JABALPUR ENGINEERING COLLEGE, JABALPUR (MP)
(An Autonomous Institute of Govt. of M.P.)
Affiliated to Rajiv Gandhi Technological University, Bhopal (MP)

Scheme of Study and Examination (w.e.f. July 2010)

M.E. II Sem. **Branch : Electrical Engg.**

Specialization : High Voltage & Power System Engineering

Course Code	Subject	Periods			EVALUATION SCHEME					Credits
					SESSIONAL EXAM			ESE	SUB TOTAL	
		L	T	P	TA	CT	TOT			
EE-123	Soft Computing Techniques & Applications to Power System	3	1	-	10	20	30	70	100	4
EE-124	Overvoltage Protection	3	1	-	10	20	30	70	100	4
EE-130	Power System dynamics & Control	3	1	-	10	20	30	70	100	4
	Elective – I (Any One)									
EE-131A	EHV AC-DC Transmission	3	1	-	10	20	30	70	100	4
EE-126B	FACTS Controller									
	Elective - II (Any One)									
EE-127B	Computer Application in Power System Engg.	3	1	-	10	20	30	70	100	4
EE-119C	SCADA									
(PRACTICAL/DRAWING/DESIGN)										
EE-132L	HVPS Engg. Lab III	-	-	2	60	-	60	90	150	6
EE-133L	HVPS Engg. Lab IV	-	-	2	60	-	60	90	150	6
	Total	**15**	**5**	**4**	**170**	**100**	**270**	**530**	**800**	**32**

T.A. Teachers Assessment, CT- Class Test, ESE - End Semester Examination, Total Marks 800
Total Periods : 24 Total Credits : 32

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COURSE CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	SOFT COMPUTING TECHNIQUES & APPLICATIONS TO POWER SYSTEMS	EE-123	Min "D"	Min "D"	5.0

SOFT COMPUTING TECHNIQUES & APPLICATIONS TO POWER SYSTEMS

Unit I Review of Probability Theory: Random variable, distribution functions, function of random variable, generation of random digit and random variants from various distribution function, Monte Carlo simulation, sampling distribution station evolution using MCS, confidence interval, coefficient of variation.

Unit II Evolution ANN, artificial neurons, activation functions, general network structure, δ – rule, back propagation rule of training, RBF and FLN network.

Unit III Draw back of classical optimization techniques, genetic algorithm: binary and real parameter GA, constraints handling in GA.

Unit IV Evolution Strategies (ES), two members non- recombinative ES, multi member ES, recombinative ES, Optimization based on swarm intelligence particle, swarm optimization and its variants.

Unit V Application of Soft Computing Techniques to Problem of Electrical Engg., e.g. Economic dispatch, reliable optimization, ANN training using evolutionary algorithms.

References:

1. R.Y. Rubinstein," Simulation and the Monte Carlo method", John Wiley & Sons 1st Edition.
2. Paul. L. Mayer," Introducing probability and statical application", Weslay.
3. Rajasekaran and Pai ," Neural Network, Fuzzy logic & Genetic Algorithms", PHI learning.
4. LiMin. Fu," Neural Networks in Computer Intelligence" ,9th Reprint TMH.
5. Kalyanmoy Deb John ,"Multi objective optimization using evolutionary algorithm", Wiley & Sons Ltd.
6. Alberto Leaon Garcia," Probability and Random processes for Electrical Engineering" IInd Pearson.
7. S.N. Shivanandan, S.N. Deepa," Principles of soft computing ",Wiley India (P) Ltd, I edition 2007.
8. Rajaserkharans, Vijaya laxmi Bai.,"Hand Book of genetic algorithm ".
9. PSO Tutorial – Kennedy educhart.
10. Sivanandam & Deepa ," An Introduction to Neural Network using Matlab 6.0", 1st ed., TMH.
11. M. Amirthavalli, Fuzzy logic and neural networks", Scitech publications

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COURSE CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	OVER VOLTAGE PROTECTION	EE-124	Min "D"	Min "D"	5.0

OVER VOLTAGE PROTECTION

Unit I Protection from direct lightning strokes with the aid of lightning conductors

General information, protective zones of lightning conductors, permissible distances between the object to be protected and the lightning conductors, specialties of constructional details of lightning arrestors.

Unit II Earthing of high voltage electrical apparatus

General information, permissible value of resistance of earthing arrangements, main electrical characteristics of soil, static resistances of simple earthing arrangements, working and protective earthing of power stations and sub stations, impulse impedance of lumped earthing arrangements, impulse impedance of long earthing arrangements, choice and calculations of complicated arrangements, earthing of lightning conductors of sub stations.

Lightning of surge arrestors General information, expulsion tube surge arrestors, auto- valve arrestors.

Unit III Over voltage protection of transmission lines

General characteristics of atmospheric over-voltages on transmission lines, induced over-voltages on transmission lines, direct stroke of lightning in a line without ground wires, direct stroke of lightning in a line with ground wires, recommended methods of lightning protection of transmission lines of different nominal voltages.

Unit IV Protection of substations from lightning

General information, parameters of waves travelling to the sub-station, index of lightning resistance of sub-stations, voltage on the insulation of sub-station in simplest lightning protective schemes, voltage on the insulation in simplest lightning protective schemes containing a long cable, permissive voltage on the insulation, investigation of lightning protection of real sub-station.

Unit V Lightning protection of rotating machines

General information, lightning protection of generators working on over head lines through transformers, lightning protection of generators connected directly to overhead of transmission lines.

Reference:

1. . D.V.Razevig , Dr M.P.Chaurasia.," High Voltage Engg.
2. M.S.Naidu , V. Kamaraju,"High Voltage Engg".

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COURSE CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	POWER SYSTEM DYNAMICS & CONTROL	EE-130	Min "D"	Min "D"	5.0

POWER SYSTEM DYNAMICS & CONTROL

UNIT I INTRODUCTION TO POWER SYSTEM STABILITY PROBLEM:- basic concept and definition: rotor angle stability, voltage stability, and voltage collapse, midterm and long term stability, classification of stability, states of operation and system security system dynamic problems.

UNIT II REVIEW OF CLASSICAL METHOD: system model, some mathematical analysis of steady state stability, analysis of transient stability, simplified representation of excitation control.

UNIT III MODELING OF SYNCHRONOUS MACHINE: introduction of synchronous machine park transformation, analysis of steady state performance per unit equivalent circuit of synchronous machine, determination of parameters of equivalent circuit, measurement for obtaining data, saturation model, transient analysis of synchronous machine.

UNIT IV EXCITATION AND PRIME MOVE CONTROLLER: excitation system modelling, system representation by state evasions, prime move control system.

UNIT V TRANSMISSION LINE , SVC & LOADS: D-Q transformation using L-B variables, static var compensators, loads dynamics of a synchronous generator connected to estimate bus: system model synchronous machine model, calculation of initial condition , inclusion of svc model, analysis of single machine system, small signal analysis with block diagram representation, synchronizing and damping torque analysis, small signal model, nonlinear oscillators.
APPLICATION OF POWER SYSTEM STABLIZERS: basic concepts, control signals , structure and tuning of PSS field implementation and operating experience 8 hours.

Reference Books

1 K.R. Padiyar," Power System Dynamics, Stability and Control", Bs Pub Hyderabad.
2 P Kunder ," Power System Stability and Control", TMH pulication
3 P.W. Sauer & M.A. Pai: Power System Dynamics and Stability: PearsonEdu.

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Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	EHV AC-DC TRANSMISSION	EE-131A	Min "D"	Min "D"	5.0

EHV AC -DC TRANSMISSION

UNIT I Introduction comparison of ac and dc transmission. Application of dc transmission. Description of dc transmission system. Planning for hvdc transmission modern trend in DC transmission. Advantages of EHV AC transmission; limitations, modeling of EHV AC transmission system.

UNIT II Simplified analysis of gratez circuit. Detailed analysis of converter. 6 hour control power reversal limitation of manual control, constant voltage verses constant current control, desired feature of control, actual control characteristic, constant minimum ignition angle control, constant current control , constant extinction angle control stability of control tap changer control power control and current limits. Frequency analog and digital controller hvdc link operation &regulation. Mtdc system. Earthing electrodes of HVDC system.

UNIT III PROTECTION: general dc reactor, prevention of consequent commutation failure, converter fault , clearing line fault and rc energizing the line, dc circuit breaker, surge arrester, over voltage protection

UNIT IV Design of EHV AC Sub station. Similarity of EHV AC and HV AC Systems

UNIT V SIMULATION OF HVDC & EHV AC System : Introduction, system simulation: philosophy and tools HVDC system for digital dynamic simulation.

Reference Books

1 K R Padiyar," Hvdc Power Transmission System"

2 E W Kimbark," Direct Current Transmission", Volume I, Wiley Futerscience, 1971.

3 Arrilaga," Hvdc Transmission" Peter Peregrinus Ltd 1983.

4 Uhlmann, "Power Transmission" By Dc Springer 1975.

5 S. Rao EHV AC&HVDC Transmission Engineering And Practice, Khanna Publisher, 1990

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COURSE CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	FACTS CONTROLLERS	EE-126B	Min "D"	Min "D"	5.0

FACTS CONTROLLERS

Unit I Power Electronic Controllers Basic , challenges and needs, static power converter structure, Ac controller based structures, DC link converter topologies, converter output and harmonic control, power converter control issues.

Unit II Shunt Compensation SVC and STATCOM: operation and control of SVC, STATCOM configuration, Control & applications.

Unit III Series Compensation Principle of operation, application of TCSC for damping of electromechanical oscillations, application of TCSC for mitigation of sub-synchronous resonance, TCSC layout and protection ,static, synchronous, series compensator (SSSC).

Unit IV Unified Power Flow Controller Steady state operation, control and characteristics, introduction to transient performance, power flow studies in UPFC embedded systems, operational constraints on UPFC.

Other FACTS Controllers

Circuit, model and operating features of Dynamic Voltage Regulator (DVR), Thyristor Controlled, Braking Resistors (TCBR), Thyristor Controlled Phase Angle Regulator (TCPAR), comparison of all FACTS controllers.

Unit V Control Strategies and Co-ordination Conventional control, Hysteresis control, Artificial neural network, fuzzy logic controls, comparison between different control schemes, co-ordination between different FACTS controllers.

Text Books:

1. E. Acha, Agelidis, Anaya- Lara," Power Electronic Control in Electrical Systems" Miller (Newnes Power Engg. Series, Londan) (International student edition).
2. Hingorani and Gyugui," Understanding FACTS", (IEEE Press, New York, IndianEdition0

References:

1. Yong Hua Song and Johns,"Flexible AC Transmission Systems (FACTS)", (IEE Power and Energy series 30)
2. Mathur & Verma," Thyristor based FACTS controllers" (IEEE Press, New York)
3. K. R. Padiyar, "Sub-synchronous Resonance", B.S. Publication, Hyderabad.
4. K. R. Padiyar ,"FACTS Controllers in Transmission & Distribution", New Age Publishers, Delhi, May 2007.

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Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	COMPUTER APPLICATION IN POWER SYSTEMS ENGINEERING	EE-127B	Min "D"	Min "D"	5.0

COMPUTER APPLICATION IN POWER SYSTEMS ENGG

UNIT I Bus incidence matrix, primitive admittance matrix, Y-bus by singular transformation, algorithm for formation of bus impedance for single phase system.

UNIT II Load frequency control, turbine speed governing system modelling, block diagram representation of single area, steady state and dynamic response, two area load frequency control.

UNIT III Load flow studies, static load flow equations, types of buses, Gauss Siedel interactive method using Y bus including PV bus, acceleration of convergence, Newton Raphson method in polar co-ordinates, Fast Decoupled Load Flow method. Representation of transformer, fixed tap setting transformer, tap changing under load transformer.

UNIT IV Economic operation of power system, Optimal distribution of loads between units within a plant, Transmission loss as a function of plant generation, determination of loss coefficients. Automatic economic load dispatch using computer.

UNIT V Transient stability studies, Numerical solutions of differential equations, modified Eulers method, Runge-Kutta IV order method, Milne's predictor-corrector method, Swing equation, representation of synchronous machine for transient stability studies, load representation, Network performance equation, solution techniques with flowcharts.

Reference Books:

1. Stag and El-Abiad, "Computer methods in power system analysis".
2. Nagrath & Kothari, "Modern Power System Analysis".
3. Grover& Sharma, "Power system analysis and design".
4. M A Pai, "Computer techniques in power system".

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COURSE CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	SCADA	EE-119C	Min "D"	Min "D"	5.0

SCADA

Unit I Introduction to SCADA and PLC: SCADA Data acquisition system, evaluation of SCADA, communication technologies, monitoring and supervisory functions.PLC: Block diagram, programming languages, Ladder diagram, Functional block diagram, Applications, Interfacing of PLC with SCADA

Unit II SCADA system components: Schemes, Remote Terminal Unit, Intelligent Electronic Devices, Communication Network, SCADA server.

Unit III SCADA Architecture: Various SCADA Architectures, advantages and disadvantages of each system, single unified standard architecture ,IEC 61850 SCADA / HMI Systems.

Unit IV SCADA Communication: Various industrial communication technologies- wired and wireless methods and fiber optics, open standard communication protocols.

Unit V Operation and control of interconnected power system- Automatic substation control, SCADA configuration, Energy management system, system operating states, system security, state estimation. SCADA applications Utility applications, transmission and distribution sector operation, monitoring analysis and improvement. Industries oil gas and water. Case studies, implementation, simulation exercises.

Text Books

1. Stuart A Boyer," SCADA supervisory control and data acquisition"
2. Gordan Clark, Deem Reynders," Practical Modem SCADA Protocols"

Reference Books

Sunil S. Rao," Switchgear and Protections", Khanna Publication

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Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	HVPS ENGG. LAB- III	EE-132L	Min "D"	Min "D"	5.0

HVPS ENGG. LAB- III

The exercises in this component shall be designed to demonstrate the basic principles outlined in different units of the theory paper. After completing the exercises the student should have developed a good grasp of the practical utilities of the theory content.

(Suggested Exercise)

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Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
	HVPS ENGG. LAB- IV	EE-133L	Min "D"	Min "D"	5.0

HVPS ENGG. LAB- IV

The exercises in this component shall be designed to demonstrate the basic principles outlined in different units of the theory paper. After completing the exercises the student should have developed a good grasp of the practical utilities of the theory content.

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