VASAVI COLLEGE OF ENGINEERING (Autonomous)

(Affiliated to Osmania University)

Scheme of Instruction and Syllabi of

M.E. (EEE)

POWER SYSTEMS AND POWER ELECTRONICS

W.E.F 2014-15

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

VASAVI COLLEGE OF ENGINEERING (Autonomous)

(Affiliated to Osmania University)

Ibrahimbagh, Hyderabad-500031

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Proposed Scheme of

M.E. (EEE)

Power Systems and Power Electronics

2014-15

VASAVI COLLEGE OF ENGINEERING (Autonomous)

(Affiliated to Osmania University)

Ibrahimbagh, Hyderabad-500 031

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
SCHEME OF INSTRUCTION & EXAMINATION

M.E. (Power Systems & Power Electronics)
Four-Semester Course (Full-Time) 2014-15

S. No	Syllabus Ref. No	Subject	Periods Per Week		Univ. Exam Duration(Hrs.)	Max. Marks		No. of Credits
			L/T	D/P		Univ. Exam	Sessional	
SEMESTER-I								
1	EE5010	Core	4	-	3	70	30	03
2	EE5020	Core	4	-	3	70	30	03
3	EE5030	Core	4	-	3	70	30	03
4		Elective	4	-	3	70	30	03
5		Elective	4	-	3	70	30	03
6		Elective	4	-	3	70	30	03
7	EE5221	Computer Simulation Lab	-	3	-	-	50	02
8	EE5236	Seminar - I	-	3	-	-	50	02
		Total	**24**	**06**		**420**	**280**	**22**
SEMESTER-II								
1	EE5040	Core	4	-	3	70	30	03
2	EE5050	Core	4	-	3	70	30	03
3	EE5060	Core	4	-	3	70	30	03
4		Elective	4	-	3	70	30	03
5		Elective	4	-	3	70	30	03
6		Elective	4	-	3	70	30	03
7	EE5241	PSPE Lab	-	3	-	-	50	02
8	EE5256	Seminar - II	-	3	-	-	50	02
		Total	**24**	**06**		**420**	**280**	**2**

S.No	SEMESTER-III							
1	EE5266	Project Seminar* + Dissertation	-	6	-	-	100**	06
		Total	**-**	**6**	**-**	**-**	**-**	**06**
SEMESTER-IV								
1	EE5276	Dissertation	-	6	Viva-Voce	Grade***	-	06
		Total	**-**	**6**	**-**	**-**	**-**	**06**

Note: Six core subjects, Six elective subjects, Two laboratory courses and Two seminars should normally be completed by the end of Semester-II.

*One Project seminar presentation

** To be awarded by the Viva Committee with Guide and two internal faculty.

*** Excellent/Very Good/Good/ Satisfactory/Unsatisfactory

VASAVI COLLEGE OF ENGINEERING (Autonomous)

M.E. (Power Systems & Power Electronics)

List of Theory and Practical Subjects

Core Subjects		
1	EE5010	Power Semi-Conductor Devices Circuits
2	EE5020	Advanced Synchronous Machine Theory
3	EE5030	Application of Power Electronics to Power Systems
4	EE5040	Distribution System Planning and Automation
5	EE5050	Power System Stability
6	EE5060	Power Electronics Controlled Electric Drives

Practicals		
1	EE5221	Computer Simulation Lab
2	EE5236	Seminar - I
3	EE5241	Power System Power Electronics Lab
4	EE5256	Seminar - II
5	EE5266	Project Seminar
6	EE5276	Dissertation Work

Elective Subjects		
1	EE5070	Machine Modeling and Analysis
2	EE5080	Advanced Computer methods in Power Systems
3	EE5090	Modern Control Theory
4	EE5100	Advanced Power System Protection
5	EE5110	Real Time Applications in Power Systems
6	EE5120	High Voltage D.C. Transmission
7	EE5130	Artificial Neural Networks
8	EE5140	Renewable Energy Sources
9	EE5150	Reliability Modeling in Power Systems
10	EE5160	Power Quality Engineering
11	EE5170	Energy Management
12	EE5180	Advanced Microprocessors Systems
13	EE5190	Digital Control Systems
14	EE5200	AI Applications to Power Systems
15	EE5210	High Voltage Engineering
16	EE5220	Programmable Logic Controllers And Their Applications
17	EE5230	Microcontrollers

EE5010 Power Semi-Conductor Devices & Circuits (Core)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I
Switching characteristics: Power MOSFETs and IGBTs, limitations and Safe Operating Areas (SOAs), – Latching in IGBTs. Thyristors-Converter & Inverter grade, GTO, RCT, MCT.

UNIT II
Switch Mode D.C-D.C Converters: Step-down converter (Buck)–Step-up converter (Boost) – Buck-Boost converter Control of D.C-D.C converters – Cuk converter.

UNIT III
Switch Mode D.C-A.C Inverters: Pulse width modulated switching schemes — sinusoidal PWM and Square wave PWM of Single phase Inverters and Three phase Voltage source Inverters – Effect of Blanking time on output voltage in PWM Inverters.

UNIT IV
Resonant Converters: Classification – Basic resonant circuit concepts, Load resonant! Resonant switch converters – Resonant D.C Link Inverters with Zero-voltage switching – High frequency Link Integral half-Cycle converters.

UNIT V
Power supply Applications: overview of switching power supplies – DC-AC converters with electrical isolation, electrical isolation in the feed back loop, fly-back converters forward converters, push pull converters – full bridge converters, power supply protection, applications

Suggested Reading:

1. Mohan, Undeland, Robbins, *Power Electronics,* John Wiley, 1996.
2. Rashid M.H., *Power Electronics,* Prentice Hall of India, 1994.
3. Singh M.D and Khanchandani K.B, *Power Electronics,* Tata McGraw Hill, 1998.
4. Sen P.C, *Power Electronics,* Tata McGraw Hill Pvt. Ltd., New Delhi.

EE5020 Advanced Synchronous Machine Theory (Core)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

The Synchronous machine - Park's transformation – Flux linkage equations – Voltage equations – Current formulation of state space equations – Per-unit conversion – Normalizing Voltage and torque equations – Torque and power – Equivalent circuits of synchronous machine – Flux linkage state space model – Treatment of saturation Synchronous machine connected to infinite bus – Current , Voltage and flux linkage models.

UNIT II

Sub-transient and transient reactances and time constants – Simplified models of the synchronous machine – Steady state equations and phasor diagrams – Machine connected to infinite bus with local load at machine terminals - Determining steady state conditions.

UNIT III

Linear models of the synchronous machine - Linearization of the generator state space current, voltage and flux linkage models.

UNIT IV
Linearization of the load equation for the one machine problem – Simplified linear models – Effect of loading – State space representation of simplified model.

UNIT V

Representation of excitation systems, Different models of excitation systems – IEEE, 1, 2 & 3 systems – Representation of loads.

Suggested Reading:

1. Kimbark, E.W., *Power System Stability,* Vol. III, Dover, New York, 1968.
2. P.M.Anderson & A.A.Foud, *Power System Control & Stability*, Iowa State University Press, U.S.A. 1977.
3. Yao-Nan-Yu, *Power System Dynamics*, *Academic Press,* 1983.

EE 5030 Application of Power Electronics to Power Systems (Core)

Instruction	:	3 Periods/Week
Duration of Univ.Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT 1

General System considerations and FACTS: Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, principles of series and shunt compensation, Basic Types of FACTS Controllers, Benefits from FACTS, Application of FACTS.

UNIT II

Shunt Compensators: Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, improvement of Transient Stability, Power Oscillation Damping, Static Var Compensators, SVC and STATCOM, The Regulation Slope, Transfer Function and dynamic Performance, Transient Stability Enhancement and Power Oscillation Damping

UNIT III

Series Compensators: Objectives of Series Compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability, power oscillation damping, GTO thyristor controlled series capacitor, thyristor controlled series capacitor, SSSC.

UNIT IV

Combined Compensators: Introduction, unified power flow controller, basic operating principles, independent real and reactive power flow control, control structure, basic control system for P and Q control.

UNIT V

Mitigation of Harmonics: Power quality problems, harmonics, harmonic creating loads, harmonic power flow, and mitigation of harmonics, filters, passive filters, active filters, shunt, series and hybrid filters.

Suggested Reading:

1. Narain G. Hingorani, Laszlo Gyugyi, Understanding FACTS, IEEE press
2. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, Electrical Power Systems Quality, McGraw Hill,2003
3. Y.H.Song, A.T.Johns, Flexible A.C.Transmission System, IEE, London, 1999

EE 5040 Distribution System Planning and Automation **(Core)**

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Distribution System Planning: Introduction, Distribution system Planning: Factors effecting planning, present techniques, planning models, planning in the future, future nature of distribution planning, Role of computer in Distribution planning. Load characteristics and Load models – Wye connected loads, Delta connected loads.

UNIT II

Sub Transmission lines & Substations: Types of sub- transmission, Distribution substation, bus schemes, substation location, rating of substation, calculation of voltage drops with primary feeders, Derivation of the K constant, Application curves, Interpretation of the Percentage Voltage drop formula.

UNIT III

Primary Feeders: Types of primary feeders, Primary feeder loading, Tie-lines, Distribution feeder exit – rectangular and radial type development, Design of radial primary feeders – Voltage drop calculations by A,B,C,D constants, Uniformly distributed load, Non uniformly distributed load. Distribution Feeder Analysis – the ladder Iterative technique.

UNIT IV

Secondary Feeders: Secondary voltage levels, Present design practice, Secondary Banking, Economic design of secondaries, Total annual cost equation, Voltage drop and Power loss calculations. Distribution system voltage regulation: Quality of services, voltage control, Application of capacitors in Distribution system.

UNIT V

Distribution Automation: Distribution Automation, project planning, Definitions, communication, sensors, Supervisory Control and Data Acquisition Systems (SCADA), Consumer Information Service(CIS), Geographical Information System (GIS), Automatic Meter Reading (AMR), Automation system.

Suggested Reading:

1. Ganen Turan, Electric Power Distribution System Engineering, CRC Press, 2007 2nd Edition
2. William.Kersting, Distribution Modelling & Analysis – CRC Press – third edition - 2002
3. A.S. Pabla, Electric Power Distribution, Tata Mc Graw Hill, 5 Edition, 2005.

EE5050

Power Systems Stability (Core)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Steady state stability: Basic concept of stability-Types of stability- Stability criteria for single and multi-machine systems – Concept of voltage stability – Characteristics of network, generator and load, for voltage stability.

UNIT II

Transient stability: The swing equation for single and multi-machine system – Basic assumptions – Different methods of solution of swing equation – Solution by indirect methods – Runge- gutta method - Swing curve – Determination of critical time and critical angle.

UNIT III

Hydraulic power and governor models – IEEE standard models – Models for steam turbine. Improvement of Transient stability- potential energy function for SVC, SSSC & UPFC.

UNIT IV

Low frequency oscillation and supply controls: Transfer function of low frequency oscillation studies – Improving system damping with supplementary excitation – Design of supplementary excitation system – State equation for single machine system – Improving system model with governor control.

UNIT V

Sub Synchronous oscillation: Turbine generator torsional Characteristics, Torsional interaction with power system controls. Sub Synchronous resonance. Damping schemes.

Suggested Reading:

1. Yao-Nan-Yu, *Power System Dynamics,* Academic Press, 1983.
2. Prabha Kunder, *Power System Stability & Controi,* Tata Mc Graw Hill edition. 2006.
3. KR Padiyar, *FACTS Controllers in Power Transmission & Distribution* New AGE International Publishers First edition 2007.
4. Stagg and Elabiad, *Computer Methods in Power systems* - McGraw Hill., 1968.

EE 5060 Power Electronics Controlled Electric Drives (Core)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Review of Power Converters: Commutation in Thyristor power converters – Principle of natural commutation – Principle of forced commutation – Discontinuous conduction in converters- DC choppers – Force commutated inverters – Frequency conversion – Inverter voltage control – Harmonic neutralization – Current source inverters – Phase controlled cyclo-converters – AC Voltage controller.

UNIT II

DC Motor Control: General considerations – Evaluation of a dc drive performance – Forced commutation schemes to improve the performance of the drives – Features and Steady state analysis of a separately excited dc motor fed from chopper – Current limit control – Regenerative braking of dc motors – Steady state performance of dc motors on phase controlled rectifiers – Dual converters – Reversible drives – State space model and digital simulation of dc motors.

UNIT III

Induction Motor Control: Speed control of induction motors – Analysis of induction motor on non-sinusoidal voltage waveforms – Analysis of current source inverter fed induction motor – Variable frequency operation of induction motors – Analysis of induction motor fed from AC voltage controller – Chopper controlled resistance in the rotor circuit of an induction motor – Static slip energy recovery schemes employing converter cascades in the rotor circuit – Dynamic behavior and Stability of induction motor fed from variable frequency supply.

UNIT IV

Microprocessors in the Control of Electrical Drives: Applications of microprocessors in variable speed drives (Block Diagram and Flowchart Approach only) – DC motor speed control using microprocessor – Microprocessor based firing scheme for a dual converter – Induction motor speed control – Synchronous motor speed control – Stepper Motor Control.

UNIT V

Brushless DC Motor and Switched Reluctance Motor Drives: Switched reluctance motor drive – Normalized torque-speed characteristics – Speed Control Schemes – Control Circuits – Brushless DC Motor – Construction – Working Principle – Control Schemes.

Suggested Reading:

1. Vedam Subramanyam, Thyristor Control of Electric Drives, Tata MGraw Hill Publishing Co., New Delhi, 2003.
2. S.B.Dewan, G.R.Slemon, A.Straughen, Power Semi Conductor Drives, Wiley Interscience, 1984.
3. B.K.Bose, Power Electronics and AC Drives – Prentice Hall, 1986.

EE5070 Machine Modeling and Analysis (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Basic Principles for Electric Machine Analysis: Magnetically coupled circuits, Electromechanical energy conversion, Basic Two pole DC Machine – primitive 2 axis machine – Voltage and Current relationship – Torque equation.

UNIT II

Theory of DC Machines: Mathematical model of separately excited DC Motor, DC Series Motor, DC shunt motor and D.C. Compound Motor in state variable form – Transfer function of the motor.

UNIT III

Reference Frame Theory: Equations of transformation - Change of variables, Stationary circuit variables Transformed to the Arbitrary Reference Frame, Commonly used reference frames, Transformation between reference frames, Transformation of a balanced set, Balanced steady state phasor Relationships, Balanced steady state equations, Variables observed from various frames.

UNIT IV

Theory of Symmetrical Induction Machines: Voltage and torque equations in machine variables, Equations of transformation for Rotor circuits, Voltage and torque equations in arbitrary reference frame variables, Analysis of steady state operation- state-space model of induction machine in'd-q' variables, Free Acceleration Characteristics, Dynamic Performance-during sudden changes in load- during a 3 phase fault at the machine terminals.

.

UNIT V

Theory of Synchronous Machines: Voltage and Torque equations in machine variables, Stator Voltage equations in Arbitrary Reference Frame Variables, Voltage Equations in Rotor Reference Frame Variables: park's Equations, Torque Equations in Substitute Variables, Analysis of steady state operation, Dynamic performance - During sudden changes in Input Torque - During a 3 phase fault at the machine terminals.

Suggested Reading:

1. Paul C. Krause, Oleg Wasynczuk, Scott D.Sudhoff, "*Analysis of Electric Machinery and drive systems*" John Wiley and Sons, 2nd Edition, 2006
2. C.V. Jones, *"Unified Theory of Electrical Machines"* Butterworths Publishers.
3. P.S. Bhimbra, "*Generalized Theory of Electrical Machines"*, Khanna publishers, 2002.
4. J. Meisel, "*Principles of Electromechanical Energy Conversion" McGraw Hill, 1966.*

EE 5080 Advanced Computer Methods in Power Systems (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I
Network graph, Incidence Matrices – Element node incidence matrix - Bus incidence matrix - Branch path incidence matrix - Basic and Augmented cut set incidence matrices - Basic and Augmented branch incidence matrices - Basic and Augmented loop incidence matrices - Primitive network - Formation of Y Bus, YBR & Z loop by singular transformation.

UNIT II
Matrix representation of power systems, Triangularization, Gaussian elimination method, LU, LOU factorization, Table of factors, optimal ordering. Algorithm for formation of ZBus matrix. Concept of branch and link addition -modification of bus impedance matrix for changes in the network, Z bus -sparse vector method.

UNIT III
Concepts of load flow -classification of buses, Representation of fixed tap setting and on load tap changing transformers, load flow solution using Gauss -Seidel, Newton-Raphson methods, Treatment of voltage controlled buses -Acceleration factors, Decoupled and fast decoupled method,- Flow chart and comparison of different methods.

UNIT IV
Representation and performance equation of 3 phase network elements -Three phase network elements with balanced and unbalanced excitation -Transformation matrices -Symmetrical and Clarke's components -Algorithm for formation of 3-phase bus impedance matrix - Modification of three phase ZBUS charges in network.

UNIT V
Basic assumption in short circuit studies -System representation - General equations for short circuit study in phase variables and Symmetrical components for fault current and node voltage –Short circuit calculations for balanced three phase network using ZBUS - Fault impedance and admittance matrices -Analysis of 3 phase, line to ground and double line to ground faults -Flow chart for short circuit study.

Suggested Reading:
1. Stagg & EI-Abiad. Computer methods in Power System Analysis, Tata McGraw Hill, 1968.
2. Kusic Gearge L -Computer Aided Power System Analysis, - Prentice Hall, 1986.
3. M.A.Pai -Computer techniques in Power System Analysis, Tata McGraw Hill, 2006.

EE5090

Modern Control Theory (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Review of state variable representation of systems - Controllability and Observability — Model control of single input — single output systems (SISO), Controllable and Observable companion forms — Effect of state feedback on Controllability and Observability, Pole placement by State feed back.

UNIT II

Classification of Non-linearities - Phenomenon exhibited by the nonlinearities - Limit cycles - Jump resonance Sub-harmonic oscillations - Phase plane analysis - Singular points - Construction of phase plane trajectories - Isocline method - Delta method - Measurement of time on phase plane trajectories.

UNIT III

Concept and definition of stability - Lyapunov stability - Lyapunov’s first and second methods - Stability of linear time invariant systems by Lyapunov’s second method - Generation of Lyapunov functions- Variable gradient method - Krasooviski’s method.

UNIT IV

Formulation of optimal control problems - Calculus of variations — Fundamental concepts — Functionals — Variation of functionals — Fundamental theorem of calculus of variations - Boundary conditions - Constrained minimization — Dynamic programming – Hamilton Principle of optimality, Jacobi Bellman equation – potryagins minimum principle.

UNIT V

Introduction to adaptive control, types of adaptive control systems. Design of model reference adaptive control systems using M/T rule and Lyapunov stability theory.

Suggested Reading:

1. IJ Nagarath , M.Gopal *Control Systems Engineering fifth edition* - , New Age International Rablishess, 1984 Wiley Eastern Ltd.
2. Ogata K, *Modern Control Engineering,* Prentice Hall, 1997.
3. Donald E Kirk, optimal control thery An introduction
4. Karl J Astrom Bjron wihenmark, Adaptive control second edition – Peasson education

EE5100 Advanced Power System Protection (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Static relays- Comparators and static relay characteristics: Relays as comparators – Amplitude and Phase comparison schemes – General equation for comparators for different types of relays – Static comparators – Coincidence circuits – Phase splitting methods–Hall effect comparators – Operating principles – Use of level detectors – Time delay circuits – Filters – Thyristors – Triggering circuits and DC power supplies.

UNIT II

Static relay hardware: Operating principles: Static time current relays directional units based on phase and amplitude comparison– Differential relays – Distance relays – Quadrilateral relay – Elliptical relay – Relay response – Principle of R-X diagram – Convention for superposing relay and system characteristics – Power swings, Loss of synchronism and its effect on distance relays.

UNIT III

Generator, motor and transformer protection: Generator protection against short circuits using differential relays against inter-phase fault – Combined split-phase and overall differential relays – Protection against stator open circuits – Rotor and Stator overheating, Loss of excitation protection and field & ground fault protection. Digital protection scheme based upon second harmonic current induced in the rotor field circuit.

UNIT IV

Transformer differential protection: Effect of magnetizing in rush currents –Grounding transformers – Bus protection with differential relays. Line protection: 3 zone protection using distance relays – Switched schemes – Auto-reclosing – Single and multi-shot auto reclosing – Single pole and three pole auto reclosing.

UNIT V

Pilot wire and carrier protection: Circulating current scheme – Balanced Voltage scheme – Translay scheme – Half wave comparison scheme – Phase comparison carrier current protection –carrier transfer scheme – carrier blocking scheme – Digital protection EHV/ UHV transmission line based upon traveling wave phenomena.

Suggested Reading:

1. Badriram and Viswakarma D.N., *Power System Protection and Switchgear* — Tata McGraw Hill, 2004.
2. L.P.Singh, *Digital Protection*, Wiley Eastern Ltd., 1994.
3. Warrington A.R. Van C, *Protective Relays* ,Vol I & II Chapman & Hall, London and John Wiley & Sons, 1977.
4. Mason C.R. *The art and science of Protective Relaying*, Wiley & Sons, 1956.

EE5110 Real Time Applications in Power Systems (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Power Flow Studies: Introduction, power flow problem, formulation of power flow equation, computational aspects of power flow problem, Gauss-Seidel iterative technique, Gauss elimination(Triangular factorization) method, Power flow solution using Zbus matrix, power flow solution by Newton-Raphson method, decoupled load flow, fast decoupled load flow, power flow control by regulating the operating conditions.

UNIT II

Contingency Analysis Techniques: 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 inter connected power systems, network reduction for contingency analysis, contingency analysis, approximate power flow method for simulating contingencies.

UNIT III

State Estimation Techniques: Data acquisition, role of a state estimator, rationale of state estimation, method of least squares for state estimation, estimation of power system state varables by the weighted least square estimation(WLSE) technique, statistical errors and bad data recognition, power system state estimator in noisy environment, composition of the Jacobian matrix H and the measurement vector Z

UNIT IV

Power System Security: Introduction, challenges for secure operation, methods of enhancing security, reliability criterion, enhancement of stability controls, online dynamic security assessment, management of system reliability, Future trends in dynamic security assessment, real time monitoring and control

UNIT V

Load Forecasting Technique: Forecasting methodology, estimation of average and trend terms, estimation periodic components, estimation of Ys(k): Time series approach, estimation of stochastic component: kalman filters approach, long term load predictions, reactive load forecast

Suggested Reading:

1. T.K.Nagsarkar, M.S.Sukhija, Power system analysis, Oxford publications
2. Prabha Kundur, Power system stability and control, TataMcGrawHill Edition, 2006
3. J.Arrillaga, C.P.Arnold, Computer modeling of electric power systems, John Wiley 1983

EE5120

High Voltage D.C. Transmission (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Comparison of AC and DC Transmission systems, Applications of DC Transmission, Description of DC Transmission Systems, Modern trends in HVDC Technology. Static power conversion - Principle -Ideal / real commutation process - Rectifier operation - Inverter operation - Power factor and reactive power - Converter harmonics, Smoothing reactors.

UNIT II

Harmonic elimination - Design of ac. Filters- D.C. side filters - Alternative methods of harmonic elimination - Control of H.V.D.C. converters and systems - Individual phase control - Equidistant firing control - D.C. system control - Characteristics and direction of D.C power flow.

UNIT III

Fault development and protection - Converter disturbances -A.C system faults -Over current protection - Transient over-voltages - Harmonic over voltages excited by A.C disturbances - Fast transients generated on the D.C system - Surges generated on the a system insulation co-ordination. DC Circuit breakers.

UNIT IV

AC – DC system interactions: System models, Torsional, harmonic interactions with HVDC systems. Reactive power control: Requirements in steady state, Sources of reactive power and control during transients.

UNIT V

Study of MTDC systems, Multi-infeed DC systems, Types of MTDC systems, Existing a.c.transmission facilities converted for use with d.c. - Generator rectifier units- Forced commutation - Compact converter stations - Microprocessor based digital control.

Suggested Reading:

1. Arrillaga J., *High Voltage Direct Current Transmission,* Peter Peregrinus Ltd., London. 1983.
2. Padiyar KR., *HVDC Power Transmission Systems,* New Age International, New Delhi, 2010.

EE5130

Artificial Neural Networks (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Neural and Fuzzy Intelligence: Fuzziness as multi-valence - Bivalent paradoxes as fuzzy midpoints - Sets as points in cubes - Subset hood and probability- The dynamical system approach to machine intelligence - Brain as a dynamical system - Neural networks as trainable dynamical system - Intelligent behaviour as adaptive model free estimation - Generalization and creativity - Learning as change- Rules vs. principles - Symbolic vs. numeric processing - Structured numerical estimators.

UNIT II

Neural Network Theory: Neurons as functions - Signal monotonicity Biological activities and signals - Neuron fields - Neuronal dypamic systems - Common signal functions - Pulse coded signal functions- Additional neuron dynamics - Additive neural feedback - Additive activation models - Bivalent BAM theorem - Hoptield model.

UNIT III

Synaptic Dynamics: Unsupervised learning - Learning laws - Probability spaces and random processes - Signal Hebbian learning- Competitive learning - Differential Hebbian learning - Supervised learning - The perceptrons - LMS algorithm - Back propagation algorithm - AVQ algorithm - Global stability of feedback neural networks.

UNIT IV

Fuzzy Logic: Fuzzy sets and systems - Geometry of fuzzy sets - Fuzzy entropy theorem- Entropy subset - Hood theorem - Fuzzy and neural function estimators - FAM system architecture - Uncertainty and estimation - Types of uncertainty - Measure o. fuzziness - Classical measures of uncertainty - Measure sol dissonance - Confusion and non- specificity. Fuzzy logic structure - Knowledge base defuzzification - Fuzzy logie, in control - Pattern recognition - Planning and Diagnosis.

UNIT V

Fuzzy Logic and ANN Application: Application to load forecasting - Load flow, Fault detection and Unit commitments - LF control - Economic dispatch.

Suggested Reading:

1. Bart Kusko, *Neural Networks and Fuzzy System* - Prentice Hall of India, 1994.

EE5140 Renewable Energy Sources
(Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2°2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells — Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations - Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT IV

Energy from the Oceans - Ocean Thermal Electric conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages energy - Geo-thermal Energy - Types of Geo-thermal Energy Systems - Applications of Geo-thermal Energy. of wave

UNIT V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass - Biomass gasifies.

Suggested Reading:

1 Rai G.D, *Non-Conventional Sources of Energy,* Khanfla Publishers, New Delhi, 1999.
2. El-Wakil, M0M., *Power Plant Technology*. McGraw Hill, 1984.

EE 5150

Reliability Modeling in Power Systems (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Introduction: The Concept of reliability – Reliability Indices – Power System reliability-Component Reliability – Non-repairable components – Hazard Models – System Reliability – network methods – Logic Diagrams – Monotonic Structures.

UNIT II

Generating Capacity Reserve Evaluation: Planning for reliability – Outage definitions – Construction of reliability models — probability of capacity deficiency – Loss of load method – Loss of energy method – Frequency and duration method – Two level representation of the daily load - Merging the generation and load models – Multilevel representation of the daily load – Comparison of the reliability indices – Generation expansion planning.

UNIT III

Operating Reserve Evaluation: General concepts – PJM method –Outage replacement rate – Generation model – Unit commitment risk – Modified PJM method – Area risk curves – Modelling rapid start units – Modelling hot reserve units – Unit commitment risk – Security function approach – Security function model – Response risk – Evaluation techniques – Effect of distributing spinning reserve – Effect of Hydro – electric units.-interconnected systems

UNIT IV

Generation and Transmission Systems: Introduction – Radial configurations – Conditional probability approach – Network configurations – State selection – Systems and load point indices – Application to practical systems – Data requirements for composite system reliability evaluation – concepts – deterministic data – Stochastic data – Independent outages – Dependent outages – Common mode outages – station originated outages.

UNIT V

Distribution Systems: Introduction – Basic evaluation techniques – state space diagrams – approximate methods – Network reduction method – Failure modes and effects analysis – Temporary and transient failures – concepts – evaluation techniques – Common mode failures – Evaluation techniques – Sensitivity analysis – Total loss of continuity(TLOC) – Partial loss of Continuity(PLOC) – PLOC criteria – Extended load – duration curve – Effect of transferable loads – General concepts – Evaluation techniques – Economic considerations

Suggest Reading:

1. Endrenyi, Relaibility Modeling in Electrical Power Systems, Johnwiley & Sons,1978.
2. Roy Billiton, Ronold N.Allan, : Relaibility Evaluation of Power Systems, Plenum press, springer international edition
3. E.Balaguruswamy, Relaibility Engineering.

EE 5160 Power Quality Engineering (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Introduction: Power Quality (PQ),PQ problems , Sags, Swells, Transients, Harmonics, Interruptions, Flicker ,Voltage fluctuations, Notch. PQ Issues, Assessing PQ: Remedies - Customer side of meter, Utility side of the meter. Power quality monitoring – Monitoring considerations, Historical Perspective of PQ Measuring Instruments, PQ measurement equipment, Assessment of PQ measurement data, Application of intelligent systems, PQ monitoring standards.

UNIT II

Voltage Sag Analysis: Voltage sag characteristics - Methodology for computation of voltage sag magnitude and occurrence — Accuracy of sag analysis — Duration & frequency of sags — Faults behind transformers — Effect of pre-fault voltage — Simple examples — Voltage dip problems, fast assessment methods for voltage sags in distribution systems.

UNIT III

PQ Consideration in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications — Sources of power system harmonics — Mitigation of harmonics — Characterization of voltage sags experienced by three-phase ASD systems — Types of sags and phase angle jumps — Effects of momentary voltage dips on the operation of induction and synchronous motors .

UNIT IV

Harmonics: Harmonic distortion, Voltage versus current distortion, Harmonics versus Transients, Harmonic Indices, Harmonic sources from commercial loads, Harmonic sources from industrial loads, Locating Harmonic sources, System response characteristics, Effects of Harmonic distortion, Inter harmonics, Devices for controlling harmonic distortion.

UNIT V

Transient Overvoltages – Sources of Transient Overvoltages. Wiring and Grounding: Resources, Definitions, Reasons for Grounding, Typical wiring and grounding problems, Solutions to wiring and grounding problems.

Suggested Reading:

1. Math H.J. Bollen, Understanding Power Quality Problems, IEEE Press, 1999.
2. Roger C.Dugan, Mark F.McGranaghan, Surya Santoso, H.Wayne Beaty, Electrical Power Systems Quality, Second Edition, Tata McGraw-Hill Edition.
3. C.Sankaran, Power Quality, CRC Press, 2002.

EE 5170

Energy Management
(Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Essentials of Energy Management: Introduction – Scope of Energy Management – Necessary Steps of Energy Management Programme – General Principles of Energy Management – Qualities and Functions of an Energy Manager – The Language of the Energy Manager. Method of investment appraisal – Rate of return method - Pay back method – Net present value method (NPV) - Internal rate of return method (IRR)– Capital budgeting.

UNIT II

Energy Auditing: Introduction – Objective of Energy Audit – Control of Energy – Uses of Energy – Energy Conservation Schemes – Energy Index – Cost Index – Pie Chart – Sankey Diagram – Load Profile – Types of Energy Audit – General Energy Audit – Sankey Questionnaire – Sample Questionnaire – Energy Audit Case Studies

UNIT III

Energy Conservations: Introduction – Indian Energy Conservation Act, 2001(EC Act) – The Electricity Act 2003 – Rules for Efficient Energy Conservation of Energy and Materials – Technologies for Energy Conservation – Design of EC – Energy Flow Networks – Critical Assessment of Energy Use – Formulation of Objectives and Constraints.

UNIT IV

Improvement of Energy Efficiency: Waste Heat – Advantages of Recuperators – Air Preheaters and Economizers – Furnaces – Fans and Blowers – Compressors – Pumps – Energy Audits – Case studies, Tips for energy conservation in domestic and industrial sectors

UNIT V

Electrical Energy Management: Introduction – Power Factor Control – Tariff – Energy Efficient Motors – Case Study – Energy Efficient Lighting – Life cycle Cost Analysis (LCC analysis) – Equivalent Annual Worth(EAW) – Break Even Analysis.

Suggested Reading:

1. KV Sharma,P.Venkataseshaiah: Energy management and conservation IK International publishing house Pvt. Ltd.
2. Guide book for national certification examination for energy managers and energy auditors, Books1,2,3 &4-Bureau of Energy Efficiency, Ministry of power, Govt. of India
3. Turner W.C.: Energy management handbook

EE 5180

Advanced Microprocessor Systems (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

8086 Microprocessor Architecture - Segmented Memory - Addressing Modes - Instruction Set - 8086 Assembly Language Programming - 8087 Numerical Data Processor Architectural details - Data types - Floating point Operations - 8087 Instructions.

UNIT II

Architectural details of 80386 Microprocessor - Special registers - Memory management - Operation in protected mode and virtual 80386 mode - Memory paging mechanism - Special instructions of 80386 - Architectural details of 80486 - Special registers - Additional instructions - Comparison of 80386 and 80486 processors.

UNIT III

Introduction to Pentium Processor - Architectural features - Comparison with the workstations - Branch prediction logic - cache structure. - Special Pentium Registers. Memory management - virtual mode of operation - Comparison with the previous processors. Features of Pentium-II, Pentium-III and Pentium Pro-processors.

UNIT IV

RISC Microprocessors – RISC Vs CISC – RISC Properties – DEC Alpha AXP Architecture - Power PC – Architecture - Programming Model – Data Types – Addressing Modes – Instruction Set. Sun SPARC – Architecture – Data Types – Instruction Sets - Features of MIPS, AMD Microprocessors

UNIT V

Motorola Microprocessors – 68000 Microprocessor – Architecture – Registers – Addressing Modes – Features of 68020 – 68030 – 68040 Microprocessors.

Suggested Reading

1. Barry B Brey “Intel Microprocessors : 8086/88, 80186/188, 80286, 80386, 80486, Pentium, Pentium – II, Pentium – III and Pentium – IV, Architecture, Programming & Interfacing”, Pearson Education, 2003.
2. Badri Ram, “Advanced Microprocessors and Interfacing”, Tata McGraw Hill.
3. A.K. Ray & K.M. Bhurchandi, “Advanced Microprocessors & Peripherals, Architecture, Programming & Interfacing”, Tata McGraw Hill.

EE-5190

Digital Control Systems (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Review of Z – Transforms: Introduction - Linear difference equations - Pulse response - Z - transforms, Theorems of Z – Transforms - Inverse Z – transforms - Modified Z- Transforms. Z-Transform method for solving difference equations - Pulse transforms function - Block diagram analysis of sampled data systems - mapping between s-plane and z-plan - Primary strips and Complementary Strips.

UNIT II

State Space Analysis : State Space Representation of discrete time systems - Pulse Transfer Function - Matrix solving discrete time state space equations - State transition matrix and it's Properties - Methods for Computation of State Transition Matrix - Discretization of continuous time state - space equations.

UNIT III

Controllability and Observability : Concepts of Controllability and Observability - Tests for controllability and Observability -Duality between Controllability and Observability - Controllability and Observability conditions for Pulse Transfer Function.

Stability Analysis (Discrete): Stability Analysis of closed loop systems in the Z-Plane. Jury stability test - Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

UNIT IV

Design of Discrete Time Control System by Conventional Methods: Design of digital control based on the frequency response method - Bilinear Transformation and Design procedure in the w-plane - Lead, Lag and Lead-Lag compensators and digital PID controllers – Design of digital control through deadbeat response method.

UNIT V

State Feedback Controllers and Observers(Discrete): Design of state feedback controller through pole placement - Necessary and sufficient conditions - Ackerman's formula - State Observers - Full order and Reduced order observers - Min/Max principle, Linear Quadratic Regulators - Kalman filters - State estimation through Kalman filters - Introduction to adaptive controls.

Suggested Reading:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition
2. Digital Control and State Variable Methods by M.Gopal, TMH
3. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
4. Digital Control Engineering, M.Gopal

EE 5200 AI Applications to Power Systems (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Fundamentals of Genetic Algorithms: Introduction to GAs, Encoding, Fitness Function, Premature Convergence, Basic Operators, Selection, Tournament Selection, Truncation Selection, Linear Ranking Selection, Exponential Ranking Selection, Elitist Selection, Proportional Selection, Crossover, Mutation

UNIT II

Fundamentals of Particle Swarm Optimization Techniques : Introduction, Basic Particle Swarm Optimization, Background of Particle Swarm Optimization, Original PSO, Variations of Particle Swarm Optimization, Discrete PSO, PSO for MINLPs, Constriction Factor Approach (CFA), Hybrid PSO (HPSO), Lbest Model,

UNIT III

Ant Colony Search Algorithms : Introduction, Ant Colony Search Algorithm, Behavior of Real Ants, Ant Colony Algorithms, The Ant System, The Ant Colony System, The Max-Min Ant System, Major Characteristics of Ant Colony Search Algorithms, Distributed Computation: Avoid Premature Convergence, Positive Feedback: Rapid Discovery of Good Solution,, Use of Greedy Search and constructive Heuristic Information

UNIT IV

Differential Evolution: Introduction, Evolutionary Algorithms, Basic EAs, Virtual Population-Based Acceleration Techniques, Differential Evolution, Function Optimization Formulation, DE Fundamentals, Initial Population, Mutation and Recombination to Create New Vectors, Selection and the Overall DE, Key Operators for Differential Evolution, Encoding, Mutation, Crossover, Other Operators, An Optimization Example.

UNIT V

Applications to power systems: Distribution Network Expansion, Dynamic Planning of Distribution System Expansion: Reactive Power Planning at Generation–Transmission Level, Benders Decomposition of the Reactive Power Planning Problem, Solution Algorithm, Reactive Power Planning at Distribution Level, Application Examples, Optimal Power Flow Under Contingent Condition with Line Capacity Limit, Optimal Power Flow for Loss Minimization

Suggested Reading:

1. Kwang Y. Lee and Mohamed A. El-Sharkawi, “Modern heuristic optimization techniques” IEEE press, Wiley-Interscience Publication
2. Soliman, Soliman Abdel-Hady, Mantawy, Abdel-Aal Hassan, “Modern Optimization Techniques with Applications in Electric Power Systems” Springer publications
3. S.N.Sivanandam, S.N.Deepa, “Introduction to Genetic algorithms” Springer publications

EE 5210

High Voltage Engineering (Elective)

Instruction	:	3 Periods/Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT I

Conduction and Breakdown of Gaseous Insulating Material: Iionization processes and current growth – Townsend's criterion for breakdown – Breakdown in electronegative gases – Time lags for breakdown – Paschen's law – Corona discharges – Breakdown in non – uniform fields – Practical considerations for selecting gases for insulation purposes.

UNIT II

Conduction and Breakdown in Liquid and solid Dielectrics : Various mechanisms of breakdown in liquid dielectrics - Liquid dielectrics used in practice – Various processes – Breakdown in solid dielectrics – Solid dielectrics used in practice.

UNIT III

Generation of High Voltages and Currents : Generation of High DC Voltages using voltage multiplier circuits – Van de Graff generator. Generation of high alternating voltages using cascade transformers – Production of high frequency AC high voltages – Standard impulse wave shapes – Marx circuit – Generation of switching surges – Impulse current generation – Tripping and control of impulse generators.

UNIT IV

Measurement of High voltages and Currents: High DC Voltage measurements techniques – Methods of measurements for power frequency AC voltages – sphere gap measurements technique – potential divider or impulse voltage measurements – measurements of high DC., AC and impulse currents – Use of CRC for impulse voltage and current measurements.

UNIT V

High voltages Testing: Tests on insulators – testing on bushings – testing of isolators and circuit breakers – cable testing of transformers surge diverter testing – Radio interference measurement – Use of I.S.S. of testing.

Suggested Reading:

1. M.S Naidu and V.Kamaraju, High voltage Engineering, Tata McGraw Hill, 1982.
2. E.Kufferl and M.Abdullah, High voltage Engineering, Pergamon Press, 1970.

EE5220 Programmable Logic Controllers And Their Applications (Elective)

Instruction	:	3 Periods/Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT-I:
PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT-II:
PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT-III:
PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT-IV:
Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT-V:
Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions.

Suggested Reading:
1. Programmable Logic Controllers – Principle and Applications by John W Webb and Ronald A Reiss Fifth edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR Hackworth and F.D Hackworth – Jr- Pearson, 2004.

EE 5230 Microcontrollers (Elective)

Instruction	:	3 Periods/Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	70 Marks
Sessional	:	30 Marks

UNIT - I

Introduction and 8051 Architecture: Introduction to microcontrollers, comparing microprocessors and microcontrollers, 4,8,16 and 32 bit microcontrollers, Development systems for Microcontrollers, Architecture, Architecture of 8051, pin configuration of 8051 microcontroller, hardware input pins, output pins ports and external memory, counters and timers, serial data input and output and interrupts.

UNIT - II

Moving Data and Logical Operations: Introduction, Addressing modes, External Data moves, Code Memory Read-only Data Moves, PUSH and POP Op-codes, Data Exchanges, Logical Operations; Introduction, Byte-Level Logical Operations, Bit-Level Logical Operations, Rotate and Swap Operations.

Unit - III

Arithmetic Operations, Jump and Call Op-codes: Introduction, Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Jump and Call op-codes, introduction, The jump and call program range, Jumps, Calls and Subroutines, call and returns, Interrupts and Returns.

Unit - IV

8051 Microcontroller Design: Introduction, A microcontroller specification, A microcontroller Design, Testing the Design, Timing subroutines, Lookup Tables for the 8051, Serial Data Transmission.

Unit - V

Applications and Serial Data Communication: Introduction, Keyboards, Displays, pulse Measurement, D/A and A/D Conversions, Multiple Interrupts, Serial data Communication, Introduction, Network Configurations, 8051 Data Communication Modes.

Suggested Reading:'

1. Kennth J. Ayala, The 8051 Microcontroller Architecture Program and Applications, 2nd edition, Penram International Publications, 1996.
2. Mohammed Ari Mazidi and Janci Gillispie, The 8051 Microcontroller andEmbedded Systems, Pearson Education Asia, New Delhi, 2003.

EE5221 COMPUTER SIMULATION LABORATORY
(List of Experiments)

Instruction	:	3 Periods/Week
Internal Marks	:	50 Marks

1. Load flow studies
2. Short circuit studies
3. Transient stability studies
4. Simulation of IGBT inverters
5. Distribution load flow studies
6. Simulation of Facts controllers
7. Simulation of thyristor converters
8. Simulation of Resonant converters
9. Load forecasting and unit commitment
10. Simulation of reactive power compensation
11. Simulation of Buck, Buck-Boost converters
12. Simulation of single -area and Two -area Systems
13. Economic Load Dispatch with thermal power plants
14. Simulation of V/F controller for 3-phase induction motor
15. Economic Load Dispatch with Hydro thermal power plants

EE5241 Power Systems & Power Electronics Lab

Instruction	:	3 Periods/Week
Internal Marks	:	50 Marks

Part-A (Power Systems)

1. To measure negative sequence and zero sequence reactance of synchronous machine
2. To measure Direct axis and quadrature axis reactance's of synchronous machine
3. To Study The Single Line To Ground Fault
4. To Study Line To Line Fault
5. To study Three-phase fault
6. To study Microprocessor based Over current relay
7. To study Percentage Differential Relay
8. To study Over Voltage Relay
9. To study Under Voltage Relay
10. To measure positive and zero sequence reactance's of three-phase transformer

Part-B (Power Electronics)

1. Three phase step down cyclo-converter
2. Three phase controlled rectifier with R and RL loads
3. Three phase half controlled rectifier with R and RL loads
4. Speed control of three phase slip ring induction drive using static Kramer's drive
5. Three phase Mc-Murray Bed-ford inverter
6. Three phase IGBT inverter
7. Closed loop control of permanent magnet dc drive
8. Single phase dual converter
9. Rotor resistance control of slip ring induction motor
10. Speed control of dc motor using chopper

Note: At least five experiments should be conducted in each part