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॥ अंतरी पेटवू ज्ञानज्योत ॥

North Maharashtra University, Jalgaon

Syllabus for Forth Year Engineering Degree Course (B.E.)

ELECTRICAL

w.e.f. July,2001

C:\ENGINEERING\COVERPAGE.doc\PRAMOD CHAVAN

NORTH MAHARASHTRA UNIVERSITY, JALGAON
B.E. (ELECTRICAL ENGINEERING)
(1998 COURSE)

TERM – I

Sr No.	Subject Code	Subject	Teaching Scheme Hours/ Week		Examination Scheme				
					Paper Duration Hours	Maximum Marks			
			Lectures	Practical		Paper	TW	PR	OR
1		Elective – I	4	-	3	100	25	-	-
2		Power Electronics	4	2	3	100	25	25	-
3		Control System I	4	2	3	100	25	-	25
4		Switch Gear &Protection	4	2	3	100	25	25	-
5		Project	-	4	-	-	50	-	-
6		Seminar	-	2	-	-	-	-	50
		Total	16	12	-	400	150	50	75
		Grand Total	28		-	675			

TERM – II

Sr No.	Subject Code	Subject	Teaching Scheme Hours/ Week		Examination Scheme				
					Paper Duration Hours	Maximum Marks			
			Lectures	Practical		Paper	TW	PR	OR
1		Elective – II	4	-	3	100	25	-	-
2		Industrial Electrical Engineering	4	2	3	100	25	25	-
3		Power System Stability	4	2	3	100	25	-	25
4		High Voltage Engg.	4	2	3	100	25	-	25
5		Project	-	4	-	-	50	-	50
6		Industrial visit	-	-	-	-	50	-	-
		Total	16	10	-	400	200	25	100
		Grand Total	26		-	725			

Total Marks of Term I + Term II = 1400 Marks

Elective I a) Power system, operation & control
b) Electromechanical energy conversion, c) Microprocessor based system

Elective II a) Power system design practice.
b) Control system II
c) Electric traction Engg.

ELECTIVE I
Term I,
(a) Power System operation & Control

Teaching Scheme
Lectures : 4 Hrs./Week

Examination Scheme
Paper : 100 Marks
(3 Hrs. duration)
Term work : 25 Marks

UNIT I : ECONOMIC LOAD DESPATCH
Input Output characteristics, Heat-rate characteristics, Incremental fuel rate and cost, Incremental production cost, Methods of obtaining incremental fuel costs, Conditions for incremental loading, optimum scheduling of generation between different units. (Neglecting transmission losses), Transmission loss as a function of plant generation (A simple system connecting two generating plants to load)

(10 Hrs., 20 Marks)

UNIT II : OPTIMUM OPERATION OF POWER SYSTEM
Co-ordination of incremental productions costs and incremental transmission loss for optimum economy, Calculation of loss coefficients (Two plants system), Optimum scheduling of generation between different plants considering transmission loss concept and significance of penalty factor, Relation between penalty factor and cost of received power at load end, Automatic load dispatch, function and applications.

(10 Hrs., 20 Marks)

UNIT III : GENERATOR VOLTAGE CONTROL
Automatic voltage control, generator controllers, Automatic voltage regulator, types of exciters and excitation system exciter modeling, transfer function modeling for control static performance and dynamic response of AVR loops.

(10 Hrs., 20 Marks)

UNIT IV : LOAD FREQUENCY CONTROL
Automatic load frequency control, speed governing system and hydraulic value actuator for individual generator, Turbine modeling, generator and load modeling transformer function representation of power control mechanism of generator.

(10 Hrs., 20 Marks)

UNIT V : ELECTRIC POWER CONTROL
Concept of control area, division of power system into control areas, Load frequency of single areas, two area and multi area (control) power system with and without integral controls. Advantage of pool operation, tie line bias control area exchange.

(10 Hrs., 20 Marks)

References:

1) Electrical Energy system theory : Elgerd
2) Power system analysis : Nagrath & Kothari
3) Elements of Power system analysis : Stevenson
4) Electric Power control : Dr. C.S. Indulkar
5) Economic Control of power system : L.K. Kirchmayer

ELECTIVE I
Term – I
(b) Electromechanical Energy Conversion

Teaching Scheme
Lectures : 4 Hrs./Week

Examination Scheme
Paper : 100 Marks
(3 Hrs. duration)
Term work : 25 Marks

UNIT I : Fundamental Equations :Solutions of Laplace equations, Analytic functions and Cauchy-Riemann equations. Fields of analytic functions. Conformal transformation, Schwartz christoffel transformation, field plotting by numerical method.

(9 Hrs 20 Marks)

UNIT II : Dynamic equations : of electromagnetic and electrostatic system. Energy balance equation. Introduction to state functions for electromechanical conservative and non conservative systems.

(9 Hrs., 20 Marks)

UNIT III : Coupled Coils : Energy storage in coupled stationary coils, energy conversion and force and torque calculations in coupled coils in translatory and rotating motions. Mutual and motional inductances. Generalized relations for a distributed windings.

(9 Hrs. 20 Marks)

UNIT IV : Generalized theory of electrical machines. : Generalized rotating machines. Energy conversion equations, Derivation of d.c. machines characteristics from generalized equations, cross field machines and their characteristics. (9 Hrs. 20 Marks)

UNIT V :Generalized theory of electrical machines II : Generalized equations for two phase and three phase a.c. machines, co-ordinate transformation, derivation of characteristics of two and three phase inductions motors and three phase synchronous machines from generalized equations

(9 Hrs. 20 Marks)

Refernce Books :

1) Rakesh Das and Bega Mudre : Electromechanical energy conversion with dynamics of machines, Wiley Eastern
2) Gauri Shankar : Electromechanical energy conversion.
3) P.S. Bhimbhra : Generalized theory of electrical machines, Khanna Publications.

ELECTIVE I
Term – I
(c) Microprocessor Based System

Teaching Scheme
Lectures : 4 Hrs./Week

Examination Scheme
Paper : 100 Marks
(3 Hrs. duration)
Term work : 25 Marks

UNIT I : 8086 up : Internal architecture : BIU pipelining concept segmentization, EV Flag registers General purpose register Addressing modes : Immediate register Direct, Indirect implied mode instruction set of 8086 Assemble directive introduction to programming 8086.

(10 Hrs., 20 Marks)

UNIT II : Procedure for 8086 : Types of procedure, near type, far type writing and using procedure parameters passing method, Reentrant and Recursive procedure macros. 8086 system configuration : Minimum mode maximum mode system bus timing, Min & max mode.
8086 Interrupts : Interrupt response type –0, type –1, type 2, type –3, type –4 software interrupts 0 to 255 interinterrupts. – 0 to 255 priority of 8086.

(10 Hrs., 20 Marks)

UNIT III : Multiprocessor system : Co processor configuration closely coupled configuration loosly coupled configuration, Numerical data processor : 8087 : Architecture communication between 8086 & 8089.

(10 Hrs., 20 Marks)

UNIT IV : 68000 MP : Internal architecture register, structure, status register : Addressing modes exception type priorities, Exception processing, sequences for different type of exception microcontrollers : mc 805 : feature and architecture with instructions set.

(10 Hrs., 20 Marks)

UNIT V : 8086 based DAS for physical parameters such as pressure temperature etc hardware interfacing software segement wise. Overview of advanced micrprocessors 80186, 80826, 80386.

(10 Hrs., 20 Marks)

Reference Books :

1) Microprocessors and Interfacing programming & h/w 2nd Edition : Douglas V. Hall (MCH)
2) Microcomputers system : 8086/8088 family , Architecture programmily & Design Liu & Gibson (PHI)
3) Introduction to microprocessors : Aditya Mathur (TMH)
4) Intel Manual for Microcontroller (MCS 51 family)
5) Microcontroller 8051 - Ajaia
6) Advanced microprocessors and peripherals A.K. Ray & K.M. Burchandani

The termwork should include a minimum of six experiments covering the above syllabus. The t4ermwork marks will be based on performance in theory and practical having a weightage of 40 %6 and 60 % resp.

TERM – I
POWER ELECTRONICS

Teaching Scheme
Lectures : 4 Hrs./Week
Practical : 2 Hrs./Week

Examination Scheme
Paper : 100 Marks
(3 Hrs. duration)
Termwork : 25
Practical : 25

UNIT I : Power Factor Improvement Techniques : Phase angle control, forced commutation, sequence control & nonideal Dual Converters : Ideal dual converter, Dual converters with and without circulating current. Cycloconverter & frequency multipliers : Principle of cyclooonverters, control circuit and application, frequency multipliers.

(10 Hrs., 20 Marks)

UNIT II : D.C. Choppers : Step-down v& step-up choppers, chopper configuration using ideal switches, single quadrant choppers (type A & B), two quadrant choppers (Type C & D), four quadrant choppers (Type E), multiphase choppers, high voltage choppers. A.C. Choppers :
Single phase a.c choppers with resistance & inductive loads, Three phase a.c. choppers.

(10 Hrs., 20 Marks)

UNIT III : Inverters : Single phase series and parallel thyristor inverter, Current source inverters, voltage fed inverters, Three phase thyristor inverter, Transistored inverters.

(10 Hrs., 20 Marks)

UNIT IV : D.C. Drives : Single phase d.c. drives for separately excited and series excited d.c. motors (Contineous and discontinuous armature current operation). Three phase drives for d.c. motors, full converter & semi converter operation of series connected converters.

(10 Hrs., 20 Marks)

UNIT V : A.C. Drives : Thyristors power circuit for control of stator voltage, phase control of induction motors, Inverter fed induction motors with voltage/frequency contro/ PWM control, Slip-power recovery system.

(10 Hrs., 20 Marks)

Reference books :

1) G. K. Dubey : Power Semiconductor controlled drives, PIII
2) V. Subramaniyam : Thyristor control electric motors.
3) M. Rashid : Power Electronics, PHI
4) Dubey, Doraida & Others : Thyristor Power Controller, New-Age Int.
5) P.C. Sen : D.C. drives, Mc Graw Hill

List of Experiments :

List of Experiments :
Two experiments oneach unit of convertors, inverters, choppers, d.c. drives and a.c. drives. Atleast 8 experiments out of 10 are to be conducted. The termwork marks will be based on the performance inthcory and practicals having a weightage of 40% & 60 % resp.

Term I,
CONTROL SYSTEM I

Teaching Scheme
Lectures : 4 Hrs./Week
Practical : 2 Hrs./Week

Examination Scheme
Paper : 100 Marks
(3 HRs. duration)
Term-work : 25 Marks
Oral : 25 Marks

UNIT I : Introduction to automatic control : Open loop and closed loop system, Servomechanisms, Mathematical modeling of physical system, transfer function - definition assumptions, transfer function of simple electrical & mechanical system, Block diagram – constructions of block diagram from system equations, Block diagram reduction techniques, signal flow graphs & mason's gain formula. Effect of feedback on sensitivity to parameter variation and reduction of the noise.
(10 Hrs., 20 Marks)

UNIT II : Control system components : Electrical/Electromechanical components such as A.C./D.C. servomotors, stepper motors, potentiometer, tachogenerators, their functional analysis and operating characteristics and their applications. Pneumatic controls devices.
(10 Hrs., 20 Marks)

UNIT III : Time response analysis : Time response of first and second order systems to standard inputs. Transient response specifications, types of system, error analysis, error coefficients, steady state errors, dynamic error series. Approximate methods for higher order system proportional, derivative and integral control
(10 Hrs., 20 Marks)

UNIT IV : Stability : Stability of control systems, characteristic equation, impulse response, Routh Hurwitz stability criterion, relative stability. Root locus : construction of root locus, determination of roots from root locus, condition of variable parameter for stability effect of addition of poles and Stability. Stability of control systems, characteristic equation, impulse response, Routh Hurwitz stability criterion, relative stability.
(10 Hrs., 20 Marks)

UNIT V : Frequency response of linear system
Specification of polar plots of various systems, Nyquist criteria /nyquist plots and stability analysis, Bode plots from open loop transfer functions for various systems. Gain margin & phase margin, stability analysis from Bode plots, Estimation of approximate transfer functions from the frequency response.
10 Hrs. (20 Marks)

Reference Books :
1) Nagrath I.J., Gopal M – Control system Engg. - Wiley Eastern
2) Ogate K _ Modern Conrol systems – Prentice Hall of India
3) Kuo B.C. – Linear control system _ Khanna Publications

List of Experiments :
1) Study of potentiometer as on a) Error detector b) Determination of sensitivity c) Determination of input & output characteristics.
2) Study of a) synchro characteristics
b) Electrical zeroing of synchro.
c) Synchronous as error detector
d) Synchros on position control system
3) To determine the transfer functions of Armature and Field controlled DC generator
4) To determine transfer function of D.C. servomotor
5) To study performance characteristic of DC motor angular position control system.

6) To plot the torque speed characteristic of two phse AC servomotor.
7) Frequency response plot of second order system.
8) To determine transfer function of AC servomotor.
9) Operation of stepper motor in single step & multistep
10) Study of P, PI, PID controller.

The term-work should include a minimum of 8 experiments from the above list. The term-work marks will be based on the performance in theory & practical having a weight age of 40 % & 60 % resp.

Term I,
SWITCH GEAR & PROTECTION

Teaching Scheme
Lectures : 4 Hrs./Week
Practical : 2 Hrs./Week

Examination Scheme
Paper : 100 Marks
(3 HRs. duration)
Term-work : 25 Marks
Oral : 25 Marks

UNIT I :
Arc phenomenon, maintenance of arc, priorities of arc interruption theories, transient recovery voltage, transient analysis, RRRV, Interruption of inductive and capacitive currents, CB rating, current chopping, construction & operation of airblast, airbreak & bulk oil circuit breakers.
(10 Hrs., 20 Marks)

UNIT II :
Construction & operation of minimum oil circuit breaker, SF6 & vaccum circuit breakers, Earth leakage & moulded case circuit breakers,. Testing installation & maintenance of CB's Rewirable fuses, HRC fuses characteristics and applications
(10 Hrs., 20 Marks)

UNIT III :
Basic principles of relaying, essential features & characteristics, relaying schemes, terminology, CT's & PT's, Electromagnetic relays constructional features, principle of operation, characteristic and application of attraction type and induction type overcurrent, directional distance and differential relays.
(10 Hrs., 20 Marks)

UNIT IV :
Protection of transmission lines, Relaying practice using over current, earth fault, directional distance and differential relays, parallel feeders and ring mains, carrier current relaying.
(10 Hrs., 20 Marks)

UNIT V :
Protection of electrical equipment and machines, like transformers, motors, generators and buses. Static relaying basic concepts, equipments used protection schemes.
(10 Hrs., 20 Marks)

Reference Books :
1) T.S. Madharao - Power system protection (static relay), Tata McGraw Hill
2) C.R. Mason – The art and science of protective relaying
3) B. Ram & Vishwakarma D.N. – Power system protection & switch gear – TMH
7) Sunil S. Rao – Switchgear & Protection - Khanna Pub.
8) Gensomoviz – High voltage circuit breakers
9) B. Ravidranath & M. Chander Power system protection & switch gear New age International

List of experiements :
1) Study of relaying components and control circuit developments.
2) To plot operating characteristic of Inverse time over current relay
3) To study the through fault stability of differential relay.
4) Study of MHO distance relay to plot
   a. R-X diagram

b. Relay voltage Vs Admittance characteristic

5) Study of combined overcurrent & earth fault protection scheme of alternator.
6) Protection of 3 phase transformer using differential relay (Merz – Price Protection scheme)
7) To plot the characteristic of rewirable fuses and MCB
8) Study of Arc extinction phenomenon.
9) Demonstration of microprocessor based protection of 3 phase IM using MM-30 L & T make Study of different types of fuses.

The term-work should include a minimum of 8 experiments from the above list. The termwork marks will be based on performance in theory & practical having a weight age of 40% and 60% resp.

Seminar

Teaching scheme
Practical : 2 hrs/week

Examination scheme
Oral : 50

Seminar should based on a deep study of any topic related to engineering field, preferably on the topics outside the syllabi of B.E. (Electrical).
Format of the seminar report should be as follows :

a. The report should be neatly written or typed on white paper. The typing shall be with normal spacing and only on one side of the paper (A4 size).
b. The report should be submitted with front and backcover of card paper, neatly cut and bound together.
c. Front cover : This shall have the following details in block capitals in the following sequence.
   i. Title at the top.
   ii. Followed by the name of the candidate with roll no and exam seat no. in the next line.
   iii. Name of the guide with designation below the details of the candidate.
   iv. The name of the institute and year of submission on separate lines at the end.
   v. The format of the text of the seminar report.

   The repost shall be presented in the form of a technical paper. The introduction should be followed by literature survey. The report of analytical or experimental work done, if any should then follow.
   The discussion and conclusion shall form the last part of the text. They should be followed by nomenclature & symbols used and then acknowledgement. The bibliography shall form the last section.
   The total number of typed pages, excluding cover, shall be about 20 to 25 only. All the pages should be numbered. Two copies of the seminar report shall be submitted to the department. The candidate shall present the seminar before the examiners. The total duration of presentation and discussion should be 30 minutes.
   The assessment of the seminar shall be based on
   1) Report submitted 2) Presentation 3) Discussion.

Project Report

Teaching scheme
Practical : 4 Hrs/Week (For term I)
4 Hrs./week (For term II)

Examination scheme
Term work : 50 Marks (Term I)
Term work : 50 Marks (Term II)
Oral : 50 Marks (term I)

Project Work
The student shall take up suitable project, preferable from the field of electrical engg. Suggested by the faculty member or it may be industry sponsored. The scope of the project shall be such as to complete the same within the time schedule. The project may be of the following nature.

1) Manufacturing / Fabrication of a prototype unit including selection, concept, design, material, manufacturing of the component, assembly of components, testing and performance evaluation.
2) Computer aided design and analysis of systems/electrical equipments.
3) Problems related to material handling systems.
4) Energy audit of organization / use of renewable energy sources.

5) Low cost automation, electric/microprocessor control of electrical machines, control systems, power systems etc.
6) Software development for solution of problems in control/power systems.

Submission of project report :
The student shall submit a detailed report based non his/her project work to his/her institutional guide. It shall include relevant circuit diagrams, graphs, photographs, specification sheets etc.
Format for the project report shall be as follows :

1) The report shall be neatly typed on white paper. The typing shall be of normal spacing and only on one side of the "A4" size paper.
2) The report shall be submitted with front and back cover card paper, neatly cut and bound together.
3) Front cover shall have the following details in block capitals in the following sequence.
   a. Title at the top.
   b. Followed by the names of the candidates of the project group and exam seat nos., in the next line.
   c. Name of the guide with his designation below the details of the candidates.
   d. The name of the institute and year of submission on separate lines at the end.
4) Project work approval sheet in the form of a certificate duly signed, shall be included.
5) The format of the text of the project report :

The symphosis shall be followed by literature survey. The report of analytical or experimental work done, if any shall then follow :

The discussion and conclusion shall form the next part of the text. It shall be followed by nomenclature and symbols used and then acknowledgement. The bibliography shall form the last section.

The total number of typed pages, excluding cover, shall be about 50 to 100. All the pages shall be serially numbered.

Number of copies of the project report submitted to the department shall be equal to number of students in a group plus three.

The oral examination will be based on the project report.

INDUSTRIAL VISIT

During seventh and eighth term every student shall visit minimum three industries, factories, construction sites or organizations, pertaining to the electrical engg. by college and accompained by teachers. The report of technical visist shall be submitted by every student in the end of eighth term which shall be evaluated by the concerned teachers through internal viva-voce.

ELECTIVE 2
TERM 2
(a) POWER SYSTEM DESIGN PRACTICE

Teaching scheme
Lectures : 4 Hrs./week

Examination scheme
Paper : 100 Marks
(3 hrs duration)
Term work : 25 marks

UNIT I :
Electrical & mechanical design of transmission lines. Design of EHV transmission lines
(8 Hrs. 20 Marks)

UNIT II :
Design of distribution systems. Improvement and expansion of power systems. Busbar arrangements, isolating switches.
(8 Hrs., 20 Marks)

UNIT III :
Circuit breakers : Operating mechanism, ratings and selection, operation under special conditions, specification and technical details for ordering and tender preparation.
(8 Hrs., 20 Marks)

UNIT IV :
Lighting arrestors : Ratings, characteristics, testing, technical defects, standards followed for details insulation coordination. Power transformers different types, tapping, fittings cooling, drying rating, cost comparison, testing, technical details for ordering and tender preparation.
(8 Hrs., 20 Marks)

UNIT V :
Shunt capacitors : need, construction, location, connections, protection, analysis, special types, testing, technical details. Earthing : Earthing systems, step potential, touch potential and transfer potential.
(8 Hrs., 20 Marks)

References :

1) Pratapsing Satnam & P.V. Gupta - Substation designmd equipment, Dhanpat Rai & Sons.
2) M.V. Deshpande : Electrical power system design.

ELECTIVE II
TERM 2
(b) CONTROL SYSTEM II

Teaching scheme
Lectures : 4 Hrs./week

Examination Scheme
Paper : 100 Marks
(3 Hrs. duration)
Term work : 25 Marks

UNIT I : **State space techniques**
State, state space and state variables. States variable models of SISO/MIMO linear systems, from differential equations, transfer function and block diagrams, state diagram (Signal flow graphs)
Decomposition of transfer functions in phase variable forms, canonical forms, Jordan canonical form, transfer function from the state model, transfer matrix.
Solution of state equations, state transition matrix (STM),various methods to obtain STM, Resolvent matrix time response of SISO systems.
Controlling and absorbability of linear systems. Gilibert's method and kalman test to test the controllability and absorbability of SISO/MIMO systems.
System design using pole placement technique for closed loop system via state variable feedback for SISO controllable system.
(12 Hrs., 20 Marks)

UNIT II : Sample Data control systems : Representations of sampled data (Discrete) systems, review of Z transforms, sample and hold zero order hold. Sampling theorem Z-transform analysis of sampled data control system. (Open loop and closed loop), Z transfer functions of systems. Solution of difference equations by Z transfer methods. Response of discrete systems. Pulse transfer functions of open loop and closed loop system with different sampler locations. Digital controller and its transfer functions. Stability analysis, relation between S and Z domains, stability by Jury's test and bi-linear transformation and root locus method.

(12 Hrs., 20 Marks)

UNIT III : Non linear system analysis I : Behavior of non-linear systems, various general non linear ties and their characteristics.
Describing functions for various typical non linear ties and their characteristics.
Stability analysis by describing function method. Existence and stability of limit cycles.
Limitation of describing function method.

12 Hrs. (20 Marks)

UNIT IV : Non-linear system analysis II : Liberalization in a small region operating point. Singular points and their nature. Phase plane method of analysis of nonlinear systems, construction of phase trajectories by isoclines method. Limit cycle behaviorstability analysis, limitations of phase plane method.

12 Hrs. (20 Marks)]

UNIT V :
Stability analysis by Liapunov method : Concept of stability , asymptotic stability in the large, instability, the sense of a Lipunov, Positive definiteness of a scale function, quadratic forms.
Second method of Lipunov, stability theorems, Lipunov functions stability of linear time invariant systems, Lipunov equations.
Krasowskii's method for time examining the stability of non-linear time invariant systems.

Reference Books :

1) Nagrath & Gopal : Control system engineering - Wiley Eastern
2) Ogata K. : Modern control theory - Prentice Hall of India
3) Naresh Sinha - Control systems - Wiley Eastern
4) Kuo B.C. : Automatic control systems - Prentice Hall of India.

ELECTIVE 2
TERM 2
(c) ELECTRIC TRACTION ENGG.

Teaching scheme
Lectures : 4 Hrs./week

Examination scheme
Paper : 100 Marks
(3 Hrs. duration)
Termwork : 25 marks

UNIT I : Train movement and performance
Sppod time curve, its analysis and construction, schedule speed and factors affecting it, train resistance and its components. Tractive effort calculations, Average acceleration and speed energy output and consumption.

(10 Hrs., 20 Marks)

UNIT II : Power transmission and weight transference : Methods of transmission of power from motor to wheels. Idea about riding quantities of an electric loco motive, grouping of motors and weight transference, adhesive weight factors affecting slip.

(8 Hrs., 20 Marks)

UNIT III : Traction motors : Performance of (i) d.c. motors (ii) a.c. single phase series phase motors at low frequencies and at commercial frequency and (iii) poly phase induction motors, under traction service conditions, specific problems and methods of overcoming them, special features of construction, effect of differences in driving wheel diameters and speed time curves on division of load, traction motor ratings, speed factor, track and overhead equipment.

(10 Hrs., 20 Marks)

UNIT IV : Power supply for traction : Overhead and conductor rail systems, third rail construction, Bonding of conductor and track rails, Overhead construction for trolley, buses and railways, catenary's construction, temperature effects, current collectors, out times of feeding and distributing systems for d.c. low frequency, a.c. and commercial frequency, a.c. traction voltage drop control, Electrolytic and inductive coordination, power loading curves, Positions of substations and load-sharing .

(10 Hrs., 20 Marks)

UNIT V : Braking on electrified railways : Mechanical versus electric braking, rheostatic braking, Regenerative braking, method and energy saved in the process, Magnetic track brakes. Traction Control : Duty cycle, methods of traction motor control, series-parallel an other types of controllers, use of interlocks, run back preventer, Multiple unit control, Master controllers, Reverses, Dead man's handle, use of Metadyna and Magnavolt.

(12 Hrs., 20 Marks)

Refernce Books :

H. Partab : Modern Electric traction, Dhanpat Rai & Sons.

TERM 2

Industrial Electrical Engineering

Teaching scheme
Lectures : 4 Hrs./week
Practical : 2 HRs./week

Examination scheme
Paper : 100 Marks
(3 HRs. duration)
Termwork : 25 Marks
Practical : 25 Marks

UNIT I : Electric Drives : Industrial, group and collective drives, types of motors, their running characteristic, characteristic of load, starting and speed control and reversing of d.c. and 3 phase induction motors, electric breaking, plugging, rheostatic breaking, regenerative breaking.

(10 Hrs., 20 Marks)

UNIT II : Types of duties
Continuous , intermittent and short time, temperature rise and rating calculations for these duties, mechanical feature, features of load diagram construction, load equalization & use of fly wheel and fly wheel calculations.

(10 Hrs., 20 Marks)

UNIT III :
Requirement of an ideal tractions system, system of track electrification and their comparison, speed time curves, energy consumption calculations, calculations of tractive effort.

(10 Hrs., 20 Marks)

UNIT IV : Traction Motors : General features and types characteristics and control of locomotive motor coaches, series parallel control. Electric breaking including regenerative breaking. Overhead equipment collector gear for over head equipment.

(10 Hrs., 20 Marks)

UNIT V : Nature of light : Units, luminous efficiency, glare, production of light - Gas discharge lamps, Fluorescent lamps, filament lamps, polar curves, control of light by reflection, refraction and diffusion, lighting calculations, factory lighting, flood lighting, street lighting.
Methods of electric heating & its advantage, transfer of heat, resistance oven, Induction heating electric welding, Tariffs.

(10 Hrs., 20 Marks)

Reference Books :

1) J.B. Gupta – A course in Electrical power.
2) S.K. Bhattacharya - Electrical Machines (2nd edition) – Tata McGraw Hill
3) V.V.L. Rao – Utilization of electric energy – TMH
4) O.E. Taylor Utilizatoin of electrical energy TMH
5) S.K. Pillai - A course in electrical drives – Wiley Eastern
6) H. Partab – Art & Science of Utilization of electrical energy.

List of experiments :

1) To plot the performance characteristics of single phase induction motor by conducting the lost test on it.
2) Load test on DC series motor.
3) Speed control of DC series motor.
4) Rheostatic breaking of three phase induction motor
5) To plot the performance characteristics of three phase induction motor by conducting load test on it.
6) Rheostatic breaking of DC shunt motor.
7) Speed control of three-phase slip ring inductions motor by rotor resistance method.
8) To plot the load test on DC shunt motors and plots its performance characteristics.
9) Study of illumination system.
10) Study of induction heating & Welding
11) Study of tariff
12) Study of different types of enclosures

The termwork should include a minimum eight experiments from above lists. The termwork marks will be based on performance in theory and practical having weightage of 40 % and 60 % resp.

TERM 2
Power System Stability

Teaching scheme
Lectures : 4 Hrs./week
Practical : 2 HRs./week

Examination scheme
Paper : 100 Marks
(3 HRs. duration)
Termwork : 25 Marks
Oral : 25 Marks

UNIT I : Basic Concept : Meaning of stability, stedy state transient & dynamic stability limits, Park's transformation equations, Analysis of transient and subtransient state operation for salient and non salient pole machines, phasor diagrams, voltage behind the transient and subtransient impendances, time constants. Determination of parameters and time constant.

(10 Hrs., 20 Marks)

UNIT II : Steady State stability : SSSL of short transmission lines, Analytical and graphical methods of solutions, lossy lines effect of inertia conservative criterion, synchronoising coefficient multimachine system.

(10 Hrs., 20 Marks)

UNIT III : More on SSS : Effect of saturation, saturated reactance, equivalent reactance, graphical method to find equivalent effect of short circuit ratio effect of governor action, effect of automatic voltage regulator.

(10 Hrs. 20 Marks)

UNIT IV : Transient state stability : Review of basic concep, TSS and equal area criterian, swing equation, point by point solution, critical cleaning angle and critical clearing time.

(12 Hrs., 20 Marks)

UNIT V : More on TSS :
Effect of types of fault, effect of grounding,effect of high speed recloseing precalculated swing curves and their use, effect of fault clearing time, effect of excitation and governing action, Methods of improving stability, multimachine problem.

(12 Hrs., 20 Marks)

Reference Books :

1) E W Kimbark – Power system stability , Vol I & 3 – John Wiley
2) S B Cray – Power system stability Vol 1 & 2- John Wiley
3) Nagrath & Kothiari - Modern power system analysis – TMH

List of experiments :

1) Parameters & time constants of synchronous machines
2) Synchronous machine on infinite bus
3) Effect of saturation & determination of equivalent reactances of synchronous machines.

4) Retardation test on synchrous machines to find moment of inertia of rotating part and angular momentum.
4) To obtain power angle characteristic of lossy & lossless lines.
5) Nominal exciter response of given DC shunt generator for a separate & self excitation by point method.
6) Nominal exciter response of a given dc generator. for a separate & self excitation by graphical method.
7) Nominal exciter response of a given dc generator on load with self and separate excitation using graphical as well as point by point method.
8) Study of Clerk's diagram
9) Study of different types of automatic voltage regulator.

TERM 2
High voltage engg.

Teaching scheme
Lectures : 4 Hrs./week
Practical : 2 HRs./week

Examination scheme
Paper : 100 Marks
(3 HRs. duration)
Termwork : 25 Marks
Oral : 25 Marks

UNIT I : Breakdown in gases, liquid & solid : classification of isolating material, gases as insulating media, Ionizatin and decay process, breakdown in gases, Townsends law. The streamer mechinism of spark, paschen's law, corona discharge, electronegative gases.

Breakdown in pure and commercial lquids, solid dielectrics and composite dielectrics, high voltage bushings guarding, shielding and field plotting.

(10 HRs., 20 Marks)

UNIT II : Lightning and switching over voltage protection :
Lighning stocks to lines and towers mechanism & characteristics. Protection of transmission lines from lighting, lightning arrestors, insulation co-ordination of HV and EHV power system and substation .

(10 Hrs., 20 Marks)

UNIT III : a) Generation of high voltage & currents : Genarations of high dc, ac and impulse voltages, standard impulse wave shapes, generation of switching surges and high impulse generator

b) HVDC Power transmission : Kinds of dc links, limitations and advantages of ac & dc transmission. Principle applications of dc transmission, ground return advantages & problems.

(10 Hrs., 20 Marks)

UNIT IV : Measurements of high voltages & currents
Methods of measurements of peak voltage, impulse voltage and high direct current, non destructive measurement and testing, high voltage dielectric loss and capacitance measurements, ratio frequency & Partial discharge measurements.

(10 Hrs., 20 Marks)

UNIT V : Basic terminology, testing of insulators, bushings, cables, transformers,surge diverters & isolators. Electric shock & threshold current, capacitance of long objects, Electromagnetic interference, E.H.V. line insulation design based upon transient over Voltages.

REFERANCES Books :

1) M.S.Naidu & V. Kamaraju- High voltage engg. –Tata Mcgraw Hill.
2) E. Kuffel and W.S. Zaengle – High voltage Engg. – PERgamon Press.
3) Rakash Das - Begamudre EHV
4) C.L. Wadhawa – H.V. Engg Wley Eastern
5) K.R. Padiyar ; HVDC Power transmission systems technology & system interaction – New Age International
6) H.V. Engg. - R.S. Jha

List of experiments :

1) Measurement of insulation resistance of 600/250 V P.T. by megger.
2) Power frequency withstand test on 11 KV, 10/5 amp CT.
3) Study of corona discharge.

4) Determination of insulation break-down strength of solid, liquid and gaseous dielectric media.
4) Power frequency high voltage withstand test on cable.
5) Study of impulse generator.
6) Dry & Wet power frequency withstand test on insulator
7) Flash over test on insulator.
8) Double voltage double frequency withstand test on transformer.
9) Study of calibration of sphere gap.
10) Study of 100 KV high voltage testing set.

The term-work should include a minimum eight experiments, from the above list. The termwork marks will be based on performance in theory and practical having weightage of 40 % & 60 % resp.

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