

Fifth Semester
AC MACHINES (DEE-501)
Discipline core (DC): Credit 4(3-0-2)

Objective:

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications

COURSE OUTLINE:

1. Synchronous Machines
 - 1.1 Main constructional features of synchronous machine including commutator and brushless excitation system
 - 1.2 Generation of three phase emf
 - 1.3 Production of rotating magnetic field in a three phase winding
 - 1.4 Concept of distribution factor and coil span factor and emf equation Armature reaction at unity, lag and lead power factor
 - 1.5 Operation of single synchronous machine independently supplying a load - Voltage regulation by synchronous impedance method
 - 1.6 Need and necessary conditions of parallel operation of alternators Synchronizing an alternator (Synchroscope method) with the bus bars
 - 1.7 Operation of synchronous machine as a motor –its starting methods
 - 1.8 Effect of change in excitation of a synchronous motor
 - 1.9 Concept and Cause of hunting and its prevention
 - 1.10 Rating and cooling of synchronous machines
 - 1.11 Applications of synchronous machines (as an alternator, as a synchronous condenser)
2. Induction Motors
 - 2.1 Salient constructional features of squirrel cage and slip ring 3-phase induction motors
 - 2.2 Principle of operation, slip and its significance
 - 2.3 Locking of rotor and stator fields
 - 2.4 Rotor resistance, inductance, emf and current
 - 2.5 Relationship between copper loss and the motor slip
 - 2.6 Power flow diagram of an induction motor 2.7 Factors determining the torque
3. Fractional Kilo Watt (FKW) Motors
 - 3.1 Single phase induction motors; Construction characteristics and applications
 - 3.2 Nature of field produced in single phase induction motor
 - 3.3 Split phase induction motor
 - 3.3.1 Capacitors start and run motor

- 3.3.2 Shaded pole motor
- 3.3.3 Reluctance start motor
- 3.4 Alternating current series motor and universal motors
- 3.5 Single phase synchronous motor
 - 3.5.1 Reluctance motor
 - 3.5.2 Hysteresis motor
- 3.6 Comparison of 3 phase and Single phase Induction motor
- 3.7 Application of 3 phase and Single phase Induction motor

4. Special Purpose Machines

Construction and working principle, characteristics and applications of linear induction motor, stepper motor, Servomotor, Submersible Motor, Introduction to Energy efficient Motors.

LIST OF PRACTICALS

1. Demonstration of revolving field set up by a 3-phase wound stator
2. To plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed
3. Determination of the relationship between the voltage and load current of an alternator, keeping excitation and speed constant
4. Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
5. Synchronization of polyphase alternators and load sharing
6. Determination of the effect of variation of excitation on performance of a synchronous motor
7. Study of ISI/BIS code for 3-phase induction motors
8. Perform at least two tests on a 3-phase induction motor as per BIS code
9. Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer BIS code)
10. Determination of effect of rotor resistance on torque speed curve of an induction motor
11. To study the effect of a capacitor on the starting and running of a single-phase induction motor by changing value of capacitor and also to reverse the direction of rotation of a single phase induction motor
12. Slip and slip measurement of three phase induction motor

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, New Delhi
2. Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar

SUBSTATION, SWITCHGEAR AND PROTECTION (DEE-502)

Discipline core (DC): Credit 4(3-0-2)

Objective: In view of the complexities associated with the modern interconnected power stations, the responsibilities and the job requirements of a diploma pass out have become more complex than what they used to be earlier. He is required to work with modern electrical equipment and maintain reliability of supply. The course is designed to understand the concepts, principles involved in the construction and working of generating stations and protective switch gear system so that one can handle, install, maintain them and also take decisions at his/her level in different situations.

COURSE OUTLINE:

1. Substations

1.1 Brief idea about substations - outdoor grid sub-station 400, 220, 132 KV, and 66 and 33 KV; 11 KV, outdoor pole and plinth mounted substations

1.2 Layout of 33/11 KV and 11KV/400V distribution substation and various auxiliaries and equipment associated with these

2. Faults

Common type of faults in both overhead and underground systems, symmetrical/ unsymmetrical faults. Single line to ground fault, double line to ground fault, 3-phase to ground fault and open circuit. Simple problems relating to fault finding.

3. Switch Gears

3.1 Purpose of protective gear. Difference between switch, isolator and circuit breakers. Function of isolator and circuit breaker. Making capacity and breaking capacity of circuit breaker (only definition)

3.2 Circuit breakers. Types of circuit breakers, construction and working of bulk and minimum oil circuit breakers, air blast circuit breakers, vacuum circuit breaker, SF6 circuit breaker and circuit breaker rating

3.3 Principles of Arc extinction blast circuit breakers in OCB and ACB. Constructional features of OCB, ACB, and their working, Method of arc extinction

3.4 Portable circuit breakers - MCB, MCCB, ELCB, for distribution and transmission system description only

5. Protection Scheme

5.1 Relays for generator protection

5.2 Relays for transformer, protection including Buchholtz relay protection

5.3 Protection of feeders and bus bars, over current and earth fault protection.

5.4 Distance protection for transmission system

5.5 Relays for motor protection

6. Over-voltage Protection

6.1 Protection of system against over voltages, causes of over voltages, utility of ground wire, surge absorber

6.2 Lightning arrestors, rod gap, horn gap, metal oxide type.

6.3 Transmission Line and substation protection against over-voltages and lightning

6.4 Transient over voltage protection

LIST OF PRACTICALS

Visit to power station/substation for the conduct of following practical work:

1. Testing of the dielectric strength of transformer oil and air
2. Study of different types of circuit breakers and isolators
3. Plot the time current characteristics of over current relay
4. Perform the overload and short circuit test of MCB as per IS specifications
5. Plot the time-current characteristics of Kit-Kat fuse wire
6. Taking reading of current on any LT line with clip on meter

RECOMMENDED BOOKS

1. Testing, Commissioning, Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi
2. Electrical Power – II by SK Sahdev, Uneek Publications, Jalandhar (Pb)

INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENTS (DEE-503) **Discipline core (DC): Credit 4(3-0-2)**

Objective: In his career as a supervisor, an electrical engineering technician will be called upon to inspect, test and modify the work done by skilled workers or artisans working under him. Many a times it will become necessary for him to demonstrate the correct method and procedure of doing certain operations. Normally manufacturers of heavy electrical equipment provide service manuals, instructions for installation, maintenance and fault location.

COURSE OUTLINE:

1. Tools and Accessories

Tools, accessories and instruments required for installation, maintenance and repair work. Knowledge of Indian Electricity rules, safety codes, causes and prevention of accidents, artificial respiration of an electrocuted person, workmen's safety devices

2. Installation

2.1 Domestic Installation Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors continuity or open circuit test, short circuit test, testing of earthing, continuity, location of faults

2.2 Installation of transmission and Distribution Line

a) Erection of steel structures, connecting jumpers, tee-off points, joints and dead ends; crossing of roads, streets, power/telecommunication lines and railway line, clearances; earthing of transmission lines and guarding, spacing and configuration of conductors: Types of arrangement for suspension and strain insulators, bird guards, anti-climbing devices and danger plates; sizes of conductor,

earthwire and guy wires, Testing and Commissioning. b) Laying of service lines, earthing, provision of service fuses, installation of energy meters

2.3 Laying of Underground Cables Inspection, storage, transportation and handling of cables, cable handling equipment, cable laying depths and clearances from other services such as: water pipes, sewerage, gas pipes, power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying, laying of cable from the drum, laying of cable in the trenches, back filling of trenches with earth or sand, laying protective layer of bricks etc, laying of cables into pipes and conduits and within buildings, introduction to cable filling compounds, epoxy resins and hardeners, cable jointing and terminations, testing and commissioning.

3. Maintenance Preventive, Predictive, Breakdown maintenance

3.1 Types of maintenance, maintenance schedules, procedures

3.2 Authorized persons, danger notice, caution notice, permit to work, arranging of shutdowns personally and temporary earths, cancellation of permit and restoration of supply

3.3 Patrolling and visual inspection of lines - points to be noted during patrolling from ground; special inspections and night inspections

3.4 Location of faults using Megger, effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system.

3.5 Maintenance of Distribution Transformers a) Transformer maintenance and points to be attended to in respect of various items of equipment b) Checking of insulation resistance, transformer oil level BDV test of oil and measurement of earth resistance, maintenance of breathers and oil level indicators

3.4 Maintenance of Grid Substations Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches. Power transformers

3.5 Maintenance of Motors Overhauling of motors, preventive maintenance, trouble shooting of electric motors

LIST OF PRACTICALS

1. Preventive maintenance of different electrical equipments available in electrical laboratories

2. Corrective maintenance of different equipments which may occur faulty during experiments/use

3. Trouble shooting of

· Water Boiler

· Geyser

· Generator set

· Pumping set

· Heating ovens

4. Patrolling inspection and fault finding of lines

5. Open circuit/Short circuit/earth fault finding of machines

6. Installation of motors, Diesel Generating set

7. Laying of underground cables

8. Detecting of faults in underground cables 9. Case study of maintenance department of industry/electricity board

RECOMMENDED BOOKS

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

ENERGY MANAGEMENT (DEE-504)

Discipline core (DC): Credit 3(3-0-0)

Objective: One of the reasons for India not been able to catch up with the desired extent of modernization of industrial processes in light of challenges posed by multinationals is the non-availability of required energy supply. The solution primarily lies in tapping all possible energy generation sources and efficient use of available energy important. Energy management focuses on these aspects. This course will develop awareness amongst the diploma engineers and will enable them to practice the energy management techniques in whatever field they are engaged in.

COURSE OUTLINE:

1. Energy Management
 - 1.1 Overview of energy management, need for energy conservation, Environmental Aspects
 - 1.2 Need for energy conservation with brief description of oil and coal crisis
 - 1.3 Alternative sources of energy
 - 1.4 Energy efficiency- its significance
2. Energy Conservation
 - 2.1 Energy conservation opportunity and measures
 - 2.2 Energy conservation in Domestic sector- Lighting, Home appliances
 - 2.3 Energy conservation in Industrial sector-Industrial lighting, Distribution system, Motor Pumps, Fans, Blowers etc
 - 2.4 Energy conservation in Agriculture sector Tubewell pumps, Diesel-generating sets, Standby energy sources
 - 2.5 Macro Level approach for energy conservation at design stage
3. Energy Efficient Devices
 - 3.1 Energy efficient technology an overview
 - 3.2 Need for energy efficient devices
 - 3.2 Initial cost versus life cycle, cost analysis on life cycle basis
 - 3.3 Energy efficient motors as compared to standard motors.
 - 3.4 BIS standards for energy efficient motors, BIS salient design features,
 - 3.5 Efficiency as a function of load, safety margins
 - 3.6 Energy efficient lighting system different sources, lumens/watt, LEDs, role of voltage on efficiency

- 3.7 Distribution system- Optimum cable size, amorphous core transformer, role of power factor, use of compensating capacitors-manual and automatic, location of capacitors
- 4. Energy Audit
 - 4.1 Energy audit methodology
 - 4.2 Efficiency of energy conversion processes, monitoring system
- 5. Environmental Impact Assessment
 - 5.1 Need for environmental impact assessment
 - 5.2 Standard format for assessment and its completion
 - 5.3 Evaluation of the assessment
- 6. Case study of energy management

RECOMMENDED BOOKS

- 1. Manual on Energy Efficiency at Design Stage, CII Energy Management Cell
- 2. Manual on Energy Efficiency in Pumping System, CII Energy Management Cell

INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES (DEE-505)

Discipline core (DC): Credit 4(3-0-2)

Objective: Industrial electronics plays a very vital role in the field of control engineering specifically in the modern industries as they mostly use electronic controls, which are more efficient, effective and precise as compared to the conventional methods. The old magnetic and electrical control schemes have all become obsolete. Electrical diploma holder many times has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control panels is must for them in order to supervise the work efficiently and effectively.

COURSE OUTLINE:

- 1. Introduction to SCR
 - 1.1 Construction and working principles of an SCR, two transistor analogy and characteristics of SCR
 - 1.2 SCR specifications and rating
 - 1.3 Construction, working principles and V-I characteristics of DIAC, TRIAC
 - 1.4 Basic idea about the selection of heat sinks for SCR and TRIACS
 - 1.5 Methods of triggering a Thyristor. Study of triggering circuits
 - 1.6 UJT, its Construction, working principles and V-I characteristics, UJT relaxation oscillator
 - 1.7 Commutation of Thyristors (Concept)
 - 1.8 Series and parallel operation of Thyristors
 - 1.9 Applications of SCR, TRIACS such as light intensity control, speed control of DC and universal motor, fan regulator, battery charger, temperature control
 - 1.10 Protection of SCR
- 11. nubber Circuit

2. Controlled Rectifiers

2.1 Single phase half wave controlled rectifier with resistive load and inductive load, concept of freewheeling diode.

2.2 Single phase half controlled full wave rectifier (No mathematical derivation)

2.3 Single phase fully controlled full wave rectifier bridge

2.4 Single phase full wave centre tapped rectifier

2.5 Three phase full wave half controlled bridge rectifier

2.6 Three phase full wave fully controlled bridge rectifier

3. Inverters, Choppers, Dual Converters and Cyclo Converters

3.1 Inverter-introduction, working principles, voltage and current driven series and parallel inverters and applications

3.2 Choppers-introduction, types of choppers and their working principles and applications

3.3 Dual converters-introduction, working principles and applications

3.4 Cyclo-converters- introduction, types, working principles and applications

4. Thyristor Control of Electric Drives

4.1 DC drives control (Basic Concept)

4.2 Half wave drives

4.3 Full wave drives

4.4 Chopper drives

4.5 AC drives control

4.6 Phase control

4.7 Variable frequency a.c. drives

4.8 Constant V/F application

4.9 Voltage controlled inverter drives

4.10 Constant current inverter drives

4.11 Cyclo convertors controlled AC drives

4.12 Slip control AC drives

5. Uninterrupted Power Supplies

5.1 UPS, Stabilizers, SMPS

5.2 UPS online, off line

5.3 Storage devices (batteries)

LIST OF PRACTICALS

1. To draw V-I characteristics of an SCR

2. To draw V-I characteristics of a TRIAC

3. To draw V-I characteristics of a DIAC

4. To draw uni-junction transistor characteristics

5. Observe the output wave of an UJT relaxation oscillator

6. Observe the wave shape across SCR and load of an illumination control circuit

7. Fan speed regulator using TRIAC

8. Speed-control of a DC shunt motor or universal motor

9. To observe the output wave shape on CRO of a Single phase half controlled full wave rectifier

10. Single phase controlled rectifier
11. Use of Variable Frequency Drive for running a 3 phase Induction motor

RECOMMENDED BOOKS

1. Industrial Control Electronics. John Webb, Kevin Greshock, Maxwell, Macmillan International editions
2. Fundamentals of Power Electronics by S Rama Reddi, Narosa Publishing House Pvt. Ltd, New Delhi

ELECTRIC TRACTION (DEE-506)

Open Elective (OE): Credit 3(3-0-0)

Objective: Nowadays, electrical energy finds major application in electric traction besides steam and diesel locomotives. Therefore, a diploma holder is required to have elementary knowledge of electric drives used in traction, accelerating and braking arrangements at the control panel.

COURSE OUTLINE:

1. Introduction

Electric traction system and its advantages over other systems, types of electric traction systems. Traction systems for India.

2. Electric Traction drives

Suitability of electric traction drives- D.C. series motor, A.C. series motor, 3 phase induction motor, characteristics of electric traction drives, special design requirements, methods of starting and speed control, different methods of braking, plugging, rheostatic, regenerative.

3. Power Supply of Electric Traction

Different systems of power supplies, their chronological evaluation, power supply arrangement i.e. traction substation major equipment, transformer, circuit breaker, interruptor, protection system, remote control system. Design consideration.

4. Mechanics of traction

System of units, speed time curves, their construction, simplification and interpretation for main line, suburban routes, tractive effort, specific energy consumption and factors effecting it. Weight transfer due to torque coefficient of adhesion

5. Rectification equipment

Equipments required for rectification, their brief theory and working.

6. Overhead equipment

Design aspects of overhead equipments catenary and its types, practical aspects of working, maintenance of overhead equipments, current collection system, their requirements.

7. Track Circuits

D.C. and A.C. track circuits, signals for traffic control.

8. Supervisory Remote Control

System of remote control, its advantages, mimic diagram, remote control system and network remote control centre (R.C.C.)

9. Rail and Return Path

Earth return protection of underground equipment, Negative booster, voltage distribution on rails.

RECOMMENDED BOOKS

1. Electric Traction by J. Upadhyaya; Allied Publisher Limited, New Delhi
2. Modern Electric Traction by H. Pratap; Dhanpat Rai & Sons, New Delhi
3. Electric Traction by A.T. Dover; Mcmillan Dhanpat Rai & Sons, New Delhi
4. Electric Traction Handbook by R.B. Brooks; Sir Isaac Pitman and Sons Ltd., London.

Network Analysis (DEE-506)

Open Elective (OE): Credit 3(3-0-0)

Unit-I:

Network Terminology

Basic circuit element, dependent and independent sources, KCL & KVL, its application in solving D.C. circuits, Mesh and Nodal Analysis.

Unit-II: AC Fundamentals

Generation of alternating Voltage and Current, important terminology: Peak value, RMS value, Average value of current and voltage, Form Factor & Peak Factor, phase and phase difference, addition of alternating quantities, AC circuit containing pure resistance, pure inductance, pure capacitance. Numerical problems

Unit-III: Single Phase AC Circuits

RL, RC and RLC series and parallel circuit, impedance triangle, phasor algebra, rectangular and polar conversion, addition, subtraction, division and multiplication, different methods for solving series and parallel circuits, series and parallel resonance, numerical problems.

Unit-IV: Network Terminology

Concept of generation of 3-phase voltage, advantage of 3-phase over 1-phase, Star-Delta connection (relationship between phase and line values of current & voltage), Expression for power measurement by 2-Wattmeter Method & 3-Wattmeter Method, numerical problems.

Unit-V: Network Theorems

Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem and their applications, Conversion of circuits from Star to Delta and vice versa, and Numerical Problems.

Text Books/ Reference Books:

1. Basic Electrical Engineering by V.K Mehta Rohit Mehta, S Chand Publication.
2. Fundamentals of Electrical Engineering by Ashfaq Husain

Haroon Ashfaq, Dhanpat
Rai & Co.

3. Basic Electrical Engineering by C L Wadhwa-, New Age International Publishers.
4. Basic Electrical Engineering, by S. K. Sahdev, Pearson Publications.
5. Fundamentals of Electrical Engineering & Electronics by S.K. Sahdev, Dhanpat Rai & Co.

COMPUTER APPLICATIONS (DEE-506)

Open Elective (OE): Credit 3(3-0-0)

Detail Content

Unit-I

Digital Computer systems, Characteristics, History, Computer Generations, Types of computers and their classifications, application of computers in various fields, Computer Hardware & Software, Elements of computer hardware-CPU, I/O devices, storage media, Computer Software- Types of software, system software, Application software.

Unit-II

Basic concept and function of an operating system, textual v/s GUI interface, type of Operating Systems, concept of multiprogramming, multitasking, multiprocessing, introduction to Disk operating System (DOS). Commands and utilities, working with MS Windows, Unix & Linux, Working knowledge of PC Software Word Processor.

Unit-III

Computer Languages, Generation of Languages, Translator, Assemblers, Interpreters, Compilers, Algorithm, Pseudo-code, Flowcharts- Rules & Symbols, Structured Programming concepts, various techniques of programming, Use of programming.

Unit-IV

Introduction to 'C', importance of C, basic structure of a C program, constants, variables and data types, operators and expressions, managing I/O operators, Control statement, 'IF' statement and its various forms, 'goto' statement, for, while and do-while loops, switch decision making statement, Arrays: Array notation, storage and representation, User define functions, and their use.