

Third Semester

FUNDAMENTALS OF ELECTRICAL ENGINEERING (DEE-301)

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

Objective: For a diploma holder in electrical engineering, it becomes imperative to know the fundamentals of the subject in order to grasp the knowledge of the field. This subject will provide acquaintance with various terms knowledge of fundamental concepts of electricity, magnetism and various principles related to it.

COURSE OUTLINE:

1. (a) Application and Advantages of Electrical Energy
 - i) Different forms of energy ii) Advantages of electrical energy iii) Uses of electrical energy
- (b) Basic Electrical Quantities
 - i) Basic concept of charge, current, voltage, resistance, power, energy and their units ii) Conversion of units of work, power and energy from one form to another
2. DC Circuits
 - 2.1 Ohm's law, resistances in series and parallel
 - 2.2 Kirchhoff's laws and their applications in solving electrical network problems
 - 2.3 Network theorems such as Thevenin's theorem, superposition theorem Maximum power and transfer theorem and Norton's theorem
3. Batteries
 - 3.1 Basic idea about primary and secondary cells
 - 3.2 Working principle, construction and applications of Lead acid, Nickel Cadmium and Silver Oxide Cells
 - 3.3 Capacity and efficiency of lead acid battery
 - 3.4 Charging methods used for lead acid accumulator
 - 3.5 Care and maintenance of a lead acid battery
 - 3.6 Grouping of cells in series and parallel (simple numerical problems)
 - 3.7 Testing of lead Acid battery for fully charged conditions and their specifications
 - 3.8 Application of lead acid battery
 - 3.9 Idea about batteries used in UPS
4. Magnetism and Electromagnetism:
 - 4.1 Introduction to electromagnetism, Magnetic field around a straight current carrying conductor and a solenoid and methods to find its direction, force between two parallel current carrying conductors.
 - 4.2 Force on a conductor placed in the magnetic field
 - 4.3 Series magnetic circuits, simple problems
 - 4.4 Concept of hysteresis, loop and hysteresis loss.
5. Electromagnetic Induction:
 - 5.1 Faraday's Laws of electromagnetic induction
 - 5.2 Lenz's law
 - 5.3 Fleming's Right and Left Hand Rule
 - 5.4 Principle of self and mutual induction

5.5 Principle of self and mutually induced e.m.f. and simple problems

5.6 Inductances in series and parallel

5.7 Energy stored in a magnetic field

5.8 Concept of eddy currents, eddy current loss

6. AC Fundamentals

6.1 Concept of a.c. generation (single phase and three phase)

6.2 Difference between a.c and d.c

6.3 Concept of alternating current and voltage, equation of instantaneous values, average value, r.m.s value, form factor, power factor etc.

6.4 Concept of phasor and phase difference

6.5 Representation of alternating sinusoidal quantities by vectors

6.6 Phasor algebra (addition, subtraction, multiplication and division of complex quantities)

7. AC Circuits

7.1 AC through pure resistance, inductance and capacitance

7.2 Alternating voltage applied to RL, RC and RLC series and parallel circuits (impedance triangle, phasor diagram and their solutions)

7.3 Concept of susceptance, conductance and admittance

7.4 J-notation and its application in solving problems in ac circuits

LIST OF PRACTICALS

1. (a) Determination of voltage-current relationship in a dc circuit under specific physical conditions and to draw conclusions (to verify ohm's law)

(b) Filament lamp: Measure the resistance of a cold lamp filament with the help of calculations. Measure the current drawn by the lamp at different voltages from zero to 220 volts and the resistance of lamp at different voltages, plot a graph between current and voltage

2. (a) To verify that $R_t = R_1 + R_2 + \dots$ where R_1, R_2 etc. are resistances connected in series

(b) To verify $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$ where R_1, R_2 etc. are resistances connected in parallel

3. Verification of Kirchhoff's current and voltage laws applied to DC circuits) To construct a circuit arrangement consisting of resistances in series, parallel combination) Identification of node points in the circuit) To see that algebraic sum of currents at node point is zero) To see that algebraic sum of emfs and voltage drops in a closed loop is zero

4. To observe the a.c and d.c wave shapes on CRO.

5. To find ratio of inductance values of a coil having air /iron core respectively and to see the effect of introduction of a magnetic core on coil inductance

6. To construct an RL and RC circuit and to measure a) Impedance of the circuit b) Phase angle between voltage and current c) Construct impedance triangle

7. Measurement of power and power factor of a single phase RLC circuit. To calculate KVA and KVAR

8. Measurement of power and power factor of a 3-phase circuit by using 2-wattmeter method using induction motor as a load and to calculate KVA and KVAR

9. Testing a battery for its charged condition i.e testing of gravity

RECOMMENDED BOOKS

1. Fundamentals of Electrical Engineering by Sahdev, Uneek Publication, Jalandhar
2. Basic Electrical Engineering by PS Dhogal, Tata McGraw Hill Education Pvt. Ltd., New Delhi

ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS (DEE-302)

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

Objective: A diploma holder in Electrical Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical and electronic engineering materials. Knowledge of various types of materials will be needed in order to execute the above mentioned functions.

COURSE OUTLINE:

1 Classification

Classification of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands

2. Conducting Materials

2.1 Introduction

2.2 Resistance and factors affecting it such as alloying and temperature etc

2.3 Classification of conducting material as low resistivity and high resistivity materials, Low resistance materials a. Copper- General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard-drawn and annealed copper, corrosion, contact resistance. Application in the field of electrical engineering b. Aluminium - General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance. Applications of aluminium in the field of electrical engineering c. Steel - General properties as conductor: Resistivity, corrosion, temperature coefficient, density, mechanical properties, solderability, Applications in the field of electrical engineering Introduction to bundle conductors and its applications Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), and their practical applications with reasons for the same

2.4 Applications of special metals e.g. Silver, Gold, Platinum etc.

2.5 High resistivity materials and their applications e.g., manganin, constantin, nichrome, mercury, platinum, carbon and tungsten, Tantalum

2.6 Superconductors and their application

3. Review of Semi-conducting Materials

Semi Conducting material such as Germanium, Silicon, Carbon-their atomic structure/application/against , pure and impure semi conductors and their use for making electronic devices. Material used for special purpose semiconductor, diode, contacts, power transistor, substrate, integrated circuits and power handling devices.

4. Insulating materials; General Properties

4.1 Electrical Properties Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant

4.2 Physical Properties Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness

4.3 Thermal Properties Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics

4.4 Chemical Properties Solubility, chemical resistance, weather ability

4.5 Mechanical properties, mechanical structure, tensile structure

5. Insulating Materials and their applications

5.1 Plastics

a. Definition and classification b. Thermosetting materials: Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and melamine - formaldehyde), epoxy resins - their important properties and applications c. Procedure of preparation of plastic (PVC) d. Thermo-plastic materials: Polyvinyl chloride (PVC), polyethelene, silicones, their important properties and applications

5.2 Natural insulating materials, properties and their applications

a. Mica and Mica products b. Asbestos and asbestos products c. Ceramic materials (porcelain and steatite) d. Glass and glass products e. Cotton
f. Silk g. Paper (dry and impregnated) h. Rubber, Bitumen i. Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation j. Enamels for winding wires k. Glass fiber sleeves

5.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF₆ their properties and applications

6. Magnetic Materials

6.1 Introduction - ferromagnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop including coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect, method of reduction of eddy current loss and hysteresis loss

6.2 Soft Magnetic Materials a) Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines

b) Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine c) Nickel-iron alloys d) Soft Ferrites

6.3 Hard magnetic materials - Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications

7. Special Materials

Thermocouple, bimetals, leads soldering and fuses material, mention their applications

8. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers

LIST OF PRACTICALS

1. A market survey of different Electrical and Electronics materials available in market will be conducted by students. They will submit a report, which will include names, types, specifications, identification, testing of components, manufacturing details and related cost.

2. Case study/data manuals of different wires/cables/fuses/sockets etc.. A report will be submitted by the students.

RECOMMENDED BOOKS

1. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi Electronic
2. Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi
Electrical Engineering Materials by Sahdev, Uneek International Publications

ELECTRONICS DEVICES AND CIRCUITS (DEE-303) **Basic Engineering and Science (BES) Core: Credit 4(3-0-2)**

Objective: At present, electronics gadgets are being extensively used in various manufacturing processes in industries, power system operations, communication systems, computers etc. Even for an electrical diploma holder, it is absolutely necessary to have a basic understanding of electronic components, their function and applications. This understanding should facilitate in operation and maintenance equipment, which are electronically controlled.

COURSE OUTLINE:

1. Introduction
 - 1.1 Brief history of development of electronics
 - 1.2 Active and passive components
2. Semi-conductor Theory
 - 2.1 Atomic structure, crystalline structure
 - 2.2 Energy band theory of crystals, energy band structure of insulator, semiconductor and conductor, generation and recombination of electron hole pairs. Energy band structure of Silicon and Germanium
 - 2.3 Concept of Doping, intrinsic and extrinsic semiconductors
 - 2.4 Effect of temperature on intrinsic and extrinsic semiconductors
3. Semiconductor Diodes
 - 3.1 PN Junction, mechanism of current flow in PN junction, drift and diffusion currents, depletion layer, potential barrier, effect of forward and reverse biasing in a PN junction. Concept of junction capacitance in forward and reverse biased conditions. Breakdown mechanism
 - 3.2 Ideal diode, Semiconductor diode characteristics, static and dynamic resistance
 - 3.3 Use of diode as half wave and full wave rectifiers (centre tapped and bridge type), ripple factor, rectifier efficiency
 - 3.4 Operation of filter circuits
 - 3.5 Diode ratings/specifications
 - 3.6 Various types of diodes such as zener diode, varactor diode, Schottky diode, light emitting diode, tunnel diode, photo diode; their working characteristics and applications
 - 3.7 Use of zener diode for voltage stabilization
4. Bi-polar Transistors

- 4.1 Concept of junction transistor, PNP and NPN transistors, their symbols and mechanism of current flow
- 4.2 Transistor configurations: common base (CB), common emitter (CE) and common collector (CC), current relation and their input/output characteristics; comparison of the three configurations
5. Transistor Biasing and Stabilization
 - 5.1 Transistor biasing, its need, operating point, effect of temperature on the operating point of a transistor and need of stabilization of operating point.
 - 5.2 Different biasing circuits, limitations
 - 5.3 Use of data book to know the parameters of a given transistor
6. Single-Stage Transistor Amplifiers
 - 6.1 Single stage transistor amplifier circuit in CE configuration, function of each component
 - 6.2 Working of single stage transistor amplifier, physical and graphical explanation, phase reversal
 - 6.3 Frequency response of a single stage transistor amplifier
7. Multi-Stage Transistor Amplifiers
 - 7.1 Need of multi-stage transistor amplifiers – different types of couplings, their purpose and applications.
 - 7.2 RC coupled two-stage amplifiers, circuit details, working, frequency response, applications
 - 7.3 Loading effect in multistage amplifiers
 - 7.4 Elementary idea about direct coupled amplifier, its limitations and applications
 - 7.5 Transformer coupled amplifiers, its frequency response.
8. Field Effect Transistor (FET)
 - 8.1 Construction, operation, characteristics and applications of a N channel JFET and P channel JFET
 - 8.2 JFET as an amplifier
 - 8.3 Types, construction, operation, characteristics and applications of a MOSFET
 - 8.4 Comparison between BJT, JFET and MOSFET
9. Operational Amplifiers
 - 9.1 Characteristics of an ideal operational amplifier and its block diagram
 - 9.2 Definition of differential voltage gain, CMRR, PSRR, slew rate and input offset current
 - 9.3 Operational amplifier as an inverter, scale changer, adder, subtractor, differentiator, and integrator

LIST OF PRACTICALS

1. a) Identification and testing of electronic components such as resistor, inductor, capacitor, diode, transistor and different types of switches used in Electronic circuits
b) Measurement of resistances using multimeter and their comparison with colour code values
2. V-I characteristics of a Semiconductor diode and to calculate its static and dynamic resistance
3. a) V-I characteristics of a zener diode and finding its reverse breakdown voltage
b) Fabrication of a zener diode voltage stabilizer circuit using PCB
4. Observation of input and output wave shapes of a half-wave rectifier
5. Observation of input and output wave shapes of a full wave rectifier
6. Plotting input and output characteristics of a transistor in CB configuration
7. Plotting input and output characteristics of a transistor in CE configuration

9. To study the effect of coupling capacitor on lower cut off frequency and upper cut off frequency by plotting frequency response curve of a two stage RC coupled amplifier
10. To plot V-I characteristics of a FET
11. To use IC 741 (op-amplifier) as
 - i) Inverter, ii) Adder, iii) Subtractor iv) Integrator

RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuit by NN Bhargava, Kulshreshta and SC Gupta, Tata McGraw Hill Education Pvt Ltd, New Delhi
2. Electronic Principles by SK Sahdev, Dhanpat Rai & Co., New Delhi

FUNDAMENTALS OF MECHANICAL AND CIVIL ENGINEERING (DEE-304)

Basic Engineering and Science (BES) Core: Credit 4(3-0-2)

Objective: A diploma holder has to assist in activities of installation, operation and maintenance etc of different machines and equipment. These activities are not branch specific and instead require him to know basics of civil and mechanical engineering

COURSE OUTLINE:

MECHANICAL ENGINEERING

1. Transmission of Power
 - 1.1 Transmission of power through belt, rope drives and pulleys, gears and chains
 - 1.2 Different type of pulleys and their application
 - 1.3 Chain drives and its comparison with belt drive
 - 1.1 Gear drives, types of gears, simple gear trains and velocity ratio
2. Air Conditioning System
 - 2.1 Basic principle of refrigeration and air conditioning
 - 2.2 Working of centralized air conditioner
 - 2.3 Concept of split air conditioner and its applications
3. Pumps - Types and their uses

PART B

CIVIL ENGINEERING

4. Construction Materials

Properties and uses of various construction materials such as stones, bricks, lime, cement and timber along with their properties, physical/ field testing and uses, elements of brick masonry

5. Foundations

i) Bearing capacity of soil and its importance ii) Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machine

6. Concrete

Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/ field testing of concrete, mixing of concrete

7. RCC

Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building

LIST OF PRACTICES

1. Observe operation of a centrifugal pump and location of common faults
2. Decide the type of foundation to be used for various types of electrical machinery and installation. Prepare a foundation for installation of a motor/ generator.
3. Identify various types of drives used in an IC engines and describe their function
4. Observe operation of air conditioning system. Identify locations of faults.
5. Trace the various paths of hot gases, cool gases, control system in a split air conditioner model. Identify the possible location of faults/ malfunctioning.

RECOMMENDED BOOKS

Mechanical Engineering

1. General Mechanical Engineering by M. Adithan; TTTI, Chandigarh
2. Basic Civil and Mechanical Engineering by Jayagopal; Vikas Publications, New Delhi

Civil Engineering

1. Textbook of Concrete Technology 2nd Edition by Kulkarni, PD Ghosh RK and Phull, YR; New Age International (P) Ltd., Publishers, New Delhi

ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS (DEE-305)

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

OBJECTIVE: Diploma holders in Electrical Engineering have to work on various jobs in the field as well as in testing laboratories and on control panels, where they perform the duties of installation, operation, maintenance and testing by measuring instruments. Persons working on control panels in power plants, substations and in industries, will come across the use of various types of instruments and have to take measurements.

COURSE OUTLINE:

1. Introduction to Electrical Measuring Instruments

1.1 Concept of measurement and measuring instruments

1.2 Types of electrical measuring instruments – indicating, integrating and recording type instruments

1.3 Essentials of indicating instruments – deflecting, controlling and damping torque

2. Ammeters and Voltmeters (Moving coil and moving iron type)

2.1 Concept of ammeters and voltmeters and difference between them

2.2 Extension of range of voltmeters and ammeter

2.3 Construction and working principles of moving Iron and moving coil instruments

2.4 Merits and demerits, sources of error and application of these instruments

3. Wattmeters (Dynamometer Type)

Construction, working principle, merits and demerits of dynamometer type wattmeter, sources of error

4. Energy meter (Induction type)

Construction, working principle, merits and demerits of single-phase and three-phase energy meters

4.1 Errors and their compensation

4.2 Simple numerical problems

4.3 Construction and working principle of maximum demand indicators

5. Miscellaneous Measuring Instruments

5.1 Construction, working principle and application of Meggar, Earth tester, Multimeter, Frequency meter (dynamometer type) single phase power factor meter (Electrodynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on meter), signal generator, AC millivoltmeter, tachometer

5.2 Instrument Transformers: Construction, working and applications a) CT b) PT and their ratio and phase angle error

6. Electronic Instruments

6.1 Cathode Ray Oscilloscope: Block diagram, working principle of CRO and its various controls.

6.2 Digital multi-meter, basic principle, constructional brief, display system

7. LCR meters

Study of LCR meter and its applications Digital LCR and Q meter

8. Power Measurements in 3-Phase Circuits

(i) 2 wattmeter method in balanced and unbalanced circuits and simple problems (ii) Three wattmeter method

LIST OF PRACTICALS

1. Use of analog and digital multimeter for measurement of voltage, current (a.c/d.c) and resistance.
2. To calibrate 1-phase energy meter by direct loading method.
3. To measure the value of earth resistance using earth tester.
4. To measure power, power factor in a single-phase circuit, using wattmeter and power factor meter and to verify results with calculations.
5. Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
6. Measurement of voltage and frequency of a sinusoidal signal using CRO time base as well as Lissagous pattern and draw wave shape of signal.
7. Measurement of power in a 3 phase circuit using CT, PT and 3-phase wattmeter.
8. Use of LCR meter,digital LCR meter for measuring inductance, capacitance and resistance.
9. To record all electrical quantities from the meters installed in the institution premises.
10. To measure Energy at different Loads using Single phase Digital Energy meter.

RECOMMENDED BOOKS

1. Electrical Measurements and Measuring Instruments by Golding and Widdis; Wheeler Publishing House, New Delhi
2. Electrical Measurements and Measuring Instruments by SK Sahdev, Unique International Publications, Jalandhar

ELECTRICAL WORKSHOP PRACTICE (DEE-306)

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

Objective: An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers working under him. In addition, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively, in addition to conceptual understanding of the method or procedure, he must possess appropriate manual skills.

COURSE OUTLINE:

1. Study of electrical safety measures as mentioned in the Electricity Rules and shock treatment including first aid
2. Types of wiring and to make different light control circuits in the following types of wiring Casing and capping, (PVC) conduct, baten wiring
3. Study of ISI standard for MCBs and ELCBs Conduct one test on MCB on above basis
4. Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and MCBs Types of wiring and to make different light control circuits in the following types of wiring.
 - 4.1 Casing and Capping (PVC) wiring
 - 4.2 Conduit wiring (surface/concealed)
5. Construction of distribution and extension board with two 5A sockets and two 15A sockets, a fuse and indicator with series test lamp provision controlled by their respective switches.
6. Testing of domestic wiring installation using meggar.
7. Fault finding and repair of a tube light circuit
8. Carry out pipe/ plate earthing for a small house and 3 phase induction motor. Testing the earthing using earth tester.
9. Connection of single phase and three phase motors through an appropriate starter.
10. Winding/ rewinding of a fan (ceiling and table) and choke.
11. Repair of domestic electric appliances such as electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace and weighing machine.