series Capacitor (TCSC) - Control schemes for TCSC, TSSC and TCSC.

UNIT- V: Unified Power Flow Controller (UPFC)

Introduction - The Unified Power Flow Controller - Basic Operating Principles - Conventional Transmission Control Capabilities - Independent Real and Reactive Power Flow Control - Control Structure - Basic Control System for P and Q Control - Hybrid Arrangements: UPFC With a Phase Shifting Transformer.

REFERENCE BOOKS:

1. Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems by Narain G. Hingorani, Laszlo Gyugyi - Standard Publishers Distributors - IEEE Press – First Edition – 2001.

M.TECH (PTPG) –IV SEMESTER

POWER SYSTEMS SIMULATION LAB –II

L	T	P	C
0	0	3	2

1. Network reconfiguration in distribution systems for balanced networks.
2. Reliability analysis of distribution systems.
3. Simulation of faults through power system fault analysis.
4. Voltage stability assessment in distribution systems.
5. Development of load frequency controller using heuristic methods such as reduced order
6. Transient stability analysis through single machine.
7. Transient stability analysis through multi machine system.

Simulation of FACTS devices in power system

8. SVC
9. TCSC
10. Analysis of dynamic stability using Mi Power
11. Network reduction using Mi Power
12. Relay coordination using Mi Power for Phase to earth over current relay
13. Line and cable parameters calculation using Mi Power