FACULTY OF ENGINEERING

Syllabus for the

T.E. Electrical Engineering

(w.e.f. 2010-2011)

University of Pune

T.E. Electrical Engineering 2008 - Course
(w.e.f. 2010-2011)

SEMESTER_I									
Sr. No.	**Subject Code**	**Subject Title**	**Teaching Scheme**		**Examination Scheme**				**Total Marks**
			L	**P**	**P**	**TW**	**PR**	**OR**	
1.	311121	Engineering Economics & Management	04	-	100	-	-	-	100
2.	303141	Micro-controller Applications	04	02	100	-	-	50	150
3.	303142	Electrical Machines-II	04	02	100	25	50	-	175
4.	303143	Power Electronics	04	02	100	25	50	-	175
5.	303144	Electrical Installation, Maintenance & Testing	04	02	100	50	-	-	150
			20	**08**	**500**	**100**	**150**		**750**

SEMESTER-II									
Sr. No.	**Subject Code**	**Subject Title**	**Teaching Scheme**		**Examination Scheme**				**Total Marks**
			L	**P**	**P**	**TW**	**PR**	**OR**	
1.	303145	Power System-II	04	02	100	25	50	-	175
2.	303146	Energy Audit & Management	04	--	100	--	-	--	100
3.	303147	Utilization of Electrical Energy.	04	---	100	--	--	--	100
4.	303148	Design of Electrical Machines	04	04	100	25	-	50	175
5.	303149	Control System -I	04	02	100	50	---	--	150
6.	303150	Seminar *	-	02	-	50	-	-	50
			20	**10**	**500**	**150**	**100**		**750**

Note : Practical/ Oral is based on Term Work.

*The Term Work marks for Seminar will be Based on the presentation and oral examination. The Examination will be conducted by two internal Examiners (among the approved teachers only) appointed by Principal of concerned college .

311121 : Engineering Economics and Management

Teaching scheme	Exam scheme
Lectures-4 hrs/week	paper-100 marks

UNIT -I

Business organizations -Types of business ownership- proprietary firm, partnership firm, joint stock company, public sector under takings, cooperative society's, private public partnership, BOT, BOLT

Introduction to economics -Basic economics concepts- supply, demand, elasticity of demand, elasticity of supply, law of variable proportion, methods of demand forecasting, Role of government in macro economics [07 Hrs]

UNIT -2

Management- Meaning, scope, function, and importance of management. Difference between administration and management, contribution of F.W.TAYLOR, HENRY FEYOL, ELTON MAYO, meaning of organization, principles, types of organization structure.

Current Trends in management- Just-In-Time (JIT), SIX SIGMA , Kanban, lean manufacturing, TQM, ISO Standards, QS and CMM for software companies,

Production and inventory Management-

Plant layout, product layout types, Types of inventory, ABC Analysis, Purchasing and store keeping Procedures. [07 Hrs]

UNIT -3

Marketing Management – Marketing function, marketing and selling, marketing planning, market survey and market research, Online Marketing.

Financial management- Definition of financial management, cost, types of costs, and methods of costing, price, capital, debit, credit, books of accounts, final accounts, financial ratios, break even analysis, budget and budget re-control, depreciation, merger and acquisition. [07 Hrs]

UNIT -4

Motivation

1.Motivation, human needs ,theories of work motivation, Maslow theory of need hierarchy, X &Y theory, Herzberg theory.

2.Group dynamics- theories of group formation,types and interactions of groups,formation of teams,team work, conflicts

3.Leadership, importance, theories and styles, qualities of good leadership.

4. Entrepreneurship-Definition, concept, traits, qualities of entrepreneur

[07 Hrs]

UNIT -5

Human resource management, introduction, importance, scope, HR planning, recruitment, selection, training and development, performance management.
Industrial Relations and Labour Welfare.
Personality, development of personality, attitude, job satisfaction and organizational commitment, self development, time and stress management.
Process and principles of learning.
Professional and business ethics. [07 Hrs]

UNIT -6

Disaster management – Concept, definition, importance and scope-types of disasters,
Preparedness and mitigation of disasters, Government machinery in India for disaster management, Use of GIS and GPS for disaster management, preparation of disaster management plan for cases like earthquake, floods, fire, tsunami, fatal road accident, terrorist attack
Industrial maintenance and TPM, industrial safety and safety measures. [07 Hrs]

Texts books :

1. O.P. Khanna, industrial engineering and management , Dhanpatrai & Sons, New Delhi
2. E. H. McGrah, S. J. Basic managerial skill for all
3. Disaster Management text and case studies- DBN Murthy, Deep and deep, 2007, XXII, ISBN 81-7629-906-5

Reference Books :

1. C. B. Mamoria- Personnel Management
2. Harold Koonz and O D'onnel – Management
3. Philip Kotler- Marketing Management
4. M.Kay Dupont, Business Etiquette & Professionalism, Vira Book Pvt.Ltd
5. Dandi Daly Mackally, Self Development, Vira Book Pvt.Ltd, Mumbai.
6. Susan L. Brock, Better Business Writing Vira Book Pvt. Ltd Mumbai.
7. Robert Heller, Managing Teams, Dorling Kindersley, London.
8. Robert Heller, Communicate Clearly, Dorling Kindersley, London.
9. dale H. Basterfields, TQM Person Education, Delhi.
10. Kelly John M, Total Quality Management, InfoTech Standard, Delhi.
11. Managerial Economics – K. L. Maheshwari

303141 : Micro controller and its Applications

Teaching Scheme	Examination Scheme
Theory: 4 Hrs/Week	Paper: 100 Marks
Practical: 2 Hrs/Week	Oral: 50 Marks

Unit 1

Introduction to concept of microcontroller, comparison of Microprocessor and microcontroller, Comparison of all 8 bit microcontrollers, Intel 8051 microcontroller architecture, Pin diagram, Memory organization of 8051. Internal structure of I/O ports . (8 Hrs)

Unit 2

Addressing modes of 8051 Instruction set of 8051, Stack and Stack Related instruction Data exchange, byte level logical operations, bit level logical operations, rotate and swap operations, instruction affecting flags, incrementing, decrementing, arithmetic operations, jump and recall instruction,
Call and subroutines, Stack Organization and stack related instruction,
Assembly language programming of 8051. (8 Hrs)

Unit 3

Timer ,Counter and its programming. Interrupts and interrupt programming .
Serial communication and its programming.
Study of SPI,I2C Modbus CAN bus MOST Bus ,FLEX RAY Bus Communication protocols. (8 Hrs)

Unit 4

Microcontroller development systems, study of simulator, emulator, assemblers, programmers, cross assembler for microcontrollers. Interfacing of 8051 with external memory Interfacing of 8051 with 8255 for expanding of I/O, Interfacing of 8051 with PC through RS232. (8 Hrs)

Unit 5

Programming and Interfacing of 8051 with 8 bit ADC(0809) , DAC(0808) , Stepper motor (speed /position) Measurement of physical parameters such as pressure, temperature flow, level, humidity. (8 Hrs)

Unit 6

Interfacing of 8051 with Keyboard and LCD
Interfacing of 8051 with single key and matrix(4 x 4) Keyboard
Measurement of voltage, current, power(KVA,KVAR,KW), frequency using 8051
Speed control of ac and dc motors, using 8051 (8 Hrs)

List of Experiments:

Note : Experiment No. 1 to 6 are compulsory and any 6 out of experiment number 7 to 15. All experiments should be performed on 89C51 Trainer kit.

1. Study and use of 8051 Microcontroller trainer kit.
2. Assembly Language Program for addition of 8 bit numbers stored in array.
3. Assembly Language Program for Multiplication by successive addition of two 8 bit numbers.
4. Assembly Language Program for finding largest number from a given array of 8 bit numbers
5. Assembly Language program to arrange 8 bit numbers stored in array in ascending order.
6. Assembly Language Program of conversion of 8 bit numbers.
7. Stepper motor control by 8051 Microcontroller.
8. Interfacing of 8 bit ADC 0809 with 8051 Microcontroller.
9. Interfacing of 8 bit DAC 0800 with 8051 Microcontroller.
10. Implementation of Serial Communication by using 8051 serial ports.
11. Assembly Language Program for use of Timer/Counter for various applications.
12. Programming 8051 using cross assembler.
13. LCD interface with 8051
14. Interfacing of matrix keyboard 7 segment display with 8051
15. Measurement of frequency /Pulse using 8051

Text Books:

1. K. J. Ayala , The 8051 Microcontrollers- Architecture, Programming and Applications, Peram International Publications
2. Muhammad Ali Mazidi, J.G. Mazidi, The 8051 Microcontroller and Embeded Systems.
3. Ajay Deshmukh Microcontroller 8051 –TATA McGraw Hill
4. Theagrajan, Microprocessor and Microcontroller , BS Publication

Reference Books.

1. 8051 Microcontroller by Scott Mackenzie –Pearson Education.
2. Intel Microcontroller data book.
3. Intel Corporation 1990- 8 bit embedded controller handbook.

303142:Electrical Machines-II

Teaching Scheme
Theory: 4 Hrs/Week
Practical: 2 Hrs/Week

Examination Scheme
Paper: 100 Marks
Practical:50 Marks
Termwork: 25 Marks
Total marks :175

Unit 1 :

Three phase Synchronous machines, Construction, principle of generator action & motor action. Rotating-field type & rotating-armature type construction, salient-pole type & non-salient-pole type construction. Their comparison. Introduction to 3-phase armature windings, e.m.f. equation & winding factors. Generator on no-load. Effect of balanced load : effects of armature currents, resistance drop, armature copper loss, leakage flux & leakage reactance drop & armature reaction m.m.f. Electro-magnetic torque developed. Losses, power – flow chart & efficiency of generator. Ratings brushless synchronous generator.

Definition of voltage regulation at a given load. Definition of short-circuit ratio. Determination of regulation by direct-loading test. Predetermination of regulation of non-salient-pole alternators by e.m.f. i.e. synchronous impedance method, m.m.f. method, Potier method. Power- power angle relation for non-salient pole alternators. Operating chart of alternator. **(8 Hrs)**

Unit 2 :

Blondel's two-reaction theory for salient-pole machines :

Direct-axis & quadrature-axis synchronous reactances, their determination by slip test. Phasor diagram of Salient-pole alternator & calculation of regulation

Parallel operation of 3-phase alternators :

Load sharing between two alternators in parallel. Parallel-Generator theorem Process of synchronizing an alternator with infinite bus-bars by lamp methods & by use of synchroscope. Synchronizing torque, power and current.

Motor action of a synchronous machine; Why a synchronous motor is not self-starting ? Various methods of starting. Phenomenon of hunting or phase – swinging – its remedies. Operation of 3-phase Synchronous motor with constant excitation & variable load. Significance of torque angle, load characteristics Phasor diagram on the basis of synchronous impedance. Power flow chart , losses. Operation of 3-phase synchronous motor with a constant mechanical load on its shaft & variable excitation. 'V' Curves & 'inverted V' (pf) curves. **(8 Hrs)**

Unit 3 :

Introduction to synchronous – induction motor.

Applications of 3-ph synchronous motors & comparison of 3 ph synchronous motor with 3-phase induction motor and 3 phase synchronous induction motor.

Speed control of three phase induction motor by V/f and rotor resistance control methods.

Introduction to testing of three phase induction motor as per IS:325 & IS: 4029,IEC 60034-2001.

Action of 3-phase induction motor as an induction generator, applications as induction generator.
3-phase Induction voltage regulator : construction, principle of working, comparison with autotransformer & tap-changing transformer**.** **(8 Hrs)**

Unit 4 : Operation of d.c. series motor on a.c. supply, nature of torque developed, problems associated with a.c. operation.
Plain Series motor : direct & quadrature axis fluxes. Transformer & rotational emfs in the field winding and the armature winding.
Approximate phasor diagram (ignoring leakage fluxes, magnetising current & currents in the short-circuited armature coils). Circle diagram, performance characteristics from circle diagram. Drawbacks of plain series motor.
Universal motors : ratings, performance & applications, comparison of their performance on a.c. & d.c. supply.
Compensated series motor : Compensating winding, conductively & inductively compensated motor. Use of compoles for improving commutation, connection of compole winding, shunted compoles. Ratings & applications of Compensated Series motors. **(8 Hrs)**

Unit 5 :
Harmonics in induction motors & synchronous generators, concept of time & space harmonics, their generation in machines. Effects of these harmonics on the performance of induction motors and synchronous generators. Remedies to reduce the harmonics.
(4 Hrs)

Special Motors (Descriptive Treatment Only)
Construction, principle of working, characteristics, ratings & applications of Brushless d.c. motors, Stepper motors (only permanent and variable reluctances type), Permanent Magnet motor & linear induction motors. **(4 Hrs)**

Unit 6 : Mmf produced by 1-phase stator winding carrying an alternating current. Its representation by two revolving fields.
Construction of 1-phase induction motor. Equivalent circuit & torque-slip characteristics on the basis of double revolving field theory. Tests to determine the parameters of equivalent circuit & calculation of performance characteristics of motor.
Methods to make 1-phase induction motors self-starting. Types of 1-phase induction motors : Split-phase motors (resistor split-phase motor, Capacitor-start motor, Capacitor motor), Shaded pole motor – their construction, connections, torque-slip characteristics & applications.
Comparison of 1-phase induction motor with 3-phase induction motor.
Introduction to cross-field theory **(8 Hrs)**

Experiments:

Minimum ten experiments are required to be performed. Experiment number **1 to 7 , 14** are compulsory and any two experiments can be conducted from the remaining list of experiments.

1. Determination of regulation of cylindrical rotor alternator by following methods
   a) EMF method b) MMF method
2. Determination of regulation of cylindrical rotor alternator by Potier method. and Regulation of alternator by Direct loading.
3. Determination of regulation of salient pole alternator by slip test.
4. V & $\wedge$ V curves of synchronous motor at constant load.
5. No load & blocked-rotor test on a Capacitor-start 1-phase induction motor & determination of its equivalent circuit parameters.
6. Simulation of performances characteristics of three phase induction motor by any sowftware.
7. synchronization of three phase alternator by Lamp & Synchroscope methods.
8. Determination of current locus of 3 phase synchronous motor at constant excitation but varying load.
9. Load test on 1-phase induction motor.
10. Load test on 1-phase series motor.
11. Performance characteristics of single phase series motor using circle diagram.
12. Performance characteristics of stepper motor
13. Study of BIS for standards of energy efficient three phase induction motor
14. speed control of three phase induction motor by V/F method.

Text Books

1. Nagrath & Kothari , Electrical Machines , 2nd Ed.,Tata McGraw Hill.
2. S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.
3. A.S. Langsdorf, Theory of Alternating Current Machinery , Tata McGraw Hill
4. P. S. Bimbhra, Electric Machinery, Khanna Pub.
5. B.R. Gupta & Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.
6. E.Openshaw Taylor, Performance & design of a.c. commutator motors, Wheeler Publishing.

Reference Books :

1. M.G. Say , Performance & Design of A.C. Machines (3rd Ed.) , ELBS
2. C.G. Veinot, J.E. Martin ,Fractional & sub-fractional kW Motors, McGraw Hill – International student edition
3. Krishna Reddy –electrical machines vol.I,II,III, SCI Tech publication

303143: Power Electronics

Teaching Scheme
Theory: 4 Hrs/Week
Practical: 2 Hrs/Week

Examination Scheme
Paper: 100 Marks
Practical:50 Marks,
Termwork: 25 Marks (175)

Unit 1 Thyristor Power Devices:

SCR: Static and dynamic Characteristics, specifications (Latching current, Holding current, dv/dt, di/dt, I^2t rating), Two-Transistor Analogy, Gate Characteristics, Trigering Circuits (R, R-C, UJT), Protection (over voltage, over current, and Thermal), GTO. (8Hours)

Unit 2 AC to DC Converters (1phase & 3 phase) :

Single phase Converter (mid point, bridge), three phase semi-controlled and fully controlled bridges with R, R-L and RLE loads. Rectification and Inversion mode of operation, Concept of overlap Angle and associated Voltage drop calculation. Dual converter. Selection of transformers and semiconductor devices for Converters. Numerical for R and RL Load only **(8Hours)**

Unit 3 AC Voltage Controllers & Protection of Power Circuits

.(a) DIAC, TRIAC- four mode operation, triggering of TRIAC using DIAC; AC Voltage regulator principle, Single phase & three phase, analysis with R & RL Load, applications of two stage, three stage & multi stage Voltage Controllers.

(b)Protection of Power Circuit: Protection from over voltage, over current, thermal, design of snubber circuit . (8Hours)

Unit 4 Transistor Power Devices:

Characteristics, Specifications, Safe Operating Areas (SOA) Protection and Switching action of Power MOSFET, IGBT, MCT and their control circuit requirement. Comparison and Area of application of these devices**.** **(8Hours)**

Unit 5 DC to DC Converter :

Principle of operation of chopper, classification on the basis of Operating quadrants. Control techniques: CLC,TRC, PWM and FM Techniques. Analysis of Step up Chopper and Numericals with RLE load. Areas of application. Necessity of input filter. Numericals (8Hours)

Unit 6 DC to AC Inverter :

Single phase & three phase inverters, Principle of operation, VSI and CSI inverters, applications, their operating frequency range.

PWM inverters: Single Pulse, Multiple Pulse and Sinusoidal Pulse modulation PWM Techniques for voltage control and harmonic elimination. (8Hours)

List of Experiments

Note: Any 8 experiments, however three (03) simulation experiment should be covered using any professional software

1. V-I characteristics of SCR , DIAC,TRIAC (any2)
2. V-I characteristics of power semiconductor devices: GTO, MOSFET, IGBT (any 2)
3. 1-ph half controlled and full controlled converter. (R & RL Load)
4. 3-ph converter (R, RL,RLE Load)
5. Step down chopper circuit (TRC techniques)
6. 3-ph voltage source transistorized inverter.
7. Firing circuit for 3-ph converter..
8. 1-ph or 3-ph. AC Voltage Regulator.
9. 3-ph AC-DC converter with RLE Load.
10. 1-Ph PWM bridge Inverter.
11. Commutation circuits of SCR.
12. Design of Snubber Circuit

Books for reference:

Text Books :

- M.H.Rashid - Power Electronics 2nd Edition, Pearson publication
- Ned Mohan, T.M. Undeland, W.P. Robbins - Power Electronics,3rd Edition, John Wiley & Sons (International) student edition.
- B.W. Williams: Power Electronics 2nd edition, Macmillan publication
- Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
- Dr. P.S. Bimbhra, Power Electronics, Thrid Edition, Khanna Publication.
- K. Hari Babu, Power Electronics , Scitech Publication.

Reference Books :

- Vedam Subramanyam - Power Electronics , New Age International , New Delhi
- Dubey, Donalda, Joshi,Sinha, Thyristorised Power controllers, Wiely Eastern New Delhi.
- M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill
- Jai P. Agrawal, Power Electronics systems theory and design LPE, Pearson Education. Asia.
- L. Umanand, Power Electronics – Essentials & Applications Wiley Publication.
- Randall Shaffer – Fundamentals of Power Electronics with Matlab.
- J. Michael Jacob – Power Electronics Principal & Applications.

303144 : Electrical Installation, Maintenance and Testing

Teaching Scheme	**Examination Scheme**
Theory: 4 Hrs/Week	Paper: 100 Marks
Drawing: 2 Hrs/Week	TW: 50 Marks

Unit-1 Distribution systems:
Classification of Supply systems. Types of supply systems (State only)
Details of supply systems: 1) 1 Phase 2 wire system
2) 3 Phase 3 wire systems
3) 3 Phase 4 wire systems.
Comparison of these systems, on the basis of volume requirement for conductor, for overhead and underground systems.
AC Distribution system Design: Types of primary distribution systems, types of secondary distribution systems, Voltage drops in ac distributors, Kelvin's law, and limitation of Kelvin's law. General design considerations, load estimation. Design of primary and secondary distribution design, economical design of distributors. (8 Hrs)

Unit 2 Substation and Earthing:
Substation: Classification and types, Layout of substation, Function and technical specifications of each equipment. Voltage levels and clearances.
Earthing : Necessity and types of earthing systems. Substation grounding. Tolerable limits of body currents, Estimation of soil resistance and its management. Tolerable step and touch voltages. Different electrode configurations. Steps in grid design reference to IEEE standard 80-2000. (8 Hrs)

Unit-3 Condition Monitoring and Maintenance:
Importance and necessity of maintenance, different maintenance strategies like breakdown maintenance, planned maintenance and condition based maintenance. Planned and preventive maintenance of transformer, induction motor, generators and powercables. Insulation stressing factors, insulation deterioration, DC test for measurement of insulation resistance, polarization index, dielectric absorption ratio, dielectric discharge ,concept or condition monitoring of electrical equipment (8 Hrs)
Unit-4 Condition Monitoring of transformers:
Testing and condition monitoring of oil as per the IS/IEC standards. Filtration/reconditioning of insulating oil. Failure modes of transformer. Condition monitoring of transformer bushings, insulation, on load tap changer dissolved gas analysis, degree of polymerization, partial discharge measurement. IS/Specifications for testing of transformer bushing and oil. (8 Hrs)

Unit-5 Testing of other electrical equipments:AC testing of insulation, tan delta, partial discharge as per relevant standard. Testing of –

i. Power cables – Causes of cable failure, fault location methods.
ii. Induction motor – Various abnormal conditions, trouble shooting, faults, causes, remedies. Signature analysis, Thermograpy. (8 Hrs)

Unit-6 Basics, Troubleshooting and Maintenance of Household Appliances:
Study of constructions, working, troubleshooting and maintenance of Fan, Mixer, Refrigerator, Water Pump, Washing machines, Electric Oven, Microwave
(Limited to electrical faults) (8 Hrs)

Drawing:

1. Single line diagram of 132 or 220 or 400 KV substation (based on actual field visit) Symbols, Plate or Pipe earthling – Using AutoCAD or other CAD software.
2. Project report on area electrification.
3. Project design and estimation of power circuit of labs/ workshops.

Experiments:

1. Measurement of insulation resistance of motors and cables.
2. Measurement of tan delta and partial discharge of transformer insulation either in the college or by arranging visit to industry/ HV Lab
3. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (Any One).
    I. Three phase induction motor
    II. Transformer.
4. Study of thermography images and analysis based on these images.
5. Assignment – Construction, working and troubleshooting of any one household electrical equipment

Text Books:

1) S. Rao, Testing Commissioning Operation & Maintenance of Electrical Equipment, Khanna publishers.
2) S.L.Uppal - Electrical Power - Khanna Publishers Delhi.
3) Hand book of condition monitoring by B.K.N.Rao, Elsever Advance Tech.,Oxford(UK).
4) S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House
5) B. V. S. Rao – Operation & Maintenance of Electrical Equipment – Asia Publication

References :

IS/IEEE Standards.

1. IS : 1180 – Distribution Transformer
2. IS : 2026 – Power Transformer
3. IS : 4029 – Testing of 3 Phase Induction Motor.
4. IS : 996 – 1 Phase AC and Universal Motor.
5. IS : 694:1986 – PVC insulated cables for working voltages upto and including 1100 V
6. IS : 900:1992 – Code of practice for installation and maintenance of Induction Motors
7. IEEE 80:2000 – IEEE Guide for Safety in AC Substation Grounding.

Books

1. B. R.Gupta- power system analysis and design, 3th edition wheelers publication.
2. P.S Pabla –electric power distribution, 5th edition, tata McGraw Hill.

303145: Power System II

Teaching Scheme	Examination Scheme
Theory: 4 Hrs/Week	**Paper: 100 Marks**
Practical: 2 Hrs/Week	**Practical: 50 Marks**

Prerequisite:

1. constants of transmission line ,circuit representation and generalized constants of short, medium and long transmission lines.

2.Calculation of inductance and capacitance for symmetrical and unsymmetrical configuration of transmission lines

Objective: To develop analytical ability for Power system subject with prerequisite of power system I

Unit 1: Performance of Transmission Line 8

Concept of complex power, power flow using generalized constants, receiving end power circle diagram for transmission line(assuming ABCD constants are already given), surge impedance loading, line efficiency, regulation and compensation, basic concepts.
Numerical based on: Power flow, circle diagram.

Unit 2: EHV-AC transmission: 7

Role of EHV-AC transmission, standard transmission voltages, average values of line parameters, power handling capacity and line losses, phenomenon of corona, disruptive critical voltages, visual critical voltages, corona loss, factors and conditions affecting corona loss, radio and television interference, reduction of interference,
Numerical Based on power handling capacity, Corona and Corona loss

Unit 3: (a) Per unit system: 9

Impedance & reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application of per unit system.
Numerical based on network reduction by using per unit system.

(b) Symmetrical Fault Analysis

Sudden 3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems, selection of circuit-breakers and current limiting reactors and their location in power system (Descriptive treatment only)
Numerical Based on symmetrical fault analysis

Unit 4: Unsymmetrical Fault Analysis: 9

Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedances and sequence networks, solution of unbalances by symmetrical components, L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance.
Numerical based on symmetrical component and unsymmetrical fault calculation.

Unit 5: Load Flow Analysis: 8

Network topology, driving point and transfer admittance, concept of Z-bus and Y-bus matrices, Introduction to load flow analysis, power- flow equations, generalization to n-bus systems, classification of buses, Newton- Raphson(using polar method) , Gauss-Seidal methods, (Descriptive treatment only)

Unit 06 HVDC Transmission (Descriptive treatment only) 7

Classification and components of HVDC systems, advantages and limitations of HVDC transmission , comparison with HVAC systems, introduction to HVDC control methods - constant current, constant ignition angle and constant extinction angle control , recent developments.

LIST OF EXPERIMENTS

NOTE: Five experiment are compulsory out of first six experiments and any three from remaining using professional software

1. Measurement of ABCD parameters of a medium transmission line
2. Measurement of ABCD parameters of a long transmission line
3. Plotting of receiving end circle diagram to evaluate performance of medium transmission line
4. Study of the effect of VAR compensation on the profile of receiving end voltage using capacitor bank.
5. Static measurement of sub-transient reactances of a salient-pole alternator.
6. Measurement of sequence reactances of a synchronous machine.
7. Formulation and calculation of Y- bus matrix of a system using a software.
8. Solution of a load flow problem using Gauss-Seidal method using a software.
9. Solution of a load flow problem using Newton-Raphson method using a software.
10. Unsymmetrical fault analysis of a 3-bus system a software
11. Calculation of inductance and capacitance for symmetrical and unsymmetrical configuration of transmission line using a software.

Visit : Compulsory visit to EHV-AC substation/ HVDC substation

TEXT BOOKS :

1. I.J. Nagrath & D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi.
2. B R Gupta , “Power System Analysis and Design”, S.Chand
3. Abhijit Chakraborty and Sunita Haldar, “Power System Analysis”
4. J.B.Gupta.”A course in power systems”.
5. P.S.R. Murthy, “Power System Analysis”, B.S. Publications.
6. Hemalatha and Jayachrista, “Power System Analysis”, Scitech Publication.

REFERENCE BOOKS :

1. H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi.
2. Stagg & Abid – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi.
3. M.E.El-Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York.
4. Rakash Das Begamudre, “Extra High voltage A.C. transmission engineering”, New age publication.
5. M.A.Pai, “Computer Techniques in Power System Analysis”, Tata McGraw Hill Publication
6. Stevenson W.D. – Elements of Power System Analysis (4th Ed.) - Tata McGraw Hill, New Delhi.
7. K.R.Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi.
8. Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi.

303146: Energy Audit and Management

Teaching Scheme
Theory: 4 Hrs/Week

Examination Scheme
Paper: 100 Marks

Unit 1

Global & Indian Energy Scenario:-

Commercial & non-commercial energy, primary & secondary sources, commercial energy production, final energy consumption, Energy needs of growing economy, short terms and long terms policies, energy sector reforms, Distribution reforms and Upgaradation management, energy security, importance of energy conservation, energy and environmental impacts, emission check standard, salient features of EC Bill 2001 & Electricity act 2003. Indian & Global energy scenario. Introduction to IE Rules.Study of Energy Conservation Building Code (ECBC),Concept of Green Building. (7 Hrs)

Unit 2

Demand Side Management:-

Scope of demand management, Advantages and Barriers, areas of developement of demand side management viz, agricultural,domestic, commercial,duties of energy manager and energy auditor , general structure of energy management/manager. (7 Hrs)

Unit 3

Energy Audit:-

Definition, need of energy audit, types of audit, procedures to follow, data and information analysis, energy consumption – production relationship, pie chart, sankey diagram, cusum technique, least square methods,numericals based on it, finding of audit, action plans, bench marking energy performance, energy audit instruments, report writing. (7 Hrs)

Unit 4

Financial analysis and Energy conservation:-

Costing techniques:- cost factors, budgeting, standard costing, sources of capital, cash flow diagrams and activity chart.

Financial appraisals:- criteria, simple payback period, return on investment, net present value method, time value of money, break even analysis, sensitivity analysis, cost optimization, cost of energy, cost of generation, PF tariff, TOD tariff, apparent energy tariff, ABT tariff. (7 Hrs)

Unit 5

Energy Conservation in: -

Motive power.

a) Illumination
b) Heating and HVAC system
c) Cogeneration and waste heat recovery systems.
d) Pumping System

Few numericals based on them (7 Hrs)

Unit 6

Energy Audit Case Studies: -

1) Steel industries/heavy manufacturing industries
2) Paper & pulp industry
3) Sugar industries
4) Petroleum / chemical industries
5) Commercial organization / Municipal corporation
6) Textile industry
7) Thermal power stations
8) T & D Sector
9) Agricultural sector
10) IT Industry
11) Educational institutions (7 Hrs)

Books: -

1) Utilization of electrical energy by S. C. Tripathi.
2) Generation of electrical energy by B. R. Gupta
3) Energy management by Murphy
4) Energy Management W R Murthy & Mckay, BS Publication

Website:-

1. www.energymanagertraining.com
2. www.em-ea.org

303147: Utilization of Electrical Energy

Teaching Scheme **Examination Scheme**
Theory: 4 Hrs/Week **Paper: 100 Marks**

Section - I

Unit 1: -Electric Heating

IntroductionAdvantages of electrical heating

Heating methods: - Resistance heating – Direct resistance heating, indirect resistance heating, electric ovens, different types of heating materials, temperature control of resistance furnaces, design of heating element, domestic water heaters and other heating appliances.Induction heating – Principle, core type and coreless induction furnaces.

Electric arc heating – Direct and indirect arc heating, arc furnaces. Dielectric heating – Principle and applications in various industrial fields. **(5 Hours)**

Electric Welding

Welding methods–Electric arc wielding and resistance wielding. Modern wielding techniques like ultrasonic wielding and laser welding **(3 Hours)**

Unit 2: -Electrochemical Process

Need of electro-deposition.Applications of Faraday's laws in electro-deposition. Factors governing electro-deposition. Objectives of electroplating. Equipments and accessories for electroplating plant, Electroplating on non-conducting materials, Principle of anodizing and its applications. **(2 Hours)**

Control devices-construction and working of push button, limit switches, float switches pressure switches, contactors, thermostats, timers, relays

Application of above devices in 1) Automatic water level controller 2) reverse forward operation of 3 –ph induction motor 3) Temperature controller in electric furnace 4) Air compressor circuit. **(3 Hours)**

Electrical Circuits Used in Refrigeration, Air Conditioning and Water Coolers

Brief description of vapour compression refrigeration cycle.Description of electrical circuits used in –Refrigerator, Air Conditioner,Water Cooler **(3 Hours)**

Unit 3: -Illumination

Definitions of flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination. Calculation of number of light points for interior illuminations; Calculation of illumination at different points, considerations involved in simple design problems and illumination schemes, indoor and outdoor illumination level.different sources of light: differences in incandescent and discharge lamps – their construction and characteristics; fittings required for filament lamp, mercury lamp, fluorescent lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, electroluminescent lamp-LEDs, types, LASERs .Comparison of all above luminaries.

Main requirements of proper lighting, absence of glare contrast and shadow. Principles of street lighting. **(8 Hours)**

Unit 4: -Electric Traction

Advantages of electric traction. Traction systems – i) Steam engine drive, ii) electric drive, iii) diesel electric drive.Introduction to metro system,mono rail system.

Systems of track electrification: D.C. system, single phase low frequency A.C. system, 3 phase low frequency A.C. systems, composite systems – kando systems, single phase A.C. to D.C. systemDifferent accessories for track electrification such as overhead wires, conductor rail system, current collector-pentagraph .Electrical block diagram of an electric locomotive with description of various equipments and accessories. **(8 Hours**)

Unit:-5 Traction Mechanics

Speed time curves, trapezoidal and quadrilateral speed-time curves, average and schedule speed.Tractive efforts.Specific energy consumption.Mechanics of train movement, coefficient of adhesion. **(8 Hours)**

Unit 6: -Traction Motors, Control of Traction Motors, Train Lighting

Desirable characteristic of traction motors. Suitability of D.C. series motor, A.C. series motor,3 phase induction motor and linear induction motor for traction.Control of traction motors, Series-parallel control, Shunt and bridge transition.Electrical breaking, Regenerative breaking in traction, Suitability of different motors for braking. Train lighting system and Rosenberg generator.

Railway signalling:- history, necessity, block system route relay interlock and necessity. Electromechanical system for route relay interlock.Introduction to train tracking system, types. Anti-collision system-brief treatment only **(8 Hours)**

Reference Books:-

1.‘Art and science of Utilization of Electrical Energy’ by H. Partab, Dhanpat Rai & Co.(P) Ltd - Delhi

2.‘Utilization of Electric Power and Electric Traction’ by J.B. Gupta, S.K. Kataria & sons, Delhi.

3.‘Generation, Distribution and Utilization of Electrical Energy’ by C. L. Wadhwa, Eastern Wiley Ltd.

4.‘A text book on Power System Engineering’ by A. Chakraborti, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, Dhanpat Rai & Co.(P) Ltd – Delhi

5.‘Utilization of Electrical Energy’ by E. O. Taylor – Revised in S.I. Units by V.V.L. Rao, Orient Longman.

6.Modern Electric Traction by H. Partb, Dhanpat Rai & Co. (P) Ltd - Delhi

7.“Lamps and lighting” by M. A. Cayless and A. M. Marsden

8.“BIS, IEC standards for Lamps, Lighting Fixtures and Lighting” By Manak Bhavan, New Delhi

9.“Illumination Engineering from Edison’s Lamp to the Laser” Joseph B. Murdoch

10. “Practical railway engineering” By Clifford F.Bonntt (Imperial college press).

11.“Two centuries of Railway signalling” by Geoffrey, Kichenside and Alan Willims (Oxford publishing CO-op).

12. Modern traction system by H.Pratab

303148: Design of Electrical Machines

Teaching Scheme	Examination Scheme
Theory: 4 Hrs/Week	**Paper: 100 Marks**
Drawing: 4 Hrs/Week	**Oral: 50 Marks,**
	TW: 50 Marks

Unit 1: Principles of Electrical Machine Design

Fundamentals of magnetic circuit, magnetization curve, Magnetic leakage. Determination of iron losses, pulsation loss ,Magnetic leakage calculations ,effects of leakage flux, leakage reactances slot leakage, tooth top leakage, zig-zag leakage ,overhang leakage, leakage reactance calculation for polyphase machines, leakage reactance with fractional pitch winding field form- Carter's fringe curve and air-gap flux distribution (curve) factor. **[7 Hrs]**

Unit 2: Transformer Design (Part-I):-

Modes of heat generation, various methods of cooling, temperature-rise, heating / cooling cycles, heating time constant, cooling time constant, maximum temperature rise and their estimation.Types, constructional features, Specifications as per IS 2026, Output equation, design of main dimensions, core, yoke, windings (including selection). **[8 Hrs]**

Unit 3: Transformer Design (Part-II) :-

Evaluation of resistance, leakage reactance of windings, no-load current, estimation of losses, efficiency and regulation.Cooling of transformers, design of tanks, temperature rise estimation, and calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. **[8 Hrs]**

Unit 4: Design of 3-phase Induction Motor (Part-I):-

Constructional features, types of ac windings, output equation, specific electrical and magnetic loadings, ranges of specific loadings, turns per phase, number of stator slots, calculations for main dimensions and stator design parameters. **[7 Hrs]**

Unit 5:Design of 3-phase Induction Motor (Part-II):-

Selection of length of air gap, factors affecting length of air gap, design of rotor, unbalanced magnetic pull and its estimation, harmonic field effect on the performance of 3-phase induction motor, suitable combinations of stator & rotor slots, design of squirrel-cage and wound rotor. **[8 Hrs]**

Unit 6 :Design of 3-phase Induction Motor (Part-III):-

Calculation of magnetic circuit, mmf calculations for air gap, stator teeth, stator core, rotor teeth and rotor core, effect of saturation, effects of ducts on calculations of magnetizing current, calculations of no-load current, leakage fluxes and leakage reactance's, performance calculations from circle diagram, calculations of losses, efficiency and temperature rise. [**8 Hrs]**

Term work:

The term work shall consist of three drawing sheets (Minimum one sheet to drawn in AutoCAD.)

1. Details and assembly of 3- phase transformer with design report.
2. Details and layout of AC winding with design report.
3. Assembly of 3- phase induction motor.(only sheet)
4. Report based on Industrial visit to a manufacturing unit.(Transformer or Induction motor)

Text Books :

1. A.K.Sawhney – A Course in Electrical Machine Design' 10th Edition, - Dhanpat Rai and sons New Delhi.
2. M.G. Say – Theory & Performance & Design of A.C. Machines, 3rd Edition, ELBS London

Reference Books

1. K.L. Narang , A Text Book of Electrical Engineering Drawings, Reprint Edition : 1993 / 94 – Satya Prakashan, New Delhi.
2. A Shanmugasundaram, G. Gangadharan, R. Palani, - Electrical Machine Design Data Book, 3rd Edition, 3rd Reprint 1988 - Wiely Eastern Ltd., - New Delhi
3. Vishnu Murti, " Computer Aided Design for Electrical Machines", B.S. Publications.

303149: Control Systems I

Teaching Scheme
Theory: 4 Hrs/Week
Practical: 2 Hrs/Week

Examination Scheme
Paper: 100 Marks
Term Work: 50 Marks

Unit-1 Introduction:
Basic Concepts of Control System, Open loop and Closed loop systems, Classifications, effect of feedbacks on Control System performance.
Transfer function modeling and representation of Control system, pole & zero concept, Linear mathematical physical systems "Mechanical System" (Translational and Rotational), Electrical analogy, Block reduction techniques, Signal flow graph, Mason's gain formula. (8 hours)

Unit-2 Time Domain Analysis:
Type and Order of Control system, Typical tests signal " Step, Ramp, parabolic and Impulse signals", Time Response of first and second order systems to unit step input. Steady state errors "Static error coefficients", series and dynamic error coefficients, Generalized Error Series method. Time Domain Specifications of Second Order System, Dominant Closed loop Poles of Higher Order Systems. (8 hours)

Unit-3 Stability
Concept of Stability: absolute, relative and marginal, nature of system response for the various location of roots in S-plane of characteristic equation, stability analysis using Hurwitz's criterion, Routh's criterion.Basic properties of Root Loci, construction of Root loci. Angle and magnitude condition for stable systems, concept of inverse root locus and root contour. (8 hours)

Unit-4 Frequency Domain Analysis

Steady state response of a system due to sinusoidal input; Relation between time & frequency response for second order systems. Frequency response specifications. Stability Analysis with bode plots, polar plots, conformal mapping, principal of argument, Nyquist stability criterion. (8 hours)

Unit-5 State Variable Analysis of Linear System
Introduction to state space analysis, advantages, important definitions- state, state variables, State vector, state space, state equation, output equation etc. State space representation for i) Electrical Network ii) nth order differential equation iii) Transfer function. State model from transfer function using: Direct, parallel,cascade ,decomposition method. TF of system using state model. (8 hours)

Unit-6
Control system components and controllers (only theoretical treatments)
Modeling and transfer function of control system components- Potentiometer, synchros, DC and AC Servomotors, gear trains, tacho-generators ac and dc .
Design concepts of a) -P, PI, PD, PID controllers b) Compensator Networks-lag and lead

(8 hours)

LIST OF EXPERIMENTS:
Minimum eight experiments should be conducted.
Note: Any professional software can be used.

1. Study of potentiometers- Modeling, transfer function and characteristics
2. Study of A.C. Servo Motor/DC. Servo Motor- modeling, Transfer function and characteristics
3. Study of Syncros: Modeling, transfer function, and characteristics
4. Study of time response characteristics of second order control system using Software
5. To design PI / PID controllers for conceptual systems and simulate the closed loop system using Software
6. To obtain the model of the Inverted pendulum and study the closed loop performance using experiments on Bytronic® Inverted Pendulum/ using Software

7. Stability analysis using a) Bode plot b) Root locus c) Nyquist plot using Software

8. To design a Lead compensator and to obtain the characteristics by simulation using Software. Verify the performance using experiments with the compensator circuit made of passive elements.

9..To design a Lag compensator and to obtain the characteristics by simulation using Software. Verify the performance using experiments with the compensator circuit made of passive elements.

10.To conduct experiments on the Level Process Control Station and to study the working of a level control loop.

TEXT BOOKS :

a. Nagrath & Gopal, "Control system engineering", New Age International Publishers, 3rd Edition, 2001.
b. N.C. Jayan, "Control Systems", 2nd Edition, B.S. Publications.
c. Ananda Natrajan, "Control System Engineering", 2nd Edition, Scitech Publication (i

REFERENCES:

1. K. Oggata, "Modern control system engineering", Pearson Education Asia, 4th Edition, 2002.
2. B. C. Kuo, "Automatic control system", Prentice Hall of India, 7th Edition, 1995.
3. Richard C Dorf & Robert H Bishop, "Modern control system", Pearson Education Asia. 8th Edition, 2004.
4. Nise N. S. John willey & sons, "Control System Engineering", 4th Edition, 2004

303150 : Seminar

Teaching Scheme:
Practicals : 2Hrs/Week

Examination Scheme :
Term Work : 50

Seminar should be based on a detailed study of any topic related to Electrical Engineering preferably the advance areas/application and the topic should preferably on the topic outside the syllabus of Electrical Engineering.

Format of the Seminar report should be as follows:

1. The report should be neatly written or typed on white paper. The typing shall be with normal spacing and on one side of the paper.(A-4 size).
2. The report should be submitted with front and back cover of card paper neatly cut and bound together with the text.
3. Front cover: This shall have the following details with Block Capitals
    a. Title of the topic.
    b. The name of the candidate with roll no. and Exam. Seat No. at the middle.
    c. Name of the guide with designation below the candidate's details.
    d. The name of the institute and year of submission on separate lines at the bottom.
4. Seminar approval sheet.
5. The format of the text of the seminar reports:

    The report shall be presented in the form of 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 conclusions shall form the last part of the text. They should be followed by nomenclature and symbols used and then acknowledgement. The reference shall form the last section.

    The total number of typed pages, excluding cover shall from 20 to 25 only. All the pages should be numbered.

    Two copies of the seminar report shall be submitted to the college. The candidate shall present the seminar before the examiners. The total duration of presentation and after-discussion should be about 30 minutes.

    The assessment for the subject shall be based on 1
    1. Report submitted.
    2. Presentation,
    3. Discussion.