...SED STRUCTURE OF M.E. (ELECTRICAL) (POWER SYSTEMS)

Name of the Subject	Teaching Scheme		Examination Scheme		
	Lect.	Tut./Pract.	Paper	T.W.	O.E.
SEMESTER-I					
1. Power System Modelling and Stability	3	1	100	25	-
2. Modern Power System Protection & Related Instrumentation.	3	1	100	25	-
3. Modern Power System Analysis and Computer Methods.	3	1	100	25	-
4. E.H.V. A.C. Transmission	3	1	100	25	-
5. Laboratory Practice-I	-	8	-	50	50
	12	12	400	150	50
SEMESTER-II					
1. Power System Planning and Economics.	3	1	100	25	-
2. Real Time Control of Power Systems.	3	1	100	25	-
3. H.V. D.C. Transmission	3	1	100	25	-
4. Elective-I	3	1	100	25	-
5. Elective-II	3	1	100	25	-
6. Laboratory Practice-II	-	8	-	75	50
7. Seminar-I *	-	1	-	50	-
	15	14	500	250	50

* Seminar topic to be based on Literature Survey for Dissertation Work.

SEMESTER-III					
1. seminar-II	-	1	-	50	-
2. Dissertation Phase-I		4	-	100	-
	-	5	-	150	-
SEMESTER-IV					
1. Dissertation Phase-II	-	5	--	100	200
	-	5	-	100	-

	Group 'A'		Group 'B'
A1.	H.V. Engg.	B1.	Advanced Microprocessor Techniques for Powe Systems.
A2.	Power Controllers	B2.	Electric Power Quality and Harmonics.
A3.	Power System Instrumentation.	B3.	Artifical Intellegence and Expert Systems.
A4.	Fuzzy logic and Artifical Neural Networks.		

Note: Elective I and II are to be opted by selecting any one subject from group A and Group B Respectively.

M.E. (Elect-Power Systems) Sem-I

P.S.1: Power System Modelling and Stability

Teaching Scheme:
Lecture : 3 Periods/week
Tutorial: 1 period/week

Examination Scheme:
Theory Paper : 100 Marks
Term Work : 25 Marks

1. Basic concepts of dynamical systems, formation of state space equations.
   Concept of dynamic instability
   a) Voltage instability
   b) Angle instability
   c) steady state and dynamic problems in A.C. systems

2. Modelling of power system components
   a) Synchronous machine, Excitation system, Prime movers, Governors
   b) Transmission lines, Transformers and loads
   c) FACTS devices.

3. Analysis of single machine and multi machine system
   221-252 KRPadiyar 297-325 KRPadiyar

4. Small signal angle instability
   Damping and synchronising torque analysis, Eigen value analysis, Mitigation using Power System Stabilizers (PSS), and supplimentary modulation and control of FACTS devices. 5 KRP
   The action of reducing severity, seriousness

5. Sub synchronous oscillation
   Analysis and counter measures, using PSS and FACTS devices.

6. Transient instability :-
   a) Analysis using digital simulation
   b) Analysis using energy function — 446 — KRPadiyar
   c) Study of various numerical methods
      1. Fixed step methods
      2. variable step methods

7. Analysis of voltage instability and counter measures

References:-

1. Power System Voltage Stability : C.W. Taylor
2. Power System Stability & Control : Anderson P.M. and Fauad - 1
3. Power System Stability & Control : P. Kundur
4. Power System Dynamics & Stability : K.R. Padiyar
5. Computer Analysis of Power Systems : Arrillaga & Arnold
6. Electric Energy Systems : Olle Elegard
7. Understanding FACTS : N.G.Hingorani & L.Gyugyi
8. Power System Operation and Control : P.S.R. Murthy 2
9. Energy Function Analysis for Power System Stability : M.A.Pai

M.E.(Elect-Power Systems) Sem-I

P.S.2: Modern Power System Protection And Related Instrumentation

Teaching Scheme:
Lecture : 3 periods/week
Tutorial : 1 Period/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work : 25 Marks

1. Review of Relaying Scheme
   a) Different protection schemes for Synchronous machine, Transformer, Bus-bar, Induction Motor.
   b) Line protection using over current, different distance schemes, carrier current protection.

2. Protective Instrument Transformer-
   Study of electromagnetic CT & PT , steady state and transient state analysis of CVT , study of residual voltage transformer, natural CT, mixing transformer, summation transformer, optical current transformer.

3. Comparator
   Characterstic and study of different types of two input phase and amplitude comparator. Study of multi input comparator.

4. Static Relays

a) Over current & Voltage

Different time- current relay charecteristic, practical static circuits for over current relay, directional/ overcurrent relay, over voltage and under voltage relays.

b) Differential relays

characteristic of static relay, different types of differential relays. Operating and restraining characteristic of static relay.

c) Distance relay

Standard three zone protection scheme, different types of static distance relays and their characteristics, switched distance relaying and polyphase distance relaying scheme, problems with distance relaying scheme.

5. Digital protection
   Philosophy and advantages of digital relaying schemes. Introduction to digital signal processing, discrete and fast fourier transform, sampling and frequency aliasing. Digital protection schemes for ~~syn~~ machine , transformer, transmission line, study of numerical relays.

6. Instrumentation
a) Study of different data transmission equipments required in digital computer protection scheme.
b) Brief study of SCADA system function, configuration, and protection scheme.
c) Application of PLC, expert system, micro-controller for the protection of power system components.

Recommended Books :-

1. The art and science of protective relaying- Mason
2. Protective relays their theory and practice Vol-I & Vol-II by A.R. Van- warrington
3. Switch gear and proection by S.S. Rao, Khanna Publishers New Delhi
4. Power system protection Static relays with microprocessor application - T.S.M. Rao Tata Mc-Graw Hill 1989.
5. Power system protection - S.S. Patra, Basu,Chaudhary
6. Power system protection and switchgear - B. Ravindranath and M. Chandar.
7. Digital protection by L.P. Singh
8. Compter relaying for power system - A.G. Phadke and J.S.Thorp John Willey and Sons New York 1988.
9. Protective Relaying Principles and Applications by J.L. Black barn Marcel Dekker New-Yark 1987.
10. Power System Protection and switchgear Bidri Ram D.N. Vishwakarma.

M.E.(Elect-Power Systems) Sem-I

P.S.3: Modern power system analysis and computer methods

Teaching scheme:
Lecture : 3 periods/week
Tut/Pract : 1 period/week

Examination Scheme:
Theory paper : 100 marks
Term work : 25 marks

1. **Introduction :-**
   Network solutions with known function voltages or currents, significance, admittance and impedance matrices.

2. **Analysis simplification:-**
   Brief review of shunt and series faults by three component method and use of two component method for shunt and series faults.

3. **Simultanous faults:-**
   Treatment by two port network theory. Two port networks such as modelling and analysis of 3 phase transformer for varios types of transformers. Interconnection of two port networks connections of sequence networks for Z , Y and H types of faults Treatment by matrix transformation method-constraint matrices for Z,Y, and H types of faults Brief introduction to use of Alpha , Beta, Gama components Fault analysis using alpha beta and gama components.

4. **Computer solution methods :-**
   Use of admittance and impedance matrices premitive matrix node incidence matrix, node admitance and impedance matrices. indefinite and definite admittance matrices, impedance matrix algorithm.

5. **Power flow analysis :-**
   Formulation of the problem, data for load flow study,. Solution techniques using Ybus. Modified Newton raphson method, Gauss iterative method using Zbus. representation of Transformer Fast decoupled load flow Introduction to Numerical solution of large sparse system.Introduction to large sparse system matrix and its application to power system such as load flow and state estimation.

T.W. based on Analysis using computer software such as MATLAB/Simulink etc.

Recommended Books:-

1. Analysis of faulted power system by Paul M. Anderson (1)
2. Circuit analysis of A.C. power system Vol II- by Edith clarke
3. Introduction to matrices and power systems by R. Bruce Shipley
4. Computer methods in power system by stagg G.W. and E.L. Abiad
5. Advanced power system analysis and dynamics by L.P. Singh

M.E. (Elect) Power system Sem -I

P.S.4: EHV AC TRANSMISSION

Teaching Scheme :-
Lecture:- 3 peroids/week
T.W./Pr.:- 1 peroid/week

Examination scheme:
Theory paper :100 marks
Term work : 25 marks

1 a)**Introduction :-**
Engineering aspects and growth of EHV AC transmission line trends and preliminaries, power transferability , transient stability limit and surge impedance loading.

b)**Calculation of line and ground parameters:-**
Resistance, power loss, temperature rise; properties of bundled conductors, inductances, and capacitances, calculation of sequence inductance and capacitance, line parameters for modes of propogations, resistance and inductance of ground return.

c)**Voltage gradients of conductor :-**
Charge potantial relations for multiconductor lines, surface voltage gradient on conductors, distribution of voltage gradient on subconductors of bundle.

d)**Corona Effects:-**
(I*I)*R and corona loss corona loss formulae, charge voltage diagram with corona. Attenuation of travelling waves due to corona loss Audible noise;Corona pulses; their generation and properties, limits for radio interface fields.

2. **Theory of travelling waves and standing waves:-**
Waves at power frequency, differential equations and solutions for general case, standing waves and natural frequencies, open ended line; double exponential response, response to sinusoidal excitation, line energization with trapped charge voltage, Reflection and Refraction of travelling waves.

3. **Lightning and lightning protection:-**
Lightning strokes to lines, their mechanism, general principles of the lightning protection problem, tower footing resistance, lightning arresters and protective characteristics, different arresters and their characteristics.

4. **Over voltages in EHV systems covered by switching operations:**
Over-voltages -their types,recovery voltage and circuit breaker, ferroresonance over voltages and calculation of switching surges single phase equivalents.

5, **Power frequency voltage control and over voltages :-**
Generalised constants, charging current, power circle diagram and its use, voltage control shunt and series compensation , subsynchronous resonance in series capacitor compensated lines and static reactive compensating systems.

6. Insulation Coordination :-
Insulation levels, voltage withstand levels of protected equipments and insulation coordination based on lightning.

7. Design of EHVAC lines

References:-

1. EHV AC Transmission Engineering by Rakosh Das Begamudre, Wiley Eastern Limited, 1986.
2. EHV AC & HVDC transmission system Engineering - Analysis and design by Twian Gonen John Wiley and Sons 1988.
3. Electric Power Transmission System Engineering - Analysis and design by Twian Gonen John Wiley and Sons 1988.

M.E. (Elect-Power Systems) Sem-I
P.S.5: Laboratory -I

Teaching Scheme :
Tutorial : 8 periods/week

Examination Scheme:
T.W. : 50 Marks
O.E. : 50 Marks

Introduction to MATLAB:-
Simple maths using MATLAB, script files, file and directory management, arrays and array operations, multidimensional arrays, relational and logical operations, set bit and base functions, character strings , time functions, control flow, function m files and script m-files debugging and profiling tools.

Applications:-
Numerical linear Algebra:-
Sets of linear eqns, matrix functions, special matrices, sparse matrices, sparse matrix functions.

Data Analysis:-
Basic statistical analysis, basic data analysis

Polynomials:- roots, multiplication, addition, division, derivatives, evaluation., rational polynomials , curve fittings, one dimensional and two dimensional interpolation.

Fourier Analysis:-
Descrete fourier analysis, fourier series.

Optimization:-
Zero finding minimization in one dimension, minimization in higher dimensions, practical issues.

Integration Differentiation and ODEs:-
Integration Differentiation , initial value problem ODEs solvers, solver options, 2-D and 3-D graphics.

Power system toolbox:-
Transmission line parameters, optimal dispatch of generation, transformers & I.M. power flow analysis, symmetrical components, fault analysis, synchronous machine transients, power system stability, power system harmonics , study of power system block sets. use of simulink for power system analysis Introduction to symbolic math toolbox

Note:- T.W. will consist of atleast 10 software experiments + 1 mini project.

List of Mini Projects:-

1. Simulation of Single Machine Infinite Bus System (SMIB)
2. SMIB System Simulation with PSS in Excitation System
3. Transient Stability Investigation using Numerical Methods
4. Modelling of FACTS Devices
5. G-S, N-R Fast Decoupled Methods For Load Flow
6. Any other topic related to power system with simulation

References:-

1. Users Guide student Eddition of MATLAB latest version .
2. Getting started with MATLAB 5.0 - Rudra Pratap
3. Mastering MATLAB 5.0 D. Hanselman & B Littlefield
4. Conrol system analysis & design using MATLAB -Fredrik and Chow
5. Conrol system analysis & design using MATLAB - B Shahian & M Hassul
6. Diff. eqn & linear Algebra using MATLAB - Golubitsky & Dellintz
7. Power system analysis - H. Saadat
8. MATLAB programming for Engineers 2/e - S.J. Chapman
9. Electrical Machinery 3/e- S.J. Chapman
10. Solving Control Engg. problems using MATLAB K.Ogata; PHInc.

M.E. (Electrical) Power Systems-Sem-II

1. Power System Planning and Economics

Lecture:- 3 Period/week — Theory:- 100 marks
T.W./Pr. 1 Period/week — T.W.:- 25 Marks

1. Load Forecasting :-
load Growth characteristics classification of Load Approches to load forecasting. Fore-casting Methodology i)Extrapolation ii) Correlation Techniques. Energy forecasting Peak load forecasting. Peak load forecasting weather sensit, total forecast.

2. System Planning :-
Introduction to strategies to planning long term, medium term and short term planning. Decomposition of problem. Reactive power planning

3. Generation planning: -
Resources of Generation, factors affect ing generation planning long term policy mix of different generations environmental considerations.

4. Transmission Planning :-
Expahsion Planning, system bottleneck contigency reinforcement. Horizon year transmission planning. Cost model, multilevel energy transmission line constraints.

5. Generation system cost analysis :-
Cost Analysis capacity cost production cost production analysis production costing production analysis involving nuclear unit production analysis Hydro unit fuel inventories energy transaction and of energy utilization.

6. Load dispatch:-
Consideration for centralised control of system operations. Requirements of the control load dispatch center system communication Telementry remote control and data transmission.

REFERENCES

1. Power System Planning : Robot L. Sullivan , McGraw Hill International Book Company New Delhi.
2. Economic Control of Interconnected System :- Kirchmayers, L.K. John Wiley and Sons New York
3. Power System Operation - Miller R.H.
4. Power Generation, Opearion Control- Allen J. Wood, Bruce F. Wollengegerg, John Willey and Sons.
5. Generation of Electrical Energy - B.R. Gupta Euressia Publishing House Pvt. Ltd. New Delhi.
6. Power System Planning - Pabla ; Tata McGraw Hill