



**SHIVAJI UNIVERSITY, KOLHAPUR
(IMPLEMENTED FROM JUNE, 2005)**

B.E. (Electrical) Part I and II

SHIVAJI UNIVERSITY, KOLHAPUR (Introduced from June, 2005)

Class: B.E. (Electrical) PART - I

Sr no	Subject	Teaching Scheme			Examination Scheme			
		L	P	T	TP	TW	PO E	TOT
1	Micro Controller & Applications	4	2		100	25	25	150
2	Industrial Drives & Controls	4	2		100	25	25	150
3	FACTS	4		1	100	25		125
4	NonLinear and Digital control Systems	4		1	100	25		125
5	Elective I*	3		1	100	25		125
6	Seminar		2			25		25
7	Project P I		2			25	25	50
	Total	19	8	3	500	175	75	750

Class: B.E. (Electrical) Part II

Sr no	Subject	Teaching Scheme			Examination Scheme			
		L	P	T	TP	TW	PO E	TOT
1	S/W & PR	4	2	1	100	25	25	150
2	Electrical M/C Design	4	2	1	100	25	25	150
3	Utilisation & Energy Conservation	4	2*	1	100	50		150
4	Elective –II*	4		1	100	25		125
5	Project PII		4**			75	100	175
6	Total	16	10	4	400	200	150	750

List of the Elective Subjects:

* ELECTIVE –I

- 1) EHVAC
- 2) DSP
- 3) Electrical system modeling.
- 4) Neural Network & Fuzzy Logic

* ELECTIVE –II

- 1) HVDC
- 2) Power System Harmonics
- 3) Electrical & Electronic Materials

The seminar should be on any standard research paper.

*The students are supposed to make a model for unconventional energy sources and write extensive report on it.

•**The Project II term work and project report should consists of following points:

- . •Literature Survey
- . •Project Theme
- . •Simulation
- . •Fabrication
- . •Test result and comparison & future scope.



**SHIVAJI UNIVERSITY, KOLHAPUR
(IMPLEMENTED FROM JUNE, 2005)**

**BE ELECTRICAL PART- I
1 Microcontroller and Applications**

Teaching Scheme
Lectures- 4 Hrs/week
Practical -2 Hrs/week

Examination Scheme
Paper 100 marks
TW – 25, POE– 25

1. 8051 Architecture: 8051 internal resources, pin diagram, I/O pins, ports and their internal logic circuits, counters, serial port, interrupt structure, SFRs and their addresses, watch dog timer, internal code memory, data memory, stack pointer, flags, bit addressable memory. Comparative study of 8051 families by diff manufacturers (ATMEL, DALLAS, PHILIPS, INFINION, SST)
2. Assembly Language Programming: Study of Instruction set of 8051- data move, logical, arithmetic, jump and call instructions, Interrupt handling, timer programming, serial port communication, use of assembler and C-8051 cross compiler, simulator
3. Microcontroller based system design: External memory and space decoding, reset and clock circuits, expanding I/O, memory mapped I/O, memory addresses decoding, system testing and troubleshooting.
4. Real World Interfacing I: Interfacing various parallel devices to 8051 like 8255 PPI, Timer counter 8253, character LCD, 12 bit ADC such as AD574, DAC interfacing such as DAC0808, matrix keyboards, seven segment LED modules
5. Real World Interfacing II: Interfacing of various serial peripherals– 8051 data communication in 8 bit UART mode, multiprocessor mode, study of SPI , I2C communication protocols.
6. Microcontroller Applications (Block Schematic and flowchart): Microcontroller based automatic pf control relay, solid state energy meter using ASIC, weighing balance, serial E2PROM interfacing, temperature indicator and controller. Real time clock using DS1307

Minimum 10 practicals based on above syllabus should be performed. 5 practical should be based on assembly language programming(h/w and simulator) and 5 practical should be based on real world interfacing

Recommended Books:

1. Kenneth Ayala, *The 8051 Microcontroller Architecture, Programming & Applications*, 2ndEd., Penram International
2. Muhammad Ali Mazidi, *The 8051 Microcontroller and embedded systems*, Pearson Education
3. Device datasheet- ATMEL, DALLAS, SST etc.

**B.E. ELECTRICAL PART - I
2. INDUSTRIAL DRIVES AND CONTROL**

Lectures : 4 Hours/Week
Practical: 2 hours/week

Papers =100 marks
TW= 25 Marks
POE=25 Marks

- 1) **INTRODUCTION TO ELECTRICAL DRIVES :**
 Types of the electrical drives, parts of the 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 multiquadrant operation classification of load torques.stead 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 .Multiquadrant 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 multiquadrant operation of D.C. shunt motor an chopper ,chopper control of series motor ,performance and stability of variable speed D.C. drives ,Regenerative braking the D.C. series. motor.
- 5) **INDUCTION MOTOR DRIVES.**
 Braking and speed control method for 3 phase power for stator voltage control. (A.C. regulator)VSI fed indirection motor drive .Power circuit circuit circle loop control block diagram , cycloconverter control of induction motor , power circuit and close loop control loop of CSI and fed induction motor drives ,comparasion of fed induction motor and drive . Analysis of the inverter fed induction using Harmonics equivalent circuit, Harmoinics torque and losses with inverter fed Induction motor drives.
- 6) **SLIP RING INDUCTION MOTOR DRIVE :**
 Chopper controlled resistance in rotor circuit , slip power recovery using cascade converter, in rotor circuit. Kramer speed control static scheribus drive.
- 7) **SUNCHRONOUS MOTOR AND BRUSHLESS D.C. MOTOR DRIVES.**
 vsi fed synschronous motor drives , Varialbe frequency control of multiple synchronous motor drives ,Brush less D.C. Motor drives.
- 8) **Special drives :**
 Stepper motor drives switched reluctance motor drive Torque equation ,converter circuit and motor of operation solar and battery powered drives.

Texts and references :

- 1) Fundamentals of the electrical drives Gopal K Dubey Narosa publication
- 2) Power Electronics converter application By N. Mohan T.M. udeland & W.P.Robbins,jhon Wiley & sons
- 3) Electrical Drives _ Concept and application Vedam Suryavanshi
- 4)Advanced power Electronics & A.C. Drives B.K. Bose
- 5) Analysis of thyristor power conditioned motors S.K.Pillar

B.E. (ELCTRICAL) PART-I
3. FACTS

Lectures: 3 hrs / week
Tutorial: 1 hr / week

TW: 25 Marks
Theory 100 Marks

1) Introduction to FACTS :

Introduction of the facts devices and its importances in transmission Network. Introduction to basic types of facts controller , comparison of HVDC and facts.

2) STATIC SHUNT COMPENSATOR : SVC AND STATCOM objectives of the shunt compensation , method of controller Vav generator , transfer , function dynamics performance of SVC and statcom , VAR reserve control , comparison between STATCOM AND svc STATIC VAR system

3) STATIC SERIES COMPENSATOR : 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 characteristics of series compensator.

4) STATIC VOLTAGE AND PHASE ANGLE REGULATION TCVR and TCPAR : objective of voltage and phase angle regulators approaches to Thyristor - controlled voltage and phase angle regulator ; switching converter based voltage and phase angle regulators.

5) Comined compensator : UPFC and IPFC UPFC - Basic principle and reactive power power control 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 .

Text/ references :-- 1) Understanding FACTS - Concept and Technology of flexible AC Transmission systems. By N.G. Hingorani & L. Gywgyi
Staandered publishers Distributors.

2) Static Reactive power compensation By T.J.E. Miller
Jhon wiley & sons
New york

BE ELECTRICAL PART-I

4. NON- LINEAR AND DIGITAL CONTROL SYSTEM.

Lectures: 4 hrs / week

Tutorial: 1 hr / week

TW: 25 Marks

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.

TEXT BOOKS :--

- 1) Nagrath Gopal Control system Engg Wiley Publication .
- 2) K.Ogata Discrete time control system Second Edition Pearson edition.

Reference Book :---

- 1) Norman nise control system Engg 4 th edition Jhonwiley & sons
- 2) Philips and Harbor feed back system PHI
- 3) D.P. Atherton nonlinear control Engg
- 4) Gelb and Vander velde Multiple input describing function and non linear system design Mc-Graw Hill
- 5) Hsu and Meyer Modern control principles and Application Mc graw Hill.

B.E. PART - I
ELECTIVE - I
 i) E.H.V. A.C.

Lectures: 3 hrs / week
Tutorial: 1 hr / week

TW: 25 Marks
THOERY :100 Marks

1) (A) Introduction : Engineering aspect and growth of EHV_ AC Transmission line trends and preliminaries, power transferability, transist stability, transit stability limit, and surge impedance loading.

(B) 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.

©Voltage gradients of conductor:

Charge potential relations for multiconductor lines , surface voltage gradients on the conductor line , surface volage gradients on conductors,distribution of voltage gradients on subconductors of bundle.

(D) $I^2 R$ and corona loss corona loss formula charge voltage diagram with corona ,attenuation of traveling waves due to corona loss Audorable noise, cprona pulses, Their generation and properties,limit for radio interface fields.

Theory of the Travelling waves and standing :

The waves at the power frequency , differential equations and solutions for generals case , standing waves and natural frequencies open ended line double exponential response , response to sinusoidal

Exitation , line energization with trapped charge voltage, Refection and refraction of traveling waves.

(3) Lighting and lighting protection :

Lighting strokes to lines , their mechanism, General principal of the lighting protections problems lowe footing , resistamce ,lighting arrestor and protection characteristics different arrestors and theis characteristics .

(4) Over voltage in EHV suestem covered By swithing operations:--Over -voltage their types ,recovery voltage and circuits breaks , ferroresonance over voltage and calculations of switching surges single phase equivalent.

(5) Power frequency voltage control and over voltage.

Generalised constants, changing , current ,power circle diagram, and its use , Voltage voltage control shunt and series components, Subsychtonous resonance in series capacitor compensated lines and static reactive compensating systems.

(6) Insulation Co ordinations :--

Insulation level , Voltage withstand levels of protected equipments and insulation condition based on the lighting.

7. Design of EHV - AC lines.

References :--

1. EHV AC transmission Engg. By R.D. Begamudre
2. EHV –AC & HVDC Transmission Engineering &Practic By S.V. Rao
3. EHV -AC & HVDC transmission system engineering Analysis and design By John Wiley & sons.

**BE ELECTRICAL PART –I
ELECTIVE – I
ii) DIGITAL SIGNAL PROCESSING**

Teaching Scheme:
Lecture1 : 3 Periods/week

Examination Scheme;
Theory Paper : 100 Marks

Tutorial: 1 period/week

Term Work : 25 Harks

SECTION - I

1. Digital Signals and Systems : (6 Hrs.)

DSP system concept. Properties of DSP system, Interconnectipn of DSP systems. Case study : Realization of an Analog Second-order Differentiator.

2. Z-Transforms : (6 Hrs.)

Z-Transform and its properties. Inverse Z-Transform, Digital transfer Function - Stability considerations and Frequency Response. Bilinear Z-Transform, Case study : Notch filter Design.

3. The Discrete Fourier Transform and Fast Fourier Transform : (14Hrs.)

DFT, Relation between DFT & Z-transform, Properties of DFT, Circular convolution, windows & DFT.

FFT Algorithms, (DIT, FFT & DIP, FFT) Implementation Aspects. Fast convolution Signal segmentation (overlap save algorithm overlap-add algorithm). Correlation - Circular correlation, DFT property of circular correlation. Spectrum Analysis. Case study : electrocardiogram Data Compression.

SECTION- II

4. Realization of Digital Linear System : (2 Hrs.)

Filter categories, IIR direct form structures, cascade, parallel realization, FIR filter realization.

5. FIR Filter Design : (6 Hrs.)

Characteristics of FIR Filter. Properties of FIR Filter. Digital Network for FIR Filter. Windowing method. Filter design using Kaiser Window.

6. IIR Filter Design : (7Hrs.)

Impulse Invariant Technique, Bilinear transformation. Frequency band transformation, Analog Filter Approximation. (Butterworth, Chebyshev, Elliptic). $(\sin x)/x$ Digital Correction Filter.

Quantization and Rounding Problems - quantization of the signal, effects of Finite Word Length on stability and frequency response, arithmetic errors. Case study : Digital Filters for FSK Modem.

7. Practical Implementation Considerations : (7 Hrs.)

Introduction, implementation using Microprocessors. Case study : Microprocessor-based Digital Filter.

DSP Chips - TMS32026 Digital Signal Processor. Case study : TMS320C26-based Digital Filter. (Block Diagram Approach).
Architecture, Features of Digital Signal Processors of Analog Devices.

References :-

1. Digital Signal Processing : A Student Guide, T. 3. Terrel and Lik-Kwan Shark.
2. Digital Signal Processing - Principles, Algorithms and Applications., John G, Proakis.
3. Discrete Time Signal Processing - A. V. Oppenheim and R. W. Schaffer (PHI)
4. Digital Signal Processing - A System Design Approach., D. 3. Defatta.
5. Introduction to Digital Signal Processing - Johnny R. Johnson.
6. Signals and Systems - D. D. Shah and A. C. Bhargava.

**B.E. ELECTRICAL PART- I
ELECTIVE-I**

iii) Electrical System Modeling

Teaching Scheme:
Lecture 1 : 4 Periods/week
Tutorial: 1 period/week

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

1. Basic concepts of dynamical systems, formation of state space equations.

Concept of dynamic instability '

- a) Voltage instability
- b) Angle instability ..
- c) steady state and dynamic problems in A.C. systems

2. Modeling of power system components

- a) Synchronous machine, .Excitation system, Prime movers Governors
- b) Transmission. lines. Transformers and loads
- c) FACTS devices

3. Analysis of single machine and multi machine system

4. Small signal angle instability

Damping and synchronizing torque analysis, Eigen value analysis, Mitigation using Power System Stabilizers (PSS) and supplementary modulation and control of FACTS devices.

5. Sub synchronous oscillation

Analysis and counter measures • using PSS and FACTS devices.,

6. Transient instability :-

- a) Analysis using digital simulation
- b) Analysis using energy function
- c) Study of various numerical methods
 1. Fixed step methods
 2. variable step methods

7. Analysis of voltage instability and counter measures

References:-

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

B. E. ELECTRICAL PART-I

ELECTIVE - I

iv) NEURAL NETWORK & FUZZY LOGIC

Teaching Scheme:

Lecture: 3 Hours/week

Tutorial: 1 Hour/week

Examination Scheme;

Theory Paper : 100 Marks

Term Work : 25 Marks

1. Introduction to Neural Network: History, Applications, Biological Inspiration.

2. Neuron Model and Network Architecture:- Neuron Model, Transfer function, Network Architecture, Recurrent Networks, Perceptron, Hamming Network, Feedforward layer, Hopfield Network.
3. Perceptron Learning Rules:- Learning Rules, Perceptron Architecture, Perceptron learning rule, constructing learning rules.
4. Signal and Weight Vector Spaces:- Linear vector spaces, inner product, norm, orthogonality, Gram Schmidt orthogonalization, linear transformations for neural networks.
5. Performance Surfaces and Optimum points:- Taylor series, directional derivatives, minima, necessary conditions for optimality, performance optimization, steepest descent, Newton's Method, Conjugate gradient.
6. Widrow- Hoff Learning rule:- Adaline network, mean square error, LMS algorithm.
7. Back propagation:- Multilayer Perceptrons, the Back propagation Algorithm, Variation of backpropagation, Heuristic modifications of back propagation, momentum, Levenberg-Marquardt Algorithm.
8. Stability and Hopfield Network:- Recurrent Networks, Lyapunov stability theorem, Hopfield Model, Lyapunov function, Hopfield Design.
9. Introduction to Fuzzy Logic:- Mathematics of Fuzzy control, Fuzzy set theory, Fuzzy relations, approximate reasoning, fuzzy if then statements, inference rules.
10. Representing a set of rules:- Mamdani versus Gödel, Properties of set of rules, continuity of a set of rules, interaction of a set of rules.
11. FKBC Design parameters:- The structure of FKBC, rule base, data base, inference engine, Choice of Fuzzification and Defuzzification procedures, PID like FKBC, Sugeno FKBC.

Note: - Term work should be based on MATLAB exercises.

TEXT BOOKS:-

1. Neural Network Design by Hagan, Demuth, Beale, First edition, PWS publishing company 1996.
2. An Introduction to Fuzzy Control by Driankov, Hellendoorn, Reinfrank, First edition Narosa publishing 1993



SHIVAJI UNIVERSITY, KOLHAPUR

(Implemented from June, 2005)

B.E. (ELECTRICAL) Part II.

1. Switchgear and Protection

Syllabus

Lectures: 4 hrs / week

Practical: 2 hrs / week

Tutorial: 1 hr / week

TW: 25 Marks

POE: 25 Marks

Circuit Breakers

- 1 – 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.
8 hrs
- 2 - 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 8 hrs
- 3 - Fuse – Rewirable and HRC fuse, fuse characteristics, application and selection of fuse. 2 hrs

Relays

- 4 - 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. 3 hrs
- 5 - Over current Protection – Plug setting, time setting, radial feeder and ring mains protection, earth fault and phase fault, numericals on relay settings, Directional relay, and microprocessor based o/c relay. 4 hrs
- 6 - Differential Relays – circulating current and opposed voltage principles, percentage differential relay, line protection, carrier aided protection scheme. 3 hrs
- 7 - Transformer protection – Problems associated with percentage differential protection, harmonic restraint and harmonic blocking schemes, restricted earth fault protection, Buchholz relay for incipient faults. 3 hrs
- 8 - 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. 3 hrs
- 9 - 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. 5 hrs
- 10 - Over voltage Protection – Causes of over voltages, surge arrestors and absorbers, metal oxide (ZnO) arrestors, insulation co-ordination in a power system. 3 hrs
-

Tutorial:

- 1 Simulation of a simple power system and operation of circuit breakers.
- 2 Calculation of relay settings for radial and ring feeders.

Practicals: Minmum 6 of the following list

- 1) Drawing sheet for 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 – t characteristics of an IDMT over current or E/F relay.
- 5) Experimental study of working of a Directional O/C relay .
- 6) Experimental realization of microprocessor based O/C relay.
- 7) Experimental realization of microprocessor based impedance relay.
- 8) Experimental realization of microprocessor based Directional O/C relay.

References:

- 1) Power System Protection and Switchgear – B.Ram & B.N. Vishwakarma
- 2) Switchgear and Protection - S.S. Rao
- 3) Digital Protection – L.P.Singh
- 4) Switchgear and Protection – M.V. Deshpande

B. E. (ELECTRICAL) PART - II
2. ELECTRICAL MACHINES DESIGN

Teaching Scheme

Lectures - 4 Hrs/Week

Practical - 2 Hrs/Week

Tutorial - 1 Hrs/Week

Examination Scheme

Paper - 100 Marks

T. W. - 25 Marks

P.O. E. - 25 Marks

1. Transformers :

(a) Constructional details : Core and shell types. Distribution and Power transformers, core and core materials, cooling of cores, windings. Terminals and leads, cooling of transformers. Tank, Transformer oil, conservators and breathers.

(b) Design : Output equation, EMF per turn. Ratio of iron loss to copper loss, Relation between core area and weights of iron and copper, optimum designs Core design. Design of windings. Design of insulation, overall dimensions.

(c) Operating Characteristics : Resistance of windings. Leakage reactance, mechanical forces. Calculation of no-load current. Equivalent circuit and performance characteristics. Temperature rise. Design of tank and radiators.

2. Three Phase Induction Motors :

(a) Constructional details : Stator, Stator windings, stator frame. Rotor core. Rotor windings. Slip rings, shaft and bearings.

(b) Design : Output equation. Specific electric and magnetic loadings. Efficiency and power factor, main dimensions, Stator windings. Type of winding and connection Turns per phase, shape of stator slots. Number of stator slots, slot insulation, Design of stator stampings.

Rotor Design : Calculation of air gap length. Design of squirrel cage rotor, Elimination, of harmonic torques. Rotor bar current. Shape and size of rotor slots. Rotor slot insulation. End ring current. Area of end rings, slip. Design of wound rotor. Number of rotor slots. Number of rotor turns. Area of rotor conductors, rotor slot insulation. Rotor windings. Rotor teeth. Rotor core, Design of rotor stampings. Use of standard stampings.

(c) Operating Characteristics : No load current Magnetizing current, loss component short circuit current. Resistances, leakage reactance. Use of circle diagram to obtain performance figures. Calculation of static torque, maximum torque, maximum output, maximum power factor. Dispersion coefficient. Effect of dispersion coefficient on maximum p.f. and overload capacity.

3. Single Phase Induction Motors :

(a) Types and constructional details : Types of single phase induction motor construction, stator, Stator windings. Rotor, Starting switches. Electrolytic capacitor.

(b) Design : Output equations, specific loadings. Main dimensions. Relative size of single phase and three phase motors, design of stator. Design of running

winding, Number of stator slots, size of stator slot, Stator teeth, Stator core, length of mean turn, Airgap length.

Design of rotor. Number of rotor slots. Area of rotor bars. Area of end ring. Rotor resistance. Rotor teeth Rotor core.

(c) Operating characteristics : MMF for air gap. Saturation factor. Iron loss. Friction and windage losses. Parameters, Running winding resistance. Rotor resistance, Leakage reactance calculation. Running performance. Equivalent circuit, Veinott's method, Pullout torque.

(d) Design of Auxiliary winding : Auxiliary winding for capacitor start/run motors, Number of turns. Distribution of turns. Length of mean turn. Starting torque.

4. Design of Synchronous Machines : Review of construction of water wheel and turbo alternators. Different parts and materials used for different parts, choice of electric and magnetic loadings, Output equation Determination of diameter and length. Length of air gap and effect of short circuit ratio on machine performance.

Term Work : The term work consists of the design reports along with the drawing sheets of assembly of machines and the details there of in case of

(i) Transformer, (ii) 1-Phase or 3-phase Induction Motor.

Books Recommended

1. A Course in Electrical Machine Design - by A. K. Sawhney, Dhanpat Rai and Sons, Delhi.
2. Design of Electrical Machines (DC S AC) by V. N. Mittle., Standard Publishers Distributors, Delhi.
3. Performance and design of AC Machines by M. fir. Say.
4. Design and Testing of Electrical Machines (Second Edn.) by, M. V. Deshpande, A. H. Wheeler and Co. Allahabad.
5. Computer Aided Design of Electric Machinery by C. G. Veinott, The MIT Press.

B.E. (ELECTRICAL) Part II

3. Utilization and Energy Conservation Syllabus

Lectures: 4 hrs / week

Practical: 2 hrs / week

Tutorial: 1hr / week

TW: 25 Marks

POE: 25 Marks

Electric Traction

- 3 **Electric traction** – DC, AC and composite traction systems, main line and sub-urban systems, Comparison with Diesel-Electric traction. 2 hrs
- 4 **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 numericals. 6 hrs
- 5 **Traction motors and their Control** – D.C. series, A.C. series and 3 Ph Induction motors for traction, Brief introduction to rheostatic speed control methods, drum controller, Multiple Unit Control, modern methods of speed control using SCR, GTO and IGBT. Use of microprocessors for control of traction motors. 6 hrs
- 6 **Braking of traction motors** – Vacuum brake and Air brake systems, regenerative braking, calculation of energy returned during regenerative braking, 2 hrs
- 7 Trolley wire, catenaries, Feeding and distribution systems, negative booster. 3 hrs

Utilization

- 6 **Electric Drives** – Choice of drive, size and rating of motors for the drive, Classes of insulation, Heating and cooling curves, derivation of heating and cooling time constants, numericals, Load equalization, flywheel calculations, capitalization of losses and selection of most economical motor. 7 hrs
- 7 **Electric Heating and welding** – Classification of electric heating methods, Resistance heating, design of heating element, Arc furnaces, Coreless Induction furnace, Dielectric heating, numericals on dielectric heating. Electric arc welding, Power supply & control of electric welding, Laser beam welding. 6 hrs

Conservation of Electrical Energy

- 8 **Energy Crisis** – Causes and effects of energy crisis, Need for energy conservation, global and Indian scenario. 1 hr
- 9 **Energy Management & Audit:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments. 9 hrs

Practical:

- 1) Visit to a local industry for the study of electrical energy utilization. A comprehensive report to be submitted.
- 2) Prepare the energy audit report for the industry visited.
- 3) Prepare a model of renewable energy source and submit a report on the same.

References:

- 1) Utilization of Electric Power & Electric Traction (VIII edition) – J.B. Gupta

- 2) Art and science of utilization of Electric Energy – H. Partab
- 3) A course in Electrical Power – Soni, Gupta & Bhatnagar
- 4) Bureau of Energy Efficiency, Energy manager training – ebook1, chapter 3

B.E. ELECTRICAL PART- II
ELECTIVE –II
i) H. V. D.C. Engineering

Teaching Scheme

Lectures : 4 Hrs/Week
Tutorial : 1 Hr/Week

Examination Scheme

Paper : 100 Marks.
TW :25 Marks.

1. 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-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:
Misoperation of converters-short circuit on a rectifier – commutation failure, causes and remedies – Protection of HVDC system, d.c. reactors, 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, Definitions used in Harmonic distortion calculations, Harmonic filters : Types, Location criteria for adequacy,
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, Potential Applications of MTDC Systems, Types of MTDC Systems, Control and Protection of MTDC Systems

TERM WORK:

Term work will consist of at least Five assignments related to the problems in HVDC Transmission.

BOOK RECOMMENDED:

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

===000===

**B.E.- (Electrical) Part-II
Elective -II**

ii) Power Systems Harmonics

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

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

Part-I :- Introduction

1. Introduction to Power, quality
2. Power quality characteristic
3. Power quality standards:

Part-II Power quality Issues and their solutions

4. Protection against voltage sags and interruptions
5. Wiring and grounding problems and their solution
6. transient over voltages due to lighting and switching
7. Power system harmonics and filtering
8. Technical impact of problems on various load equipments
9. Utility and end user strategies for improving power quality

Part-III Power quality assessment and Economics

- 10 Power quality measurement tools
- 11 Power quality assessment.
- 12 Power quality Economics
- 13 Future trends

References:

1. Electrical Power Systems quality Roger C. Dugan, McGranaghan, H Wyne, McGraw Hill Professional Publishing 1995
2. Power Systems. Harmonics by j. Arrillaga

**BE ELECTRICAL PART-II
ELECTIVE -II**

iii) Electrical and Electronic Materials

Teaching Scheme

Lectures : 4 Hrs/Week
Tutorial : 1 Hr/Week

Examination Scheme

Paper : 100 Marks.
TW :25 Marks.

1. Introduction to Electrical and Electronic 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 resistivity 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 polarisibility, 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, Dimagnetism, Paramagnetism, ferromagnetic domains, Magnetostriction, factor affecting permeability and hysteresis loss, anti ferromagnetism, ferrimanetism, magnetic resonance

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

K:\eback\newsyllabus\engineering\B.E\B.E. (Electrical)\syllabus be part i & ii electrical engg..doc/ birje

SURESH P. SAWANT

BIRJE SR/ JC