KALASALINGAM UNIVERSITY

Anand Nagar, Krishnankoil - 626 190

Department of EEE

M.TECH - POWER SYSTEM ENGINEERING

CURRICULUM

Semester I

Code No.	Subject	L	T	P	C
MAT5101	Applied Mathematics	3	0	0	3
EEE5001	Systems Theory	3	0	0	3
EEE5002	Power System Modelling	3	0	0	3
EEE5003	Computer Aided Power System Analysis	3	0	0	3
EEE5004	Numerical Protection	3	0	0	3
EEE****	Elective I	3	0	0	3
EEE5081	Power System Simulation Laboratory	0	0	3	2
	Total	-	-	3	20

Semester II

Code No.	Subject	L	T	P	C
EEE5005	Power System Planning	2	1	0	3
EEE 5006	Power System Dynamics and stability	3	0	0	3
EEE 5007	Flexible AC Transmission Systems	3	0	0	3
EEE 5008	Optimal Power System Operation	3	0	0	3
EEE 5009	Power System Control	3	0	0	3
EEE****	Elective II	3	0	0	3
EEE 5082	Power System Dynamics Laboratory	0	0	3	2
	Total	-	-	3	20

Semester III

Code No.	Subject	L	T	P	C
EEE 6001	Power Quality	3	0	0	3
EEE****	Elective III	3	0	0	3
EEE****	Elective IV	3	0	0	3
EEE 6098	Project Work Phase-I	0	0	18	6
	Total	-	-	18	15

Semester IV

Code No.	Subject	L	T	P	C
EEE 6099	Project Work Phase-II	0	0	36	12
	Total	-	-	36	12

TOTAL CREDITS – 67

LIST OF ELECTIVES

Code No.	Subject	L	T	P	C
	I Year				
EEE5010	High Voltage Direct Current Transmission	3	0	0	3
EEE5011	Solid State Drives	3	0	0	3
EEE5012	EHV Power Transmission	3	0	0	3
EEE5013	Digital Signal Processing	3	0	0	3
EEE5014	Electrical Distribution System	3	0	0	3
EEE5015	Renewable Power Generation	3	0	0	3
EEE5016	Computer Network Engineering	3	0	0	3
EEE5117	Soft Computing	3	0	0	3
	II Year				
EEE6010	Voltage Stability	3	0	0	3
EEE6011	Evolutionary Computation Techniques	3	0	0	3
EEE6012	Power System Automation	3	0	0	3
EEE6013	Power System Deregulation	3	0	0	3
EEE6015	Power Plant Engineering	3	0	0	3
EEE6016	Energy Efficiency in Electrical Utilities	3	0	0	3

Semester – I

MAT5101	APPLIED MATHEMATICS	L	T	P	C
		3	0	0	3

CLASSICAL OPTIMIZATION TECHNIQUES

Statement of optimization problem – classification – Optimization technique-unconstrained Optimization – equality constraints – inequality constraints – Lagrange Multiplier method – Kuhn-Tucker Condition - Indirect search methods – Gradient of a function – Steepest descent method – Conjugate gradient method – Newton's method.

LINEAR PROGRAMMING

Standard form of Linear programming problem – definitions and theorems – Solution of linear simultaneous equations – simplex algorithm – graphical method – dual simplex method – transportation problem - applications.

MATRIX THEORY

Matrix Norms- Jordan Canonical form Generalized Eigen vectors-Singular Value Decomposition- Pseudo Inverse-Least square Approximations –QR Algorithm.

PROBABILITY AND RANDOM PROCESS

Probability- random process variables - binomial, Poisson, geometric, uniform normal, exponential distributions - moment generating and their properties- functions of random variables.

QUEUING THEORY

Single and multiple server Markovian queuing models- customer impatience- Queuing applications.

TEXT BOOK

1. Singiresu S.Rao ,Engineering Optimization , New Age International (P) Ltd , 2001
2. Gupta S.C. and Kapoor V.K. Fundamentals of Mathematical Statistics, sultan Chand and sons , Newdelhi,2001
3. Lewis.D.W. Matrix Thoery, Allied Publishers, Chennai 1995

REFERENCES

1. S.D.Sharma, Operations Research, Kedar Nath Ram Nath & co,20
2. M.K. Ochi., Applied Probability and Stochastic processes, John Wiley & sons 1992.
3. Bronson.R. Matrix operations , Schaums outline series , Tata Mcgraw Hill, Newyork

EEE5001	SYSTEMS THEORY	L	T	P	C
		3	0	0	3

STATE SPACE ANALYSIS

State space modeling of physical systems -solution of state equations – state transition matrix and its properties – free and forced responses – Properties: Controllability and observability.

NON-LINEAR SYSTEMS

Types of non-linearity – typical examples – equivalent linearization - phase plane analysis – limit cycles – describing functions- analysis using describing functions- jump resonance-model reduction technique-dominant pole concept, pade approximation-stability of trajectories-phase pole circuits.

STABILITY

Stability concepts – equilibrium points – BIBO and asymptotic stability – direct method of Liapunov – Application to non-linear problems – frequency domain stability criteria – Popov's method and its extensions-stability loop-Kalman's stability.

OPTIMAL CONTROL

Statement of optimal control problem – problem formulation and forms of optimal control – selection of performance measures. necessary conditions for optimal control – Pontryagin's minimum principle – state inequality constraints – minimum time problem.

ADAPTIVE CONTROL

Classification of adaptive control – introduction to auto tuning – types of adaptive control- MRAC- MIT rule- design and approaches –SIR – introduction, direct & indirect method applications.

TEXT BOOKS

1. Gopal,M, Modern Control Engineering, Wiley, 1996
2. Ogatta,K., Modern Control Engineering, Pearson Education Asia, 1997
3. Kirk D.E., 'Optimal Control Theory – An introduction', Prentice hall, N.J., 1970
4. Karl.J.Astrom & B.John Wittermark, Adaptive Control, Pearson Education Singapore 2nd Edition 2003

REFERENCES BOOKS

1. Eroni-Umez and Eroni, System dynamics & Control, Thomson Brooks/ Cole, 1998
2. Thaler,G,J.,Automatic control systems, Jaico publishers, 1993
3. John. S. Bay, Linear State Space Systems, McGrawHill International edition, 1999

4. Chalam, V.V., "Adaptive Control Systems", Techniques & Applications, Marcel
5. Dekker, Inc. NY and Basel, 1987.

EEE5002	POWER SYSTEM MODELLING	L	T	P	C
		3	0	0	3

SYNCHRONOUS MACHINE MODELLING

Physical description- dqo transformation-per unit representation-equivalent circuits for direct and quadrature axes- steady state analysis-electrical transient performance-magnetic saturation-equations of motion.

SYNCHRONOUS MACHINE REPRESENTATION IN STABILITY STUDIES

Simplifications for large scale studies- simplified model with amortissuers neglected-constant flux linkage model – reactive capability limits.

MODELLING OF EXCITERS AND PRIME MOVERS

Excitation system requirements –types of excitation systems –dynamic performance machines – control and protective functions – modelling of excitation systems- hydraulic turbines and governing systems-steam turbines and governing systems.

MODELLING OF TRANSMISSION LINES AND TRANSFORMERS

Transmission lines-electrical characteristics –equivalent circuit –voltage power characteristics- thermal limits- transformers –representation of two winding and three winding transformers –phase shifting transformers.

LOAD MODELLING

Basic load modelling – static load models – dynamic load models – acquisition of load model parameters –measurement based approach – component based approach-sample load characteristic- induction motor equivalent circuits and parameters – free acceleration characteristics – dynamic performance – changes in load torque – effect of three phase short circuit – effect of unbalanced faults.

TEXT BOOKS

1. Prabha Kundur ,Power System stability and control ,Tata MC Graw Hill Edition 1994

REFERENCES

1. Padiyar,K,R., Power System Dynamics, Stability and Control, B.S.Publications, 2nd edition, 2002.

EEE5003	COMPUTER AIDED POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

SOLUTION TECHNIQUES

Sparse Matrix techniques for large scale power systems: Optimal ordering schemes for preserving sparsity. Flexible packed storage scheme for storing matrix as compact arrays; Factorization by Bifactorization and Gauss elimination methods; Repeat solution using Left and Right factors and L and U matrices.

LOAD FLOW STUDY

Newton Raphson method – Fast Decoupled Load flow method – formulation of three continuous power flow – control of voltage profile.

SHORT CIRCUIT STUDIES

Analysis of three phase faults – admittance matrix equation – impedance matrix equation – fault calculations – analysis of unbalanced faults – admittance matrices – fault calculations – short circuit faults – open circuit faults – program description and typed solutions.

CONTINGENCY ANALYSIS

Security in a power system- approximations in contingency analysis- simulation of addition and removal of multiple lines in a power system-simulation of tie lines in interconnected power system –network reduction for contingency analysis – approximate power flow method for simulating contingencies.

STATE ESTIMATION

Maximum likelihood weighted least squares estimation- concepts, matrix formulation - example for weighted least - squares state estimation - state estimation of an ac network-development of method - typical results of state estimation on an ac network- state estimation by orthogonal decomposition algorithm – introduction to advanced topics-detection and identification of bad measurements - estimation of quantities not being measured - network observability and pseudo- measurements - application of power systems state estimation.

TEXT BOOKS

1. Stagg G.W, El.Abaid A.H , “Computer Methods in power system Analysis, Tata MC GrawHill,1968.
2. Allen J.Wood and Bruce .F. Woolenberg, “Power Generation Operation and Control”, John Wiley & sons , New York, 1996.
3. T.K.Nagsarkar and M.S.Sukhija, “Power System Analysis”, Oxford Higher Education, Oxford University Press,2007.

REFERENCE BOOKS:

1. Pai ,M,A.,.Computer techniques in power system analysis-Tata MC GrawHill 1999.
2. Hadi Saadat, Power System Analysis, McGrawHill, 2003.
3. John J. Grainger, William D.Stevenson,Jr, Power System Analysis", Tata MC Graw Hill Edition, 2003.

EEE5004	NUMERICAL PROTECTION	L	T	P	C
		3	0	0	3

PROTECTION COORDINATION

Requirements of protection in electrical system-characteristics of protective relaying – types of protective relays-electromechanical and static relays –microprocessor and numeric relays –protection co-ordination -time and current grading.

MICROPROCESSOR BASED RELAYS

Typical block diagram- hardware and software architecture-sampling interval-capabilities of relays in numerical design- structure of intelligent electronic device(IED)-substation automation using IEDs-setting approach in conventional relays-configuring numerical relays-configuration security through password-methods adopted for setting numerical relays .

DIGITAL COMPUTER RELAYING

Substation automation setup using numerical relays –problems of compatibility between vendoprs-DNP3 communication standard-new substation standard IEC 61850-logical grouping of functions-interconnection suing GOOSE-Example of substation automation system with IEDs compatible with IEC 61850.

RELAY LOGIC

Numerical distance protection-elements of signal processing-direct on line evaluation of impedances using Fourier transformation-curve fitting and kalman filter-digital current differential protection--digital current differential protection for transmission circuits-digital transformer differential protection-digital over current protection-numerical low impedance bus bar protection.

WIDE AREA PROTECTION

Role of wide area protection scheme (WAPS) – Achievements with WAPS on power systems – Power system phenomena with possible WAPS solutions – Classification of WAPS – Detailed description of various WAPS – Voltage stability assessment(VSA)guidelines – On- line VSA execution modes – On-line VSA requirements - Interfaces requirements – The implementation of wide area protection**.**

TEXT BOOKS:

1 Paul M.Anderson, Power system protection, IEEE press series on Power Engineering,Mc Graw Hill..

2.Van C. Warrington, Protective relays – their theory and practice Chapman &Hill.

REFERENCE BOOKS

1.M.A.Date, Bhuvanesh Oza, N.C.Nair, Power system protection,First Edition 1999,Bharti Prakashan.

2. Badriram and Vishwakaram D.N.,Power system Protection and Switchgear, Tata Mc Graw Hill, New Delhi 1995.

EEE5081	POWER SYSTEM SIMULATION LABORATORY	L	T	P	C
		0	0	3	2

LIST OF EXPERIMENTS

1. Formation of Bus Admittance Matrix (Y Bus) and Bus impedance matrix(Z Bus)
2. Sparse Matrix techniques
3. Optimal ordering schemes
4. Load flow problem using Gauss Siedal method
5. Load flow problem using Newton Raphson method.
6. Load flow problem using Fast decoupled power flow
7. Continuation power flow method
8. Contingency analysis
9. Short circuit studies
10. Economic dispatch using linear programming
11. State Estimation
12. Unit Commitment.

SEMESTER II

EEE 5005	POWER SYSTEM PLANNING	L	T	P	C
		3	0	0	3

LOAD FORECASTING

Components of Electricity Load – Long Term Forecasting Techniques: Extrapolation of Trend Curves – Box-Jenkins Forecasting Procedure – Multivariate Procedures – Combination Methods – Forecasting Long Term Electricity Demand – Energy Demand and Peak Demand Forecasting techniques – Forecasting Load-Duration Curve.

POWER SYSTEM RELIABILITY

Mathematical basis for Reliability Calculation – Power System Component Reliability Models – Reliability of a Power Generation System – Dentritic and Annular Interconnected system reliability computation.

POWER SYSTEM PROBABILISTIC PRODUCTION SIMULATION

Equivalent Load Duration curve – Process of Production Simulation – Cumulant method – Equivalent Energy Function Method – Simulation of Hydro Electric Generating Units and Pumped Storage Units.

GENERATION PLANNING

Objectives – Economic analysis – Economic Assessment Method – Generation Planning optimized according to Generating Unit Categories – WASP – Generation Planning optimized according to power plants – JASP.

NETWORK PLANNING

Heuristic Methods – D.C Load flow equation – Sensitivity Analysis – Linear Programming techniques network planning by mathematical optimization – probabilistic load flow calculation.

Text Book:

3. X. Wang., and J.R. Donald., “Modern Power System Planning”, McGraw Hill, 2000

Reference Book:

Robert Lee Sullivan, “Power System Planning”, McGraw Hill, 1977.

Hossein Seifi and M.S. Sepasian, “Power System Planning: issues, Algorithms and Solutions”, Springer-London, 2010

A.S. Pabla, “Electrical Power System Planning”, Macmillan Pub., 1998.

Jurgen Schlabbach and K.H. Refalski, “Power System Engineering: Planning, Design and operation”, Wiley, 2008.

Arthur Mazer, "Electric Power Planning for regulated and deregulated markets", IEEE Press, 2007.

Roy Billinton,"Power system stability evaluation", Gorden Breach Science Publishers, Newyork, 1970.

EEE 5006	POWER SYSTEM DYNAMICS AND STABILITY	L	T	P	C
		3	0	0	3

BASIC CONCEPTS OF STABILITY

Basic concepts and definitions – Rotor angle stability – voltage stability and voltage collapse- Mid term and long term stability- classification of stability- historical review of stability problems.

SMALL SIGNAL STABILITY ANALYSIS

State space representation – Eigen properties of State Matrix – Participation factor- SMIB configuration – Effects of field circuit dynamics – Effect of field flux variation on system stability – Analysis with numeric examples .

SMALL SIGNAL STABILITY INCLUDING CONTROLLERS

Effect of excitation system – Thyristor excitation system – AVR – Effect of AVR on synchronizing and damping components – PSS- System state matrix including PSS - Small signal stability of multi machine systems-small signal stability improvement methods – delta-omega and delta P – Omega stabilizers.

TRANSIENT STABILITY ANALYSIS

Factors influencing transient stability – numerical integration method: euler and rk method – simulation of power system dynamic response-transient stability of multi machine system- synchronous machine representation – excitation system representation-transmission network and load representation – overall system equation and their solution –transient stability enhancement method.

VOLTAGE STABILITY

Basic concepts related to voltage stability – voltage collapse – classification of voltage stability – voltage stability analysis – prevention of voltage collapse – system design measures – system operating measures .

TEXT BOOK

1. Prabha Kundur, Power System stability and control- Tata MC GrawHill Edition

REFERENCES

1. Peter. W. Sauer & M.A Pai, Power System Dynamics and Stability, Pearson Edition, Delhi , 2003

EEE 5007	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

INTRODUCTION

FACTS - concept and general system considerations- Basic type of FACTS controller- Brief description and definition of FACTS controller-benefits from FACTS technology.

STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS

Voltage control by SVC – advantages of slope in dynamic characteristics – influence of SVC on system voltage – design of SVC voltage regulator – applications- enhancement of transient stability – steady state power transfer – enhancement of power system damping – prevention of voltage instability.

THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS

Operation of the TCSC- different modes of operation – modeling of TCSC – variable reactance model – modeling for stability studies- applications – improvement of the system stability limit – enhancement of system damping – voltage collapse prevention.

STATIC SHUNT AND SERIES COMPENSATORS

Static Compensator (STATCOM) – principle of operation – V-I Characteristics-application- Static Series Synchronous Compensator (SSSC) – principle of operation – V-I characteristics-Application- enhancement of power system stability limit

UNIFIED POWER FLOW CONTROLLER

Unified Power Flow Controller (UPFC) – Principle of operation - Modes of Operation – Applications – Modeling of UPFC for Power Flow studies- Independent active and reactive power flow control-Comparison of UPFC with the controlled series compensators and phase shifters.

TEXT BOOKS

1. Mohan Mathur.R., Rajiv . K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc.
2. John,A,T., "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers(IEEE), 1999.

REFERENCE S

1. Narain G.Hingorani, Laszio. Gyugy.L, "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers –Delhi, 2001.

EEE 5008	OPTIMAL POWER SYSTEM OPERATION	L	T	P	C
		3	0	0	3

ECONOMIC DISPATCH AND UNIT COMMITMENT

Co-ordination equations - solution by direct method and λ-iteration method- base point and participation factors- economic dispatch with piecewise linear cost functions- economic dispatch using dynamic programming **-** **c**onstraints in unit commitment – spinning reserve, thermal unit constraints, and other constraints – solution echnique: priority list method,dynamic programming method , forward dp approach, Lagrangian relaxation method .

OPTIMAL POWER FLOW

Introduction- solution of Optimal Power Flow (OPF) – the gradient method, Newton's method, Linear Sensitivity Analysis- LP methods – with real power variables only – LP method with AC power flow variables and detailed cost functions- Security Constrained Optimal Power Flow- Interior Point Algorithm- Bus Incremental Costs.

OPTIMAL HYDROTHERMAL SCHEDULING

Long Range Hydro Scheduling – short range hydro scheduling - hydro electric plant models – scheduling problems – the short term hydrothermal scheduling problem – pumped storage schemes.

MULTIOBJECTIVE GENERATOR SCHEDULING

Multi objective optimization-state of the Art-Surrogate worth trade off approach-Fuzzy set theory in power system-∑-constraint method-multi objective for active and reactive power balance-multi objective short range fixed hydrothermal scheduling-approximate Newton Raphson method .

GENERATION MAINTENANCE SCHEDULING

Factors considered in maintenance scheduling for generator units-turbines-boilers-problem statement- maintenance scheduling using mathematical programming.

TEXT BOOK

1. Allen J.Wood and Bruce F Wollenberg, "Power Generation, Operation and Control",John Wiley and sons, Newyork, 1996.
2. D.P. Kothari and J.S.Dhillon," Power system Optimization" Prentice Hall of India, New delhi, 2004.

REFERENCE BOOK

1. A,T.,Kothari,A,P.,Ahson,S,I., "Computer Aided Power System Analysis and Control", Tata Mcgraw Hill Publishing Co. Ltd., NewDelhi 1988.

EEE 5009	POWER SYSTEM CONTROL	L	T	P	C
		3	0	0	3

ACTIVE POWER AND FREQUENCY CONTROL

Fundamentals of speed governing - control of generating unit Power output – composite regulating characteristic of Power Systems – Response rates of turbine – governing systems – fundamentals of automatic generation control – Implementation of AGC - development of state variable model for a two area Power System for use in simulation of AGC-Under frequency Load Shedding

REACTIVE POWER AND VOLTAGE CONTROL

Production and absorption of reactive Power – methods of voltage control - shunt reactors – shunt capacitors – series capacitors – synchronous condensers – static var systems – principle of transmission system compensation – modeling of reactive compensating devices – application of tap changing transformers to transmission systems – distribution system voltage regulation – modeling of transformer ULTC control systems.

SECURITY MONITORING

System operating states -security control functions – monitoring, evaluation of system state by contingency analysis – linear sensitivity factors, contingency selection, concentric relaxation method and bounding method-corrective controls-preventive, emergency and restorative .

COMPUTER CONTROL OF POWER SYSTEM

Energy control centre- Functions - Monitoring, data acquisition and control. System hardware configuration – SCADA and EMS functions- Network topology determination, state estimation, security analysis and control- Load shedding and system islanding.

POWER SYSTEM CONTROL UNDER DEREGULATED ENVIRONMENT

New system structures under competition- classification of operational tasks in today's power industry- temporal decomposition within the real time operation- classification of operational tasks in the competitive industry- meeting predicted demand in today's industry- meeting demand in the new industry- balancing supply and demand in real time- load frequency control under deregulated environment

TEXT BOOKS

1 Allen J.Wood and Bruce .F. Woolenberg, "Power Generation Operation and Control", John Wiley & sons , New York, 1996.

2. Prabha Kundur, Power System stability and control- Tata Mc Graw Hill Edition, 1994.

REFERENCES

Elgerd O.I, "Electric Energy System Theory - an Introduction" - Tata McGraw Hill, New Delhi, 2002.

Mahalanabis A.K., Kothari. D.P. and Ahson.S.I., "Computer Aided Power System Analysis and Control", Tata McGraw Hill publishing Ltd , 1984.

Vaibhav Donde, M.A. Pai & Ian A.Hiskens - "Simulation & Optimization in an AGC system after deregulation" IEEE transactions on Power Systems Vol:16, No.3, Aug 2001.

4. Hadi Saadat , " Power System Analysis", Mc GrawHill, 2003.
5. Marija Ilic, F.Galiana, L.Fink, "Power System Restructuring : Engineering and Economics" Kluwer Academic Publishers, 2000.

EEE 5082	POWER SYSTEM DYNAMICS LABORATORY	L	T	P	C
		0	0	3	2

1. Transient stability analysis using step by step method
2. Solution of Swing equation using Runge kutta method.
3. Simulation and analysis of Power Converters.
4. Harmonic Analysis using ETAP.
5. Modelling and simulation of FACTS devices
6. Simulation of induction motor starting using PSCAD/ EMTDC software
7. Small signal Stability Analysis.
8. Simulation and analysis of Automatic Voltage Regulator
9. Simulation and analysis of Load Frequency Control
10. Simulation and analysis of Power System Stabilizer
11. Voltage stability analysis

Semester – III

EEE6001	POWER QUALITY	L	T	P	C
		3	0	0	3

INTRODUCTION

Introduction –power quality- overview of power quality phenomena-classification of power quality issues- transients - long-duration voltage variations - short-duration voltage variations - voltage imbalance - waveform distortion - voltage fluctuation - power frequency variations - power quality terms – IEEE standards.

HARMONICS

Harmonic Distortion - voltage versus current distortion - harmonics versus transients - harmonic indexes - harmonic sources from commercial loads - harmonic sources from industrial loads - locating harmonic sources - system response characteristics effects of harmonic distortion - interharmonics - harmonic distortion evaluations - principles for controlling harmonics - devices for controlling harmonic distortion -harmonic filter design: a case study,

VOLTAGE RELATED PROBLEMS

Voltage variations, Voltage sags and short interruptions – flicker-longer duration variations - sources – range and impact on sensitive circuits-standards – solutions and mitigations – equipment and techniques.

POWER QUALITY MONITORING

Monitoring Considerations - power quality measurement equipment - assessment of power quality measurement data - application of intelligent systems - power quality monitoring standards.

POWER QUALITY IMPROVEMENT

Power Quality conditioners – shunt and series compensators-D-STATCOM-dynamic voltage restorer-unified power quality conditioner-case studies.

TEXT BOOKS

1. Arrillaga, J.," Power System Quality Assessment" , John Wiley, 2000.
2. Arrillaga J., Smith,B,C.,Vatsan,N,R and Wood,A,R., "Power System Harmonic Analysis," John Wiley, 1997.
3. Surya Santoso, H.Wayne Beaty, Roger .C.Dugan, Mark .F.Mcgranaghan , Electric Power System Quality'Mc Graw hill 2002.

REFERENCE BOOK

1. Loi Lei Loi, "Power System Restructuring and Deregulation – Trading, performance & information technology", John Wiley Publications.
2. Ashok,S,A.," Selected Topics in Power quality and customer power " ,Course book for STTP 2004.
3. Acha, E., Agelidis,V,G.,Anaya.,O., Laraand T.J.E.Miller, Power Electronic control in electrical systems.
4. Proceeding of VSAG 2005 – National Seminar Power Quality, EEE/A.K.College of Engineering.

LIST OF ELECTIVES

EEE5010	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

DC POWER TRANSMISSION TECHNOLOGY

Introduction-comparison of AC and DC transmission- application of DC transmission – description of DC transmission system- planning for HVDC transmission-modern trends in DC transmission.

ANALYSIS OF HVDC CONVERTERS

Pulse number, choice of converter configuration-simplified analysis of Graetz circuit-converter bridge characteristics – characteristics of a twelve pulse converter-detailed analysis of converters.

CONVERTER AND HVDC SYSTEM CONTROL

General principles of DC link control-converter control characteristics-system control hierarchy-firing angle control-current and extinction angle control-starting and stopping of DC link-power control-higher level controllers-telecommunication requirements.

HARMONICS&FILTERS

Introduction-generation of harmonics-design of AC filters-DC filters-carrier frequency and RI noise.

SIMULATION OF HVDC SYSTEMS

Introduction-system simulation: Philosophy and tools-HVDC system simulation-modeling of HVDC systems for digital dynamic simulation.

TEXT BOOKS

1. Padiyar, K.R., "HVDC Power Transmission System", Wiley Eastern Limited, New Delhi 1990. First edition.

2. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering" New Age International (P) Ltd., New Delhi, 1990.

REFERENCES

1. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
2. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.

EEE5011	SOLID STATE DRIVES	L	T	P	C
		3	0	0	3

DRIVE CHARACTERISTICS

Introduction – classification and advantages -equations governing motor load dynamics - equilibrium operating point and its steady state stability - mathematical condition for steady state stability and numerical problems - multi quadrant dynamics in the speed torque plane - basics of regenerative braking - typical load torque characteristics - acceleration, deceleration, starting and stopping.

CONVERTER / CHOPPER FED DC MOTOR DRIVE

Phase controlled drives- four quadrant DC motor drive - steady state analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive- Continuous and discontinuous conduction mode - chopper fed D.C drive- time ratio control and current limit control - four quadrant chopper.

INDUCTION MOTOR DRIVES

Stator voltage control – braking and energy saving - slip-power recovery drives - adjustable frequency drives:-v/f control, constant slip-speed control and constant air-gap flux control – principle of vector control –methods of improving power factor - basics of voltage/current fed inverters - block diagram of closed loop drive – switched reluctance and stepper motor drives.

SYNCHRONOUS MOTOR DRIVES

Open loop volts/hertz control and self-control of synchronous motor- marginal angle control and power factor control – vsi/csi fed drives – need for leading power factor operation – excitation system- permanent magnet synchronous motor.

DESIGN OF CONTROLLERS FOR DRIVES

Transfer function for dc motor, load and converter – closed loop control with current and speed feedback - armature voltage control and field weakening mode control - design of controllers- current controller and speed controller - converter selection and characteristics.

TEXT BOOKS

1. R. Krishnan, 'Electric Motor & Drives: Modelling, Analysis and Control', Prentice Hall of India, 2001.
2. Bimal K. Bose. 'Modern Power Electronics and AC Drives', Pearson Education, 2002.

REFERENCE BOOKS

1. Dubey, G,K.,'Power Semi-conductor Controlled Drives', Prentice Hall of India, 1989.
2. Pillai, S,K.,'A First Course on Electrical Drives', Wiley Eastern Limited, 1993.

EEE5012	EHV POWER TRANSMISSION NETWORK	L	T	P	C
		3	0	0	3

INTRODUCTION

Standard Transmission Voltages – average values of line parameters – power handling capacity and line loss – costs of transmission lines and equipment – mechanical considerations in line performance.

CALCULATION OF LINE PARAMETERS

Calculation of resistance, inductance and capacitance – calculation of sequence inductances and capacitances – line parameters for modes of propagation.

VOLTAGE GRADIENTS OF CONDUCTORS

Charge-Potential relations for multi-conductor lines – surface voltage gradient on conductors – gradient factors and their use – distribution of voltage gradient on sub conductors of bundle - voltage gradients on conductors in the presence of ground wires on towers.

CORONA EFFECTS

Power losses and audible losses- i^2r loss and corona loss -attenuation of traveling waves due to corona loss - audible noise generation and characteristics - limits for audible noise - day-night equivalent noise level.

Radio Interference **:** corona pulse generation and properties - limits for radio interference fields - the CIGRE Formula - the RI Excitation Function -measurement of RI, RIV and excitation function - design of filter.

ELECTROSTATIC FIELD OF EHV LINES

Capacitance of Long Object - calculation of Electrostatic Field of AC Lines Effect of High Field on Humans, Animals, and Plants - meters and measurement of electrostatic fields - electrostatic induction in unenergised circuit of a D/C Line - induced voltages in insulated ground wires - electromagnetic interference.

TEXT BOOK

1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International Pvt. Ltd., 1990, Second Edition.

REFERENCE

1. Kuffel, E., Zaengl, W.S., and Kuffel J., High Voltage Engineering Fundamentals, Newness, Second Edition, Butterworth-Heinemann Publishers, New Delhi, 2000

EEE5013	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

INTRODUCTION TO DIGITAL SIGNAL PROCESSING

Digital Signal Processing and its benefits – digital filtering – discrete transformation – Modulation – typical real-time DSP systems – analog to digital conversion process – digital to analog conversion process (signal recovery) –constraints of real-time signal processing with analog input/output signals-convolution and correlation.

DISCRETE TRANSFORMS

Z-transform and its properties – Inverse Z-transform – Discrete Fourier Transform and its properties – Radix-2 Fast Fourier Transform – Computational advantages of FFT over DFT – Decimation-in-time FFT algorithm – Decimation-in-frequency FFT algorithm – Inverse FFT by direct DFT – wavelet series – multiresolution – analysis – scaling functions and wavelet – harr, sine and spine wavelets.

DESIGN OF FILTERS

Introduction to Digital Filters – types of digital filters: FIR and IIR filters – window method - impulse invariant method – bilinear transformation method - adaptive algorithms - basic least mean square adaptive algorithm – recursive least squares algorithm –adaptive filter as a noise canceller.

MULTIRATE DSP

Decimation by a factor D, interpolation by a factor i, filter design and implementation for sampling rate conversion, multistage implementation of sampling rate conversion – sampling rate conversion by an arbitrary factor – applications of multirate signal processing – digital filter banks – quadrature mirror filter bank.

DSP PROCESSORS AND DSP APPLICATIONS

General purpose Digital Signal Processors: Texas Instruments TMS320 family – Motorola DSP 56333 family – analog devices ADSP 2100 family – Instruction set of TMS320C50 – simple programs. Detection of foetal heart beats during labour – FFT Spectrum Analyser – musical sound processing.

TEXT BOOKS

1. Sajit K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998
2. Emmanuel C. Ifeacher and Barrie W. Jervis, 'Digital Signal Processing – A Practical Approach', Addition-Wesley Longman Limited, UK, 1993
3. John G. Proakis and Dimitris G. Manolakis, 'Digital Signal Processing, Algorithms and Applications'. PHI, New Delhi, 1995

REFERENCE BOOKS

1. Texas Instruments, "Users Guide TMS320C50".
2. Alan V. Oppenheim, Ronald W. Scafer and John R. Buck, 'Discrete – Time Signal Processing'. PHI, 2nd Edition, 1999
3. Richard G. Lyons, 'Understanding Digital Signal Processing', Addition Wesley Longman, Delhi, 1997
4. Stephane mallat, A Wavelet tour of signal Processing, Academic press,California,2006.

EEE5014	ELECTRICAL DISTRUBUTION SYSTEM	L	T	P	C
		3	0	0	3

INTRODUCTION

Industrial and commercial distribution systems – energy losses in distribution system – system ground bounding for safety and protection – comparison of o/h lines and under ground cable system – single phase and three phase unbalanced network model – power flow, short circuit and loss calculations.

DISTRIBUTION SYSTEM PLANNING

Distribution system expansion planning – load characteristics – load forecasting – design concepts – optimal location of sub station – design of radial lines – solution technique.

VOLTAGE CONTROL OF DISTRIBUTION SYSTEM

Voltage control – application of shunt capacitance for loss reduction – harmonics in the system – static VAR systems – Optimization for loss reduction and voltage improvement.

DISTRIBUTION SYSTEM PROTECTION

System protection – requirement – fuses and section analyzers over current. Under voltage and under frequency protection – coordination of protective device.

DISTRIBUTION AUTOMATION

Introduction-function of distribution automation-Distribution automation for improved energy management.

TEXT BOOKS

1. **.**Sullivan." Power System Planning, TtaMcGraw Hill
2. . Pabla," Electrical Power Distribution" , Tata Mc G?raw Hill

REFERENCE

1. Roy Billingtaon , Allan,R,N., Reliability evaluation of power system , Pitman,London, 1984 Edition
2.

EEE5015	RENEWABLE POWER GENERATION	L	T	P	C
		3	0	0	3

SOLAR ENERGY

Introduction – solar constant – physical principles of the conversion of solar radiation into heat – flat plate collectors – energy balance equation and collector efficiency – solar cell principles – conversion efficiency and power output – basic photovoltaic system for power generation – solar cell modules.

WIND TURBINES

Wind source – wind statistics - energy in the wind – aerodynamics - rotor types – forces developed by blades – aerodynamic models – braking systems – tower - control and monitoring system – power performance.

WIND GENERATION

Wind driven induction generators-power circle diagram-steady state performance – modeling-integration issues –impact on central generation- transmission and distribution systems – wind farm electrical design.

BIO MASS POWER

Introduction – biomass conversion technologies – photosynthesis – biogas generation – factors affecting biodigestion or generation of gas – classification of biogas plants – bio gas from plant wastes – materials used for bio-gas generation – selection of site for a biogas plant – methods for obtaining energy from biomass.

OTHER RENEWABLE SOURCES

OTEC : Introduction – Energy from tides.

MHD Power Generation**:** Introduction – Principles of MHD power generation – MHD systems – MHD design problems and developments – Voltage and power output of MHD generator.

Thermo nuclear fusion energy**:** Introduction – Requirements for nuclear fusion – Plasma confinement – Magnetic confinement fusion – Inertial confinement fusion – Muon catalysed fusion – characteristics of D-T reaction.

TEXT BOOKS

1. John F.Walker & Jenkins. N , 'Wind energy Technology ' , John Wiley and sons, chichester , U.K ,1997.
2. Agarwall ,M,P., ' Future sources of electrical power', S.Chand Co.Ltd., New Delhi, 1999.
3. G.D. Rai, 'Non-conventional Energy sources', Kanna Publishers, Delhi.

REFERENCE

1. Van Overstraeton and Mertens R.P., 'Physics, Technology and use of Photovoltaic', Adam Hilger, Bristol, 1996.

EEE5016	COMPUTER NETWORK ENGINEERING	L	T	P	C
		3	0	0	3

PROTOCOLS AND ARCHITECTURES

Protocols-layered approach-OSI model-DoD model-hierarchical approach-Local Network Technology- Bus/Tree topology-Ring topology-medium access protocols - details of IEEE 802 standards.

NETWORK ACCESS PROTOCOL & INTERNETWORKING

Circuit Switched Network Access-Packet Switched Network Access-Broadcast Network Access-Principle of Internetworking-Bridges, Gateways-X, 75-internet protocols-ISO internet protocol standard.

TRANSPORT PROTOCOL & ROUTING TECHNIQUES

Transport service protocol mechanisms-network service-transport standards-internet transport protocols-Wireless UDP-overview of routing techniques.

PRESENTATION/APPLICATION PROTOCOLS

File Transfer Protocols-World Wide Web-Electronic Mail-Overview of ISDN-ISDN Protocols.

NETWORK MANAGEMENT

Architecture of network management-Fault management-congestion control algorithms-security management.

TEXT BOOK

1. Andrew Tannenbaum S., "Computer Networks ", 3rd Edition, Prentice Hall of India, 1997.

REFERENCES

1. Stallings, "Data and Computer Communication: Architectures, Protocols and Standards", IEEE Computer Society, 1987.
2. Kernel Texpian A.S., "Communication Network Management ", Prentice Hall, 1992.
3. " Network Management ", Standards, Uylers Black, McGraw Hill, 1995.
4. Commer and Stevens, " Internetworking with TCP/IP Vol.III: Client Server Programming and application ", Prentice Hall , USA, 1994.

EEE5117	SOFT COMPUTING	L	T	P	C
		3	0	0	3

ARTIFICIAL INTELLIGENCE (AI)

Intelligent search – Predicate Calculus – Learning Systems - Knowledge Representation and Reasoning – Semantic Networks – Frames - Knowledge Acquisition - Expert Systems - Intelligent Control.

ARTIFICIAL NEURAL NETWORKS (ANN)

Biological Neural Networks - Artificial Neural Networks - Topology of ANN – Learning rules – Supervised, Unsupervised, and Reinforcement Learning – Single Layer and Multilayer Perceptrons - Feed forward neural networks-The Back-propagation Training Algorithm - Binary and Continuous Hopfield Network - Associative Memory - Self-Organizing Maps.

FUZZY SYSTEMS

Classical Set – Fuzzy Set – Linguistic Variables - Membership Functions - Fuzzy relations – Fuzzy rules and Reasoning – Fuzzy Inference Systems – Defuzzification methods – Mamdani, Sugeno and Tsukamoto Fuzzy models – Fuzzy Decision Making – Fuzzy logic control

GENETIC ALGORITHMS (GA)

Survival of Fittest – GA Terminologies - Working Principle of Binary GA – Genetic Operators – Reproduction, Cross over and Mutation – Similarities and Differences with traditional methods – Schema and Schemata – GA theorem – Real Coded GA - Advantages and Limitations of GA – Applications.

CASE STUDIES/APPLICATIONS

Case studies in neural networks -Applications of fuzzy logic control - Hybrid system-Neuro fuzzy system-ANFIS applications.

Text Book:

J.S.R. Jang., et al., "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", PHI, 2010.

Amit Konar, "Artificial Intelligence and Soft Computing: Behavioral and Cognitive modeling of the Human Brain", CRC Press, 2008.

Reference Book:

4. Simon Haykin, "Neural Networks and Learning Machines", 3rd Edition, Pearson, 2009.

5. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Wiley, 2010.
6. Kalyanmoy Deb, "Multi-Objective Optimization Using Evolutionary Algorithms", 3rd Edition, Wiley, 2010.
7. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson, 2009.
8. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2008.
9. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", Wiley India, 2008.

SEMESTER III

EEE6010	VOLTAGE STABILITY	L	T	P	C
		3	0	0	3

INTRODUCTION

Voltage instability in power systems- voltage collapse ,causes of voltage instability- voltage instability mechanisms- classification of voltage instability – transmission system aspects – maximum deliverable power , Power – voltage relationship, P-V and Q-V curves.

GENERATION ASPECTS

Review of synchronous machine theory – frequency and voltage controllers – limiting devices affecting voltage stability – voltage – reactive power characteristics of a synchronous generator – capability curves – effects of machine limitations on deliverable power.

LOAD ASPECTS

Load aspects – Voltage dependence of loads – load restoration dynamics- Induction motors- load tap changers – thermostatic load recovery – generic aggregate load models.

VOLTAGE STABILITY

Loadability limit -sensitivity and bifurcation analysis- saddle node bifurcation, static approaches-modal analysis, eigen value method, power margin using continuation power flow-l-index- dynamic approaches – time domain simulation.

VOLTAGE STABILTY ENHANCEMENT

Countermeasures for short term voltage instability – corrective actions against long term instability- Static VAR compensator for voltage stability enhancement.

TEXT BOOK

1. T.V Custem,C.Vournas, ' Voltage stability of Power systems" Kluwer Academic publishers,1998.

REFERENCE

Kundur,P., "Power System Stability and control", EPRI publications.

EEE6011	EVOLUTIONARY COMPUTATION TECHNIQUES	L	T	P	C
		3	0	0	3

EVOLUTIONARY COMPUTATION (EC): THE BACKGROUND

Outline of Evolutionary Algorithms (EA) – EA Terminologies – Robust adaptation and Machine Intelligence – Principles of Evolutionary Processes – Principles of Genetics – No-free Lunch theorem for EA – Advantages of EA over other approaches.

GENETIC ALGORITHM (GA)

Binary GA – genetic operators – Tournament, Proportionate and Ranking Selection – Single point, two-point and uniform crossover – Elitism – Real Parameter GA – Linear, naïve, blend and Simulated Binary Crossover – Random, Non-uniform, Normally distributed and Polynomial Mutation – Constraint Handling Techniques in GA.

EVOLUTIONARY STRATEGIES (ES) & EVOLUTIONARY PROGRAMMING (EP)

Non-Re combinative ES – Re combinative ES – Self Adaptive ES – Connection between RGA and Self adaptive ES – Evolutionary Programming (EP) – EP and ES: Similarities and Differences – Genetic Programming (GP) – Population size and Dynamics – Convergence and Stopping Criteria – Exploration and Exploitation.

PARTICLE SWARM OPTIMIZATION (PSO)

Concepts and formulation – Simulating the Social behavior – PSO algorithm – Topology – Parameter Selection and Improvements for Convergence – Maximum Velocity – Acceleration Constants - Constriction factor - Inertia weight – Advantages of PSO.

ANT COLONY OPTIMIZATION (ACO)

Ants' Foraging Behavior – Stigmergy – Double Bridge Experiment – Real Ants to Artificial Ants – Behavioral Differences – Properties of Artificial Ants – ACO Algorithms – Ant System - MAX–MIN Ant System – Ant Colony System (ACS) – Advances of ACO.

Text Book:

10. Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", 3rd Edition, John Wiley & Sons, 2008.

11. D.B.Fogel,"Evolutionary Computation", Prentice Hall India publications, 2001.

Reference Book:

Thomas Back, David B Fogel and Zbigniew Michalewicz, "Evolutionary Computation 1: Basic Algorithms and Operators", Institute of Physics Publishing, 2000.

Thomas Back, David B Fogel and Zbigniew Michalewicz, "Evolutionary Computation 2: Advanced Algorithms and Operators", Institute of Physics Publishing, 2000.

Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", MIT Press, 2004.

Jürgen Branke, Kalyanmoy Deb, Kaisa Miettinen and Roman Slowinski (Eds.), "Multi-Objective Optimization: Interactive and Evolutionary Approaches", Springer-Verlag, 2008.

S.N.Sivanandam and S.N.Deepa, "Introduction to Genetic Algorithms", Springer-Verlag, 2008.

Thomas Baeck, D.B.Fogel and Z.Michalewicz,"Handbook of Evolutionary Computation" aylor and Francis, 1997.

EEE6012	POWER SYSTEM AUTOMATION	L	T	P	C
		3	0	0	3

INTRODUCTION

Definition of SCADA – applicable processes – elements of SCADA systems – SCADA architecture - operation and control using SCADA - development from telemetry – dependence on communications & computers.

COMPONENTS OF AUTOMATED SYSTEMS

Sensors, transducers and actuators: forgotten cost - special considerations - standardization & maintenance-remote terminal unit: communication interface – protocol detailed – discrete control – analog control - pulse control – serial control – monitor discrete & analog signals – monitor pulse count & serial signals-Master Terminal Unit: communication interface – configuring a picture of the process – data storage – applications.

COMMUNICATIONS

Analog to digital conversion –communication models and types – communication standards - communications system components – protocol – modems – field buses – synchronous or asynchronous – telephone cable or radio – simplex and duplex.

PROGRAMMABLE LOGIC CONTROLLERS

Structure of PLC - Control program – Programming: Simple Relay Layouts and Schematics - PLC Connections - Ladder Logic Inputs - Ladder Logic Outputs – tutorial problems.

SUBSTATIONS AND DISTRIBUTION AUTOMATION

Substation Automation: Structure of Subsystem Automation - Substation functions through SCADA-Distribution Automation: Functions of distribution automation - distribution automation for improved Energy Management

TEXT BOOKS

1. Stuart A. Boyer, "SCADA: Supervisory Control and Data Acquisition", 3rd Edition, ISA-The instrumentation systems and Automation Society.
2. ISA's Practical Guide Series, "Analytical Instrumentation (1996), Maintenance of Instrumentation and systems – 2nd Editions (2005), Fundamentals of Industrial Control – 2nd Edition (2006).

EEE6013	POWER SYSTEM DEREGULATION	L	T	P	C
		3	0	0	3

INTRODUCTION

Introduction and different entities – Background and current situation in the world – Need – Benefits – Effects from competitive electricity market – Background to deregulation among various countries in the world – After effect of deregulation.

POWER SYSTEM OPERATION IN DEREGULATED ENVIRONMENT

Role of ISO – Operational planning activities of ISO – ISO in pool and bilateral markets – Operational planning activities of GENCO – GENCO in pool and bilateral markets – Competitive Bidding.

POWER GRID IN DEREGULATED INDUSTRY

Power wheeling – Transmission open Access – Cost components in transmission – Pricing of power transactions – Postage Stamp method – MW –mile method – Locational marginal pricing- Embedded cost based transmission pricing – Incremental cost based transmission pricing.

ANCILLARY SERVICES FOR DEREGULATION

Frequency control – Reserve – Reactive power control – Block start – Scheduling and dispatching services – Distribution in competitive environment – Maintaining distribution planning – Distribution Automation- Retail Energy Service Company (RESCO) identities and industry position.

INDIAN ELECRICITY ACT – 2003

Power sector reforms in India – Availability based Tariff (ABT) – Role of Indian Energy Exchange(ICE) – Central Electricity Authority (CEA) – Central Electricity Regulatory Commission (CERC) – Role of Load Dispatch Centers – Importance of Unscheduled Interchange (UI).

TEXT BOOKS

1.Kankar Bhattarchaya, et, al., Operation of restructured power systems, Kluwer academic publishers, 2001.

REFERENCE BOOKS:

1. Marija Illic, F.Galiana, L.Fink, "Power system restructuring: Engineering and Economics" Kluwer Academic publishers, 2000
2. Loi Lei Loi, "Power System Restructuring and Deregulation – Trading, performance &information technology", John Wiley Publication,1997.
3. Lorrin Philipson and H.Lee Wills, "Understanding Electric Utilities and Deregulation, Taylor & Francis Group. 2006.
4. S.M.Shahidehpour, H.Y.Yamin, Z.Li, "Market operations in Electric Power systems".Willey, 2002.
5. www.cerc.in
6. www.cea.in
7. www.iexindia.in

EEE6015	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

THERMAL POWER PLANT

Method of power generation, layout and energy conversion process, types of boilers, types of turbines, types of generators, types of pumps and fans,material handling system, study of all loops- water, steam, fuel etc.

THERMAL POWER PLANT INSTRUMENTATION

Control and monitoring of combustion process Air to fuel ratio, three element drum level, temperature, pressure, furnace draft, air, water, exhaust gas, Burner management system, Automation strategy of power plant, Block diagram, control equipment, protections, Governors.

HYDROELECTRIC POWER PLANT

Site selection, Hydrology, Estimation electric power to be developed, classification of Hydropower plants, types of turbines pumped storage plants, storage reservoir plants.

TURBINE INSTRUMENTATION

Speed calculation, valve actuation, thermal stress control, vibration, and eccentricity, axial shift various control loops and interlocks. Alternator instrumentation generator cooling systems, hydrogen charging & discharging systems.

NUCLEAR POWER PLANT

Nuclear Power Plant systems, Fission theory, Steam Supply, Operation and Maintenance, Reactor Safety, Cooling Towers, Water treatment.

TEXT BOOKS

1. S.C. Arora and S. Domkundwar, A Course in Power Plant Engineering", Dhanpat Rai and Sons, Tata McGraw Hill, 1998.
2. G.R. Nagpal, " Power Plant Engineerig ", Khanna Publishers, 1998.
3. M.V. Deshpande, Elements of power station design, Tata Mc Graw Hill
4. P.K.Nag, Power plant Engineering –steam & nuclear, Tata Mc Graw Hill

REFERENCE BOOKS

1. Fredtrick T. Morse. Power Plant Engineering, east west press private Ltd
2. Mahesh Varma : Power Plant Engineering , Mctrolitan Co Pvt Ltd
3. Joel Weisman and Roy Eckart, " Modern Power Plant Engineering ", Prentice Hall International Inc., 1985.
4. Bernhardt G. Askrotzki & William A. Vopat, " Power Station Engineering and Economy ", Tata McGraw Hill Publishing Co. Ltd., 1972.

EEE 6016	ENERGY EFFICIENCY IN ELECTRICAL UTILITIES	L	T	P	C
		3	0	0	3

ELECTRICAL STATIC SYSTEMS AND MOTORS

Electrical System : Introduction to Electric Power Supply Systems - Electricity Billing - Electrical Load Management and Maximum Demand Control -Power Factor Improvement and Benefits – Transformers- Energy Efficient Transformers - System Distribution Losses - Harmonics - Analysis of Electrical Power Systems - Maximum Demand Controllers - Automatic Power Factor Controllers.

Electric Motors : Introduction - Motor Types - Motor Characteristics - Motor Efficiency - Motor Selection - Energy Efficient Motors - Factors Affecting Energy Efficiency and Minimising Motor - Losses in Operation - Rewinding Effects on Energy Efficiency - Speed Control of AC Induction Motors - Motor Load Survey: Methodology -Energy Efficient Motors - Soft Starter - Variable Speed Drives

ELECTRO MECHANICAL EQUIPMENTS – I

Compressed Air System: Introduction - Compressor Types - Compressor Performance - Compressed Air System Components - Efficient Operation of Compressed Air Systems - Compressor Capacity Assessment - Checklist for Energy Efficiency in Compressed Air System.

HVAC And Refrigeration System: Introduction - Types of Refrigeration System - Common Refrigerants and Properties - Compressor Types and Application - Selection of a Suitable Refrigeration System - Performance Assessment of Refrigeration Plants - Factors Affecting Performance and Energy Efficiency of - Refrigeration Plants - Energy Savings Opportunities

ELECTRO MECHANICAL EQUIPMENTS – II

Fans and Blowers: Introduction - Fan Types - Fan Performance Evaluation and Efficient System Operation - Fan Design and Selection Criteria - Flow Control Strategies - Fan Performance Assessment - Energy Saving Opportunities.

Pumps and Pumping System: Pump Types -System Characteristics - Pump Curves - Factors Affecting Pump Performance - Efficient Pumping System Operation - Flow Control Strategies - Energy Conservation Opportunities in Pumping Systems.

DG SET SYSTEM AND COOLING TOWERS

DG set system: Introduction - Selection and Installation Factors - Operational Factors - Energy Performance Assessment of DG Sets- Energy Savings Measures for DG Sets.

Cooling Towers: Introduction - Cooling Tower Performance - Efficient System Operation - Flow Control Strategies - Energy Saving Opportunities in Cooling Towers

LIGHTING SYSTEM

Introduction - Basic Terms in Lighting System and Features - Lamp Types and their Features - Recommended Illuminance Levels for Various - Tasks/Activities/Locations - Methodology of Lighting System Energy Efficiency Study - Case Examples - Some Good Practices in Lighting - Electronic Ballasts - Energy Efficient Lighting Controls

Text Book:

1.Book-3: Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency, New Delhi, India, II edition 2005