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SHIVAJI UNIVERSITY, KOLHAPUR.

Revised Syllabus of

(B.E. Electrical Engineering Sem –VII & VIII)

To be introduced from the academic year 2010-11
(i.e. from June 2010) Onwards

(Subject to the modifications will be made from time to time)

SHIVAJI UNIVERSITY, KOLHAPUR
B.E.(Electrical) SEM. VII

Sr. No.	Subject	Teaching Scheme		Examination Scheme				
		L	P	Theory	TW	POE	OE	TOTAL
1	Electrical Drives and Control	4	2	100	25	25	--	150
2	High Voltage Engineering	3	2	100	50	--	--	150
3	Advanced Switchgear and Protection	4	2	100	25	--	25	150
4	Renewable Energy Sources	4	2	100	50	-	--	150
5	Elective-I	3	--	100	--	-	--	100
6	Project Phase-I	--	4		-	--	50	50
7	T.E. Vacation Training Evaluation	--	--	--	50	--	--	50
	Total	18	12	500	200	25	75	800

B.E.(Electrical) PART-II SEM. VIII

Sr. No.	Subject	Teaching Scheme		Examination Scheme				
		L	P	Theory	TW	POE	OE	TOTAL
1	Electrical Utilization and traction	4	-	100	-	-	--	100
2	HVDC Systems	4	2	100	25	-	--	125
3	Electrical Installation, testing and maintenance	4	4	100	50	--	50	200
4	Elective -II	4	-	100		--	--	100
5	Electrical Machine Design Laboratory	-	4	--	50	--	50	100
5	Project Phase- II		4		75	--	100	175
	Total	16	14	400	200	--	200	800

ELECTIVES (SEMISTER I):

1. FACTS
2. Digital Control System
3. Embedded System
4. Electrical Engineering Materials
5. Thermal Engineering

ELECTIVES (SEMISTER II):

1. EHVAC
2. Computer Aided power Systems
3. Advanced Digital Signal Processing
4. Restructured Power Systems

[Note :- Examination scheme and term work marks strictly as per above structure]

1. ELECTRICAL DRIVES AND CONTROL

Teaching Scheme:
Lectures : 4 Hours/week
Practical: 2 Hours/week

Examination Scheme:
Papers :100 marks
TW: 25 Marks
POE:25 Marks

1.INTRODUCTION TO ELECTRICAL DRIVES: Types of the electrical drives, parts of electrical drives, criteria for selections, choice of electrical drives, selection of motor rating determinations for various types of duty ratio. Selection of converter rating.

2. DYNAMICS OF ELECTRICAL DRIVES: Fundamental torque equation, speed torque, connection and multi-quadrant operation classification of load torques. Steady state stability of drives

3.CONTROL OF ELECTRICAL DRIVES: Modes of the operation, speed control and drive classification, close loop control of drives.

4. D.C. MOTOR DRIVES: Method of the D.C. motor control, starting braking and speed control, single phase and three phase full controlled and half controlled converter fed D.C. drives. Multi-quadrant operation of separately excited D.C. shunt motor, Dual converter fed D.C. drives, converter control of D.C. series motor, Chopper controlled d.c. shunt motor drives, Single quadrant and multi-quadrant operation of D.C. shunt motor and Chopper, Chopper control of series motor, performance and stability of variable speed D.C. drives Regenerative breaking the D.C. series motor.

5. INDUCTION MOTOR DRIVES: Braking and speed control method for 3 phase Induction Motor, power for stator voltage control (A.C. regulator),VSI fed induction motor drive , Power circuit circle loop control block diagram, power circuit and close loop control loop of CSI and fed Induction motor drives ,comparison of fed induction motor and drive, Analysis of the inverter fed induction motor using Harmonics equivalent circuit, Harmonics torque and losses with inverter fed Induction motor drives, Dynamics dq model, Axes transformation, Stationary frame a-b-c to ds-ds axes transformation, stationary frame $d^s - d^s$ to synchronously rotating $d^e - d^e$ transformations. Synchronously rotating reference frame-Dynamic Model (Kron Equation) Stationary frame Dynamic model (Stanley equation).Vector or field oriented controlled Drive Analogy, Principles of vector control, Direct or feedback vector control.

6. SLIP RING INDUCTION MOTOR DRIVE: Chopper controlled resistance in rotor circuit, slip power recovery using Cascade converter, Static Sherbius drive.

7. SYNCHRONOUS MOTOR AND BRUSHLESS D.C. MOTOR DRIVES: VSI fed synchronous motor drives, Variable frequency control of multiple Synchronous motor drives, Brush less D.C. Motor drives.

TERM WORK:

Minimum 10 experiments to be performed from the list given below:

1) Study of torque-speed characteristics of separately excited DC motor from single phase full converter.

2) Study of torque-speed characteristics of armature voltage controlled of separately excited DC motor from single phase full converter

3) Study of torque-speed characteristics of separately excited DC motor from three phase full converter

4) Study of torque-speed characteristics of DC series motor using chopper.

5) Three phase induction motor speed control using slip power recovery scheme.

6) V/f Control of induction motor.

7) open loop speed control of separately excited DC motor using chopper at high frequency.

8) Three phase induction motor speed control using rotor resistance control
9) Simulation of chopper fed DC drive using MATLAB/SIMULINK.
10) Simulation of variable frequency induction motor drive using MATLAB/SIMULINK
11) Simulation of three phase converter fed separately excited DC motor control using MATLAB/SIMULINK.
12) Simulation of t single phase converter fed separately excited DC motor control using MATLAB/SIMULINK.

Texts and references :

1) Fundamentals of the electrical drives: Gopal K Dubey, Narosa publication
2) Power Electronics converter application : N. Mohan T.M. Undeland & W.P.Robbins, John Wiley & sons Inc.
3) Electrical Drives Concept and application: Vedam Subrahnyam
4) Advanced power Electronics and A.C. Drives: B.K. Bose
5) Analysis of thyristor power conditioned motors: S.K.Pillai

2. HIGH VOLTAGE ENGINEERING

Teaching Scheme:
Lectures: 3 Hours /week
Practical: 2 Hours/week

Examination Scheme:
Paper: 100 Marks
T.W.: 50 Marks

1.INTRODUCTION TO HIGH VOLTAGE TECHNOLOGY AND APPLICATIONS: Electric Field Stresses, Gas or Vacuum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.

2.BREAK DOWN IN GASEOUS AND LIQUID DIELECTRICS: Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids.

3.BREAK DOWN IN SOLID DIELECTRICS: Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

4.GENERATION OF HIGH VOLTAGES AND CURRENTS: Generation of High DC Voltages, Generation of High AC voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators.

5.MEASUREMENT OF HIGH VOLTAGES AND CURRENTS: Measurement of High direct Current voltages, Measurement of High Voltages alternating and impulse, measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.

6.OVER VOLTAGE PHENOMENON AND INSULATION CO-ORDINATION: Natural causes for over voltages, Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

7.NON-DESTRUCTIVE HIGH VOLTAGE TESTING AND QUALITY CONTROL: Measurement of D.C Resistively, Measurement of Dielectric Constant and loss factor, Partial discharge measurements.

8.HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS: Testing of Insulators and bushings, Testing of Isolators and circuit breakers, Testing of cables, Transformers and Surge Arresters, Radio Interference measurements.

TERM WORK:

List of Experiments:

1. Partial Discharge Measurements of Transformer windings and Cables
2. Impulse Tests on Transformers
3. Capacitance Measurement of Cables
4. Condition Monitoring Of Transformers
5. Transformer oil Testing
6. Measurement of Dielectric properties with Schering Bridge

Texts and references :

1. High Voltage Engineering: M.S.Naidu and V. Kamaraju, TMH Publications, 3rd Edition
2. High Voltage Engineering: Fundamentals: E.Kuffel, W.S.Zaengl, J.Kuffel , Elsevier
3. High Voltage Engineering: C.L.Wadhwa, New Age Internationals (P) Limited, 1997.
4. High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.

3. ADVANCED SWITCHGEAR AND PROTECTION

Teaching Scheme:
Lectures:4 Hours /week
Practical: 2 Hours/week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks
OE: 25 Marks

1.Circuit Breakers: a)Voltage -current characteristics of arc, Principles of DC and AC arc interruption, high resistance and current zero interruption, arc voltage, Transient Restriking Voltage (TRV), Recovery voltage, RRRV, current chopping, resistance switching, capacitive current interruption.
b) Classification of circuit breakers, brief study of construction and working of bulk oil and minimum oil CB, Air break and Air Blast CB, SF6 and Vacuum CB, HVDC breakers, ratings of CB and testing of CB
c) Fuse: Rewirable and HRC fuse, fuse characteristics, application and selection of fuse.
2. Relays: Selectivity, sensitivity, reliability and speed of operation of a relay, CT burden calculation, attracted armature, balanced beam, moving coil relays, theory and construction of induction disc and induction cup relays, numerical relays, microprocessor based relaying.
3.Over current Protection : Plug setting, time setting, radial feeder and ring mains protection, earth fault and phase fault, Directional relay, and microprocessor based o/c relay.
4. Differential Relays: circulating current and opposed voltage principles, percentage differential relay, line protection, carrier aided protection scheme
5. Transformer protection: Problems associated with percentage differential protection, harmonic restraint and harmonic blocking schemes, restricted earth fault protection, Buchholz relay for incipient faults.
6. Generator protection: stator earth fault, phase fault, stator current unbalance (NPS) protection, Rotor overheating, earth fault protection, excitation failure and protection against motoring, generator-transformer unit protection.
7. Distance protection: Impedance, reactance and admittance characteristics, relay settings for 3-zone protection, out of step blocking scheme, blinder relay, numerical relays for transmission line protection, microprocessor based impedance, reactance and mho relays.
8. Over voltage Protection: Causes of over voltages, surge arrestors and absorbers, metal oxide (ZnO) arrestors, insulation co-ordination in a power system

TERM WORK:
1) Drawing sheet showing construction of MOCB, ABCB, SF6 CB and Vacuum CB.
2) Drawing sheet for Generator and transformer protection schemes.
3) Study of construction and working of induction disc type relays.
4) Plotting of I α t characteristics of an IDMT over current or E/F relay.
5) Experimental study of working of a Directional over current relay.
6) Experimental realization of microprocessor based over current relay.
7) Experimental realization of microprocessor based impedance relay.
8) Experimental realization of microprocessor based Directional over current relay.

Texts and References :
1) Power System Protection and Switchgear: B.Ram and B.N. Vishwakarma
2) Switchgear and Protection: Sunil.S. Rao, Khanna Publications
3) Digital Protection: L.P.Singh
4) Switchgear and Protection: M.V. Deshpande

4. RENEWABLE ENERGY SOURCES

Teaching Scheme:
Lectures: 4 Hours /week
Practical: 2 Hours/week

Examination Scheme:
Paper: 100 Marks
T.W.: 50 Marks

1. Renewable Energy Overview: Sources of renewable energy, renewable energy trends, key factors affecting renewable energy supply.
2. Wind Resource Characteristics: Wind speed characteristics and variations, Wind speed and power relation, available power and power extracted from the wind, Wind speed distribution and statistics, Weibull wind speed probability distribution function, Mean, mode, root mean cube, Wind energy production.
3. Fundamental of Wind Turbines: System components, System design features, number of blades, vertical and horizontal axis rotors, tower spacing, airfoils and general concepts of aerodynamics, aerodynamics of wind turbines, drag and lift, aerodynamic power controls, pitch, stall, active stall, rotor power characteristics CP-λ, Power curves.
4. Electrical aspects of Wind Turbines: Induction and synchronous generators, Constant speed wind turbines, Fixed-speed direct connect generator systems, Direct-connect synchronous generator, Direct-connect induction generation, Multi-speed generator systems.
5. Modeling of fixed-speed direct-connect wind turbines: Wind turbine modeling concepts, Aerodynamic models, Tip-speed ratio, Wind turbine and gear box, Induction machine.
6. Variable Speed Wind Turbine Systems: Synchronous generators with static frequency inverters, Induction generators with slip controls, Doubly-fed induction generators, Direct rotor-driven generators.
7. Impacts of Wind Farm Interconnections: Voltage variations, Short-circuit capacity, Power quality, Generation reliability analysis.
8. Photovoltaic Power: PV cell technologies, Module and array, Equivalent electrical circuit, Open circuit voltage and short circuit current, i-v and p-v curves.

TERM WORK:
A) Minimum 8 experiments to be performed from following list.
1. Introduction to software tools dealing wind energy systems.
2.Mathematical Modeling of SEIG wind turbine system.
3.Simulation of SEIG wind turbine system using MATLAB/SIMULINK
4.To investigate the effect of the exciting capacitance, resistive load and inductive load on the power output and speed of SEIG using DC motor- SCIM set.
5.Study of Variable rotor resistance control of WECS using DC motor- WRIM set.
6.Study of characteristics of wind power by simulating a wind farm composed of a doubly-fed induction generator (DFIG) and wind turbine using MATLAB SIMULINK.
7.Modeling of PV Solar Array using MATLAB/SIMULINK
8.Modeling of PEM Fuel Cell using MATLAB/SIMULINK

B) A Field visit to Renewable Energy Plant and Preparation of Report

Texts and references:
1.Wind Energy Explained: Theory, Design and Application : James Manwell, J. F. Manwell, J. G. McGowan 2nd Edition John Wiley and Sons, Inc.
2.Wind Energy Systems : Gary-L. Johnson: Tata Mc-Graw-Hill Book Company
3.Wind Power, Renewable Energy for Home, Farm, and Business : Paul Gipe

ELECTIVES (SEMISTER I)

1. FACTS

Teaching Scheme: Examination Scheme:
Lectures: 4 hrs / week Theory: 100 Marks

1. Introduction to FACTS : Introduction of the facts devices and its importance in transmission Network. Introduction to basic types of facts controller, comparison of HVDC and facts.
2. STATIC SHUNT COMPENSATORS : SVC AND STATCOM objectives of the shunt compensation ,method of controller VAR generator , transfer function dynamics performance of SVC and STATCOM, VAR reserve control ,comparison between STATCOM AND svc STATIC VAR system
3. STATIC SERIES COMPENSATORS: GCSC ,TSSC , TCSC AND SSSC objectives of the series compensation , series capacitive compensation , power oscillation damping , variable Impedance type series compensation switching converter type series compensators chrematistics of series compensator.
4. STATIC VOLTAGE AND PHASE ANGLE REGULATION TCVR and TCPAR: Objective of voltage and phase angle regulators, Thyristor controlled voltage and phase angle regulator, switching converter based voltage and phase angle regulators.
5. COMBINED COMPENSATOR: UPFC and IPFC UPFC - Basic principle and reactive power control structure basic control system for P & Q control, comparison of UPFC to series compensator and phase angle regulations. IPFC-Basic operating principle characteristics, Control structure and applications.

Texts and references :
1.Understanding FACTS - Concept and Technology of flexible AC Transmission systems. : N.G. Hingorani & L. Gywgyi IEE Press.
2. Static Reactive power compensation : T.J.E. Miller, Jhon wiley and sons New york

2. DIGITAL CONTROL SYSTEM

Teaching Scheme:
Lectures: 4 hrs / week

Examination Scheme:
Theory: 100 Marks

1. Non linear control system: Properties of the non linear system, common physical Non - linearities. Classification of the non linearities - single valued and multi-valued and explicit implicit non linearities , static and dynamic non linearities
2. Analysis of Non linear control system: Linearization, phase plane method , singular points, construction of phase trajectories using method of isoclines, delta and lineards construction ,Limit cycle phase plane construction using MATLAB . Describing function method, use of describing function, stability by Lyapunov's direct method, the concept of definiteness, lyapunov stability theorem.
3. Digital control system: Introduction the Z transform, properties of Z transform, the inverse Z transform , Z transform method for solving difference equation . Impulse sampling and Data hold, Pulse transfer function, sampling theorem, Z transform & Inverse Z transform using MATLAB.
4.Design of digital control system By conventional methods: Mapping between S plane and the Z plane, stability analysis of the close loop system in Z plane, transient and steady state analysis . Design based in the Root locus method, design based on the frequency response method.
5. State space analysis of digital control system: State space representation of digital control system . Solving Digital control State space equations pulse transfer function matrix.
6.Pole placement and observer design: Controllability, observability, ,useful transformation in state –space Analysis and Design , Design Via pole placement, state observers.

Texts and references :
1) Control system Engineering. : Nagrath Gopal, Wiley Publication .
2) Discrete time control system: K.Ogata, Second Edition Pearson Publications.
3) Control system Engineering: Norman Nise, 4th edition Jhonwiley & sons
4) Feed back systems: Philips and Harbor, PHI
5) Nonlinear control Engineering: D.P. Atherton
6) Multiple input describing function and non linear system design: Gelb and Vander Velde, Mc-Graw Hill
7) Modern control principles and Application: Hsu and Meyer, Mc-Graw Hill.

3. EMBEDED SYSTEMS

Teaching Scheme: Examination Scheme:
Lectures: 4 hrs / week Theory: 100 Marks

1. Introduction to Embedded Computing :Overview, Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process Requirements, specifications, Architecture Design, Designing of Components, System Integration

2. Embedded System Architecture: Instruction Set Architecture, CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller Architecture, CISC Example 8051,RISC Example ARM, Harvard Architecture, PIC, Memory System Architecture, Caches, Virtual Memory, Memory Management Unit and Address Translation, I/O Sub-system, Busy-wait I/O, DMA, Interrupt driven I/O, Co-processors and Hardware Accelerators, Processor Performance Enhancement, Pipelining, Super-scalar Execution

3. Designing Embedded Computing Platform: Bus Protocols, Bus Organisation, Memory Devices and their Characteristics, RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM, I/O Devices, Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Component Interfacing, Memory Interfacing, I/O Device Interfacing, Interfacing Protocols, Designing with Processors, System Architecture, Hardware Design, FPGA Based Design, Debugging Techniques, Manufacturing and Testing

4. Programming Embedded Systems: Program Design, Design Patterns for Embedded Systems, Models of Program, Control and Data flow Graph, Programming Languages, Desired Language Characteristics, Introduction to Object Oriented Programming, Data Typing, Overloading and Polymorphism, Multi-tasking and Task Scheduling, Timing Specifications, Run-time Exception handling, C for Programming embedded systems, Programming and Run-time Environment, Compiling, Assembling, Linking, Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing

5. Operating System: Basic Features of an Operating System, Kernel Features, Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System, Processes and Threads, Context Switching, Cooperative Multi-tasking, Pre-emptive Multi-tasking, Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling, Inter-process Communication, Shared Memory Communication, Message-Based Communication, Real-time Memory Management, Process Stack Management, Dynamic Allocation, Synchronous and Asynchronous I/O, Interrupt Handling, Device Drivers, Real-time Transactions and Files, Evaluating and Optimizing Operating System Performance, Response-time Calculation, Interrupt latency, Time-loading, Memory Loading, Power Optimization Strategies for Processes

6.Embedded Control Applications: Open-loop and Closed Loop Control Systems, Speed Control of motor, PID Controllers, Software Coding of a PID Controller, PID tuning, Fuzzy Logic Controller, Application Examples of Washing Machine, Automotive Systems and Air-conditioner

Texts and references:

1.Embedded System design : Peter Marwedel, Springer publication.

2.An Embedded Software Primer, David E. Simon Pearson Education, Asia Publication

3.ARM System developers guide designing & optimizing system software: Andrew N., Dominic Sloss, and Chris Wright.

4.Embedded System Design A Unified Hardware/ Software Introduction : Frank Vahid/ Tony Givargis ,Wiley publication

5.Embedded/ Real-Time Systems: Concepts, Design & Programming : Dr. KVKK Prasad ,Dreamtech Press

4. ELECTRICAL ENGINEERING MATERIALS

Teaching Scheme:
Lectures: 4 hrs / week

Examination Scheme:
Theory: 100 Marks

1. Introduction to Electrical Materials: Engineering materials, Classification, properties, Energy bond description.
2. Conductive materials: Ohm's law and relaxation time of electrons, relaxation time, collision time and mean free path Electric scattering and resistively of metals Heat developed in current carrying conductor, Thermal conductivity of metals, Superconductivity, cryoconductors.
3. Dielectric materials:
A) Dielectric properties in static field: Polarization and its mechanism, dielectric constant of monoatomic gases,
a) Dielectric breakdown in liquid: colloidal theory, Bubble theory, Breakdown due to liquid globules.
b) Dielectric breakdown of solid: Intrinsic breakdown, Frochlich's theory, Theory of Van Hippel, Thermal and discharge breakdown.
c) dielectric breakdown in gases : Growth of current, breakdown mechanism, electron ionization coefficient, secondary ionization coefficient, Townscnd's criterion
B) Dielectric properties in alternating field: Frequency dependence of electronic polarisiblity, ionic polarization as function of frequency, complex dielectric constant of non dipolar solids, dielectric losses.
4.Insulating materials: Dielectric gases, liquid insulating materials, solid insulating materials, modern trends in electrical insulators, insulation measurement, electric strength of liquids, factor influencing the characteristics of insulating system. Effect of moisture on insulating system. Insulating materials for electric and electronic equipments.
5. Magnetic properties of materials: Magnetic material classification, origin of permanent magnetic dipole, Diamagnetism, Paramagnetism, ferromagnetic domains, Magnetostriction, factor affecting permeability and hysteresis loss, anti ferromagnetism, ferrimagnetisms, magnetic resonance

Texts and references :
1.Electronic Engineering Materials and devices : J.Allison , Mc-Grawhill Pub.
2. Electric and radio engineering materials: B. M. Tareev, Mir Publication
3. Electric engineering Materials: A. J. Dekker , Prentis Hall Publication

5. THERMAL ENGINEERING

Teaching Scheme:
Lectures: 4 hrs / week

Examination Scheme:
Theory: 100 Marks

1. Second law of thermodynamics: Limitations of first law, Statements of second law, Equivalence of Kelvin-Planck and Clausius statements, Corollaries of Second law, Refrigerators and Heat pumps, Reversibility and irreversibility, Causes of irreversibilities, Carnot theorem and Phase Property diagram.
2. Steam Engineering: Rankine cycle, steam boilers, flow of steam through nozzles, critical pressure ratio, maximum discharge, effect of friction calculation of throat and exit areas, nozzle efficiency, use of Mollier chart. Introduction to steam turbines and condensers.
3. Heat transfer: Modes and laws of heat transfer, steady state heat conduction, concept of thermal resistance, Heat Exchangers- Classification and types.
4. Air Compressors: Classifications, thermodynamic analysis of single stage and multi stage reciprocating air compressors without clearance volume. Construction and working of centrifugal and axial Flow air compressors. Applications of Compressed air.
5. Refrigeration and Air conditioning: Reversed Carnot cycle, Bell Coleman Cycle, Analysis of Simple Vapor Compression Cycle, introduction to Vapor absorption cycle , types and properties of refrigerants, Eco friendly refrigerants, concepts of Psychometry, Psychometric terms and processes, Summer, Winter and Industrial Air conditioning Systems.

Texts and references :

1. Thermal Engineering : P.L. Ballaney, Khanna Publishers
2. Basic & applied thermodynamics : P.K.Nag, TMH
3. Thermal Engineering : R.K.Rajput, Laxmi Publications
4. Thermal Engineering : B.K.Sarkar, TMH
5. Thermal Engineering : Kothanderman, New Age International Publication
6. Basic Engineering Thermodynamics : Rayner Joel, ELBS
7. IC engines : Mathur and Sharma , Dhanpat Rai and Co.
8. Basic Refrigeration and Air Conditioning : Ananthnarayanan, TMH
9. Heat Transfer : R.K.Rajput, S.Chand and Co.

Semester II -Part VIII

1. ELECTRICAL UTIZATION AND TRACTION

Teaching Scheme:
Lectures: 4 Hrs / week

Examination Scheme:
Theory: 100 Marks

1.Electric traction: DC, AC and composite traction systems, main line and suburban systems, Comparison with Diesel-Electric traction, traction equipments, Trolley wire, catenaries, Feeding and distribution systems, negative booster, overhead lines, current collectors, traction substations .
2.Train movement and Energy consumption: Trapezoidal and quadrilateral speed-time curves, Maximum, average and scheduled speeds, Mechanics of train movement, tractive effort calculation, Power and energy output from driving axles, Specific Energy Output.
3. Traction motors and their Control : D.C. series, A.C. series and 3 Phase Induction motors for traction, Brief introduction to rheostatic speed control methods, drum controller, Multiple Unit Control, Static control of traction morors. Use of microprocessors for control of traction motors.
4. Braking of traction motors: Vacuum brake and Air brake systems, regenerative braking, calculation of energy returned during regenerative braking.
5. Electric Drives: Classes of insulation, Heating and cooling curves, derivation of heating and cooling time constants, Load equalization, flywheel calculations, capitalization of losses and selection of most economical motor.
6. Electric Heating and Welding: Classification of electric heating, heating methods, Resistance heating, design of heating element, Arc furnaces, induction heating, Induction furnaces, Dielectric heating, Electric arc welding, welding transformer, Power supply and control of electric welding, Laser beam welding.

Texts and references :
1. Utilization of Electric Power and Electric Traction: J.B. Gupta, 8th Edition
2. Art and science of Utilization of Electric Energy: H. Partab
3. A course in Electrical Power: Soni, Gupta and Bhatnagar
4. Utilization of Electric Energy: Openshaw Taylor

2. H.V.D.C. SYSTEMS

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours /week	Paper: 100 Marks
Practical: 2 Hours/week	T.W.: 25 Marks

1. General Background: Trends in transmission Voltages, Hierarchical Levels in transmission and distribution, Standard rated voltage of EHV-AC and HVDC, General aspects HVDC Transmission: Constitution of EHVAC and DC links, Kinds of DC links, HVDC projects in India and abroad, limitations and advantages of HVDC transmission over EHVAC, Layout of HVDC station.
2. Grid Control and Characteristics: Grid control of thyristor, valve-Analysis with grid control with no overlap, overlap less than 60 degrees and overlap greater than 60 degrees. Basic means of control, Power reversal, manual control and its limitations-constant current versus constant voltage, desired features of control, actual control characteristics-constant minimum ignition angle, current and extinction angle controls – stability of control, power control and current limits.
3. Protection: Disoperation of converters-short circuit on a rectifier – commutation failure, causes and remedies – Protection of HVDC system, d.c. rectors, damper circuits, Over-current protection and over-voltage protection, clearing fault and reenergizing the line.
4. Harmonics and Filters: Characteristic and uncharacteristic harmonics-causes, consequences and suppression-Troubles caused by harmonics, Harmonic filters- Types, Location, series or shunt, sharpness of tuning.
5. Reactive Power Compensation: Concept of reactive power compensation- reactive Power balance in HVDC substations-Effect of angle of advance and extinction angle on reactive power requirement of converters.
6. Multi-terminal DC Systems: Introduction, Configurations and Types of MTDC Systems, Control and Protection of MTDC Systems

TERM WORK:

Minimum 8 experiments to be performed based on simulation:
MATLAB/SIMULINK/PSCAD/EMBTC or PSPICE may be used for simulation.

1. Simulation of converters for DC transmission purposes
   a. Grid control with no overlap
   b. Grid control with overlap >60°
   c. Grid control with overlap >120°
2. Simulation of basic means of control and study of V_d-I_d characteristics of both controlled rectifier and inverter.
3. Simulation to study V_d-I_d characteristics with constant minimum ignition angle control for controlled rectifier.
4. Simulation to study Vd-Id characteristics with constant current control for converter and inverter.
5. Study of V_d-I_d characteristics with constant extinction angle control of inverter.
6. Study of commutation failure on inverter side.
7. Study of consequent commutation failure .
8. Study of prevention of consequent commutation failure .
9. Study of effect of angle of advance and extinction angle on reactive power on the converter and inverter side.
10. Study of harmonics generated on converter and inverter side due to angle of advance and extinction.
11. Study of effect of filters(Tuned filters and high pass filter) on the converter input harmonics.
12. Simulation of DC circuit breaker.

Texts and references :

1.Direct Current Transmission: E.W. Kimbark. Vol. I, John Wiley, New York Edn. 1971,
2.HVDC Power Transmission System: K.R. Padiyar , Wiley Eastern Ltd. New Delhi.
3.Power Transmission by Direct Current : E. Usdimann Springer Verlag, Berlin Edn. 1975.
4.EHVAC and HVDC Transmission: S.S. Rao Khanna Pub. Delhi.

3. ELECTRICAL INSTALLATION, TESTING AND MAINTENANCE

Teaching Scheme:	Examination Scheme:
Lectures:4 Hours /week	Paper: 100 Marks
Practical: 2 Hours/week	T.W.: 50 Marks
	OE: 50 Marks

1.Tools, accessories: Tools, accessories and instruments required for installation, maintenance and repair work, India Electricity rules, safely codes causes and prevention of accidents, artificial respiration, workmen's safety devices.

2.Installation of Transmission and Distribution Lines: Erection of steel structures, connecting of jumpers, tee-off points, joints and dead ends: crossing of roads, streets, power/telecommunication lines and railway crossings clearances: earthing of transmission lines and guarding, spacing and configuration of conductors, Arrangement for suspension and strain insulators, bird guards anti-climbing devices and danger plates. sizes of conductor earth wire and guy wires. Testing and Commissioning Laying of service lines earthing, provision of service fuses, installation of energy meters

3.Laying of Underground Cables: Inspection, storage, transportation and handling of cables, cable handing equipment, cable laying depths and clearances from other services such as water sewerage, gas, heating and other mains, and also a series of power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying (including laying of cable from the drum, laying cable in the trench, taking all measurements and making as installed drawing, back filling of trenches with earth or sand, laying protective layer of bricks etc). laying of cables into pipes and conduits and within buildings introduction to cable filling compounds epoxy resins and hardeners, cable jointing and terminations testing and commissioning.

4.Inspection and handling of transformers: Pole mounted substations, plinth mounted substation, busbars, isolation, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches.

5.Testing of various electrical equipment: Electrical motor, transformers cables and generator and motor control centers, medium voltage distribution panels power control centers motor control, lighting arrangement, storage, pre-installation checks, connecting and starting pre-commissioning checks drying out

6. Maintenance: Types of maintenance, maintenance schedules, procedures, Maintenance of Transmission and Distribution System, danger notice, caution notice permit to work, arranging of shutdowns personally and temporary earths cancellation of permit and restoration of supply, Patrolling and visual inspection of lines – points to be noted during patrolling from ground: special inspections and night inspections, Location of faults using Meggar, effect of open or loose neutral connections provision of proper fuses on service lines and their effect on system, causes and dim and flickering lights

7.Maintenance of Distribution Transformers: Transformer maintenance and points to be attended to be attended to in respect of various items of equipment, Checking of insulation resistance transformer oil level and BDV test of oil, measurement of earth resistance

8.Maintenance of Grid Substations: Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches, Power Transformers

9.Maintenance of Motors: Over hauling of motors, preventive maintenance, trouble shopping of electric motors

10.Domestic installation :Introduction, testing of electrical installation of a building, testing of insulation resistance to earth testing of insulation and resistance between conductors continuity or open circuit test, short circuit test testing of earthing continuity location of faults IE rules for domestic installation

TERM WORK:

A) List of Experiments:

1. Identification of tools and equipment used for installation and maintenance of electrical equipment

2. Study of codes and practices pertaining to safety in installation and maintenance of electrical equipment.

3. Study of electrical equipment by visiting a grid power station/sub station and to prepare a report of maintenance system adopted there

4. Study of the testing of electrical equipment by visiting a grid power station/sub station and to prepare a report

5. Study of motors and their repair and overhauling by visiting a repair workshop or manufacturing unit

6. Study of maintenance of electrical distribution system by visiting a sub station and to prepare a report.

7. Study of Power factor improvement of a single-phase load using capacitor bank

B) One field visit to substation for study of maintenance work.

Text and References:

1. Testing, Commissioning Operation and Maintenance of Electrical Equipment : S Rao, Khanna Technical Publication ,New Delhi
2. Preventive Maintenance of Electrical Apparatus : SK Sharotri, Katson Publishing House Ludhiana

4. ELECTRICAL MACHINE DESIGN LABORATORY

Teaching Scheme: Examination Scheme:
Lectures: Nil T.W.: 50 Marks
Laboratory work: 04 Hours/week O.E.: 50 Marks

1.Basic Concept of Design: a)Introduction b) Specifications c)Output Coefficient d) Importance of specific Loadings e) Electrical Material i)Conducting ii)Insulating iii)Magnetic f)Magnetic Circuit Calculations g) Types of Enclosures h) General Procedure for Design of Electrical machines i) Optimal Design with Computer Aided Design Flow Chart

2. D.C. Machine Design:

a) Step by Step Design Procedure i) Calculation of output Coefficient ,main dimensions of armature i.e. D,L and flux per pole checking the peripheral velocity and voltage between Commutator segments ii) Calculations of no. of slots, conductor size, checking current density, Calculation of tooth flux density, height of cor, weight of iron, iron losses and temperature rise. iii) Calculation of dimensions of main poles, field coils, yoke and ampere turns required. iv) Calculation of copper size, no. of turns for shunt and series field v) Determination of the diameter of Commutator and it's no. and size of brushes, check of peripheral velocity and gap between brush arms. vi) Calculation of dimensions of interpoles and interpole windings. Calculation of total losses, total weight and KG/KW

b) Main Pole brick and interpole brick drawing

c) Commutator drawing

d) Brush gear assembly drawing

e) Complete layout drawing of D.C.motor.

3. Three Phase Transformer Design

a) Step by Step Design Procedure: i) Calculation of main dimensions of magnetic frame consisting of windows and yoke, Calculation of flux densities in these parts, Calculation of iron losses. ii) Calculation of ampere turns and no load current iii) Calculation of no. of turns, size of copper and final dimensions of LV windings iv) Calculation of no. of turns, size of copper and final dimensions of HV windings v) Check whether clearance between magnetic frame and windings are ok. vi) Calculation of winding copper losses, total losses, efficiency, reactance and percentage regulation. vii) Calculation of main dimensions of cooling tank, no. and size of cooling tubes, temperature rise, total weight/KVA

b) Detailed design of different types of core sections used for Three Phase Transformer with complete dimensioned drawing.

c) Layout drawing of a 3 phase transformer core frame in detail.

d) Complete Layout drawing of 3 phase core type transformer.

4. Three Phase Induction Motor Design

a) Step by Step Design Procedure: i) Calculation of Output Coefficient, main dimensions of stator core i.e.D, L and flux per pole ii) Calculation of no. and size of stator slots, conductor size, by checking current density and slot balances, calculation of tooth flux density, copper losses and weight of copper, core flux density, height of core, iron losses. iii) Calculation of air gap length, Rotor Diameter, no. of rotor slots, conductor size, copper losses, flux densities in tooth and core, weight of rotor copper. iv) Rotor end ring design v) Calculation of Carter's Coefficient and ampere turns for air gap, stator tooth and stator core, rotor tooth and rotor core, and total no load ampere turns, magnetizing current, no load power factor vi) Calculation of reactance, short circuit current and short circuit power factor. vii) Calculation of total losses, efficiency, slip, starting torque, temperature rise, total weight, KG/KW

b) Rotor and Stator Lamination Drawing

c) Complete layout of 3 phase squirrel cage induction motor.

5. Computer Aided Optimal Design Flow Charts For

a) D.C.Motor b) 3 phase core type transformer c) 3 phase sq. cage IM

TERM WORK:
Computer aided design of any three machines based on above guidelines.

Texts and references :
1. Performance and design of D.C. Machine : Clayton
2. Performance and design of A.C. Machine :M.G.Say
3. Design of Electric Machine : A.K. Sawhney
4.Computer Aided Design of Electrical Machine: K.M. Vishnu Murthy

ELECTIVES (SEMISTER II)

1. EHVAC

Teaching Scheme: Examination Scheme:
Lectures: 4 hrs / week Theory: 100 Marks

1. Introduction to EHVAC: Engineering aspect and growth of EHVAC Transmission line trends and preliminaries, power transferability, transient stability, transit stability limit, and surge impedance loading.
2.Calculation of line and ground parameters: Resistance power loss, temperature rise properties of bundled conductors, Inductance and Capacitance , calculation of sequence inductions and capacitance line parameters for modes of propagations, resistance and inductance of the ground return.
3.Voltage gradients of conductor: Charge potential relations for multi-conductor lines , surface voltage gradients on the conductor line , surface voltage gradients on conductors, distribution of voltage gradients on sub conductors of bundle. I*I * R and corona loss corona loss formula charge voltage diagram with corona ,attenuation of traveling waves due to corona loss Audible noise, corona pulses, Their generation and properties, limit for radio interface fields.
4.Theory of the Traveling waves and standing : The waves at the power frequency, differenential equations and solutions for generals case , standing waves and natural frequencies open ended line double exponential response , response to sinusoidal Excitation , line energization with trapped charge voltage, Refection and refraction of traveling waves.
5.Lighting and lighting protection : Lighting strokes to lines , their mechanism, General principal of the lighting protections problems, low footing resistance ,lighting arrestor and protection characteristics different arrestors and their characteristics .
6.Over voltage in EHV system covered by switching operations Over –voltage their types , recovery voltage and circuits breaks , Ferro resonance over voltage and calculations of switching surges single phase equivalents.
7. Power frequency voltage control and over voltage: Generalized constants, charging current, power circle diagram, and its use , Voltage control shunt and series components, Sub synchronous resonance in series capacitor compensated lines and static reactive compensating systems.
8. Insulation Co-ordinations: Insulation level, Voltage withstands levels of protected equipments and insulation condition based on the lighting.

Texts and references :
1. EHV AC transmission Engineering : R.D. Begamudre
2. EHV –AC and HVDC Transmission Engineering &Practice : S.V. Rao
3. EHV -AC and HVDC transmission system engineering analysis and design : John Wiley & sons.

2. COMPUTER AIDED POWER SYSTEM

Teaching Scheme: Examination Scheme:
Lectures: 4 hrs / week Theory: 100 Marks

1.Optimization Techniques**:** Introduction, Statement of an optimization problem, design vector, design constraints, constraint surface, objective function, classification of optimization problem. Classical optimization Techniques, single variable optimization, multivariable optimization with equality constraints, Direct substitution method, constrained variation method, Lagrange Multiplier method, formulation of multivariable optimization, Kunh- Tucker conditions.
2.Optimization techniques**:**Nonlinear Programming, Unconstrained optimization Techniques, Direct search methods, Indirect search methods, Descent methods, One dimensional minimization methods, unimodal function, elimination methods.
3.Load flow studies: Revision of Load flow studies by using Newton Raphson method (polar and rectangular) . Contingency evaluation, concept of security monitoring, Techniques of contingency evaluation, Decoupled load flow and fast decoupled load flow.
4.Optimal Power Flow Analysis: Optimal power flow analysis considering equality and inequality constraints. Economic dispatch with and without limits(Classical method) Gradient method, Newton's method, Newton Raphson method, calculation of loss coefficients, loss coefficients using sensitivity factors, power loss in a line, Generation shift distribution factors, Transmission loss coefficients, transmission loss formula as a function of generation and loads, economic dispatch using loss formula which is function of real and reactive power, linear programming method.
5.Three phase Load flow :Three phase load flow problem notation, specified variables, derivation of equations. AC-DC load flow, Introduction, formulation of problem, D.C. System model, converter variables, Derivation of equations, Inverter operation, generalized flow chart for equation solution.
6.Fault Analysis: Revision of symmetrical and unsymmetrical faults, formulating the sequence impedance matrix, fault configurations and equations, General computer simulation of faults.

Texts and references:

1. Computer Aided Power System operation and Analysis:R.N.Dhar, Tata Mc-Graw Hill New Delhi.
2. Computer Techniques in Power System Analysis:M.A. Pai, Tata Mc-Graw Hill New Delhi.
3. Computer Methods in Power System Analysis: Stagg and El.Abiad, Mc-Graw Hill (International Student Edition.)
4. Computer Analysis of Power Systems:J.Arrilinga, C.P.Arnold. Wiely Eastern Ltd.
5. Optimisation Techniques: S.S.Rao, Wiely Eastern Ltd, New Delhi

3. ADVANCED DIGITAL SIGNAL POCESSING

Teaching Scheme:
Lectures: 4 hrs / week

Examination Scheme:
Theory: 100 Marks

1.DISCRETE RANDOM SIGNAL PROCESSING: Discrete Random Processes, Expectations, Variance, Co -Variance, Scalar Product, Energy of Discrete Signals - Parseval's Theorem, Wiener Khintchine Relation- Power Spectral Density-Periodogram – Sample Autocorrelation- Sum Decomposition Theorem, Spectral Factorization Theorem - Discrete Random Signal Processing by Linear Systems - Simulation of White Noise - Low Pass Filtering of White Noise.

2.SPECTRUM ESTIMATION: Non-Parametric Methods-Correlation Method - Co-Variance Estimator-Performance Analysis of Estimators -Unbiased, Consistent Estimators-Periodogram Estimator-Barlett Spectrum Estimation-Welch Estimation-Model based Approach - AR, MA, ARMA Signal Modeling-Parameter Estimation using Yule-Walker Method

3.LINEAR ESTIMATION AND PREDICTION: Maximum likelihood criterion-efficiency of estimator-Least mean squared error criterion -Wiener filter-Discrete Wiener Hoff equations-Recursive estimators-Kalman filter-Linear prediction, prediction error whitening filter, inverse filter-Levinson recursion, Lattice realization, and Levinson recursion algorithm for solving Toeplitz system of equations.

4.ADPATIVE FILTERS:FIR adaptive filters-Newton's steepest descent method -adaptive filter based on steepest descent method- Widrow Hoff LMS adaptive algorithm- Adaptive channel equalization-Adaptive echo chancellor-Adaptive noise cancellation-RLS adaptive filters-Exponentially weighted RLS-sliding window RLS-Simplified IIR LMS adaptive filter.

5.MULTIRATE DIGITAL SIGNAL PROCESSING: Mathematical description of change of sampling rate - Interpolation and Decimation - continuous time model - Direct digital domain approach - Decimation by an integer factor - Interpolation by an integer factor – Single and multistage realization - poly phase realization - Application to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

Texts and references :

1.Statistical Digital Signal Processing and Modeling: Monson H.Hayes,, John Wiley and Sons, Inc., New York, 1996.

2. Optimum Signal Processing: Sopocles J.Orfanidis,, McGraw Hill, 1990.

3. Digital Signal Processing: John G.Proakis, Dimitris G.Manolakis,Prentice Hall of India, 1995.

4. RESTRUCTURED POWER SYSTEMS

Teaching Scheme: Examination Scheme:
Lectures: 4 hrs / week Theory: 100 Marks

1.DEREGULATION OF THE ELECTRICITY SUPPLY INDUSTRY : Deregulation, Reconfiguring Power systems, unbundling of electric utilities, Background to deregulation and the current situation around the world, benefits from a competitive electricity market, after-effects of deregulation
2.POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT : Role of the independent system operator, Operational planning activities of ISO: ISO in Pool markets, ISO in Bilateral markets, Operational planning activities of a GENCO: Genco in Pool and Bilateral markets, market participation issues, competitive bidding
3. TRANSMISSION OPEN ACCESS AND PRICING ISSUES: Power wheeling, Transmission open access, pricing of power transactions, security management in deregulated environment, congestion management in deregulation
4. ANCILLARY SERVICES MANAGEMENT :General description of some ancillary services, ancillary services management in various countries, reactive power management in some deregulated electricity markets
5. RELIABILITY AND DEREGULATION: Reliability analysis: interruption criterion, stochastic components, component models, calculation methods, Network model: stochastic networks, series and parallel connections, minimum cut sets, reliability costs, Generation, transmission and distribution reliability, Reliability and deregulation: conflict, reliability analysis, effects on the actual reliability, regulation of the market

Texts and references:
1. Operation of Restructured Power Systems: K. Bhattacharya, MHT Bollen and J.C Doolder, Kluwer Academic Publishers, USA, 2001.
2. Power System restructuring and deregulation: Lei Lee Lai, John Wiley and Sons, UK. 2001.
3. Power System Operations and Electricity Markets: Fred I Denny and David E. Dismukes CRC Press

SHIVAJI UNIVERSITY, KOLHAPUR
EQUIVALENCE FOR B.E.(Electrical . Engg.)

Name of the Subject (Old Syllabus)	Name of the Subject (New Syllabus)
1.Microcontroller& Applications	No. Equivalence Same subject to be Given till student passes the subject
2.Industrial Drives & Control	**Electrical Drives and Control**
3.FACTS	FACTS (Elective)
4. Nonlinear & Digital Control System	No. Equivalence Same subject to be Given till student passes the subject
5. Elective I	No. Equivalence Same subject to be Given till student passes the subject

BE. Part II

Name of the Subject (Old Syllabus)	Name of the Subject (New Syllabus)
1.Switchgear & Protection	**Advanced Switchgear and Protection**
2.Electrical Machine Design	No. Equivalence Same subject to be Given till student passes the subject
3.Utilization & Energy Conservation	**Electrical Utilization and traction**
4. Elective II	4. Elective II