Module 4: Alternating Current, Earthing and Wiring

30 Important Questions and Answers

1. Alternating Current

Q1. What is alternating current (AC)?

Ans: A current that changes its magnitude and direction periodically with time. A sinusoidal AC wave rises to a positive peak, falls to zero, reaches a negative peak and returns to zero in one cycle.

Q2. Define cycle, time period and frequency. What is the supply frequency in India?

Ans: Cycle: one complete set of positive and negative values. Time period (T): time taken for one cycle. Frequency (f): number of cycles per second, f = 1 / T, unit hertz (Hz). The supply frequency in India is 50 Hz.

Q3. State the advantages of AC over DC.

Ans: AC can be easily stepped up or down by a transformer, so it is transmitted at high voltage with low loss and cost. AC generators and induction motors are simple, cheap and rugged, and AC can be converted to DC by rectifiers.

Q4. Define peak value, average value and RMS value of AC. Give the relations.

Ans: Peak (maximum) value Vm is the highest instantaneous value. Average value = 0.637 x Vm. RMS (effective) value = Vm / 1.414 = 0.707 x Vm, the AC value that produces the same heating effect as an equal DC value.

Q5. The peak value of a supply voltage is 325 V. Find its RMS value.

Ans: V(rms) = 0.707 x 325 = approx. 230 V.

Q6. What is the difference between single-phase and three-phase supply?

Ans: Single-phase supply has one live (phase) wire and a neutral, giving 230 V, and is used in homes. Three-phase supply has three live wires with voltages 120 degrees apart, giving 415 V between lines (line voltage = 1.732 x phase voltage in star), and is used for industries and heavy motors.

2. Earthing

Q7. What is earthing?

Ans: Connecting the non-current-carrying metal parts of an electrical installation or equipment (body, frame, metal casing) to the general mass of earth through a low-resistance conductor.

Q8. Why is earthing necessary?

Ans: To protect persons from electric shock, to protect equipment, to allow enough fault current to flow so that the fuse, MCB or ELCB trips quickly, and to reduce the risk of fire. The metal body stays at earth potential even if the insulation fails.

Q9. Name the types of earthing.

Ans: Pipe earthing, plate earthing, rod earthing and strip or wire earthing. By purpose, earthing is also divided into equipment earthing (metal body) and system earthing (neutral of the supply).

Q10. Describe pipe earthing.

Ans: A GI pipe about 38 mm in diameter and 2.5 m long, with holes in its lower part, is driven vertically into the ground. It is surrounded by alternate layers of charcoal and salt, and a funnel at the top is used to pour water and keep the soil moist. The earth wire is bolted to the pipe.

Q11. Describe plate earthing. What is the usual size of the plate?

Ans: A GI plate (about 60 cm x 60 cm x 6.3 mm) or copper plate (about 60 cm x 60 cm x 3.15 mm) is buried vertically about 3 m deep, packed with charcoal and salt, and connected by a GI strip or wire to the equipment. Water is poured through a pipe fitted above it.

Q12. What is the desirable value of earth resistance? What wire colour is used for earth?

Ans: Earth resistance should be as low as possible: generally not more than about 5 ohm for ordinary installations, and around 1 ohm for large power stations (follow the limit in your rules or syllabus). Earth wire colour is green (green/yellow in the newer colour code), measured with an earth tester.

3. Types of Wiring (Domestic and Industrial)

Q13. Name the different types of wiring used in domestic installations.

Ans: Cleat wiring, batten (wooden casing) wiring, casing and capping wiring, conduit wiring (surface or concealed), and lead-sheathed or TRS/CTS wiring.

Q14. What is cleat wiring? State where it is used.

Ans: PVC or VIR cables are run on porcelain cleats fixed to the wall or ceiling. It is cheap and easy to install and repair, but not safe or neat. It is used only for temporary work such as exhibitions, function halls and construction sites.

Q15. What is casing and capping wiring?

Ans: Cables are laid in grooves of a wooden or PVC casing and covered by a capping. It gives better protection than cleat wiring, but is affected by dampness, termites and fire, so it is now rarely used.

Q16. What is conduit wiring? State its advantages.

Ans: Cables are run inside GI or PVC pipes (conduits) fixed on the surface or concealed in walls. It gives protection against mechanical damage, dampness and fire, has a long life and a neat appearance. It is the most widely used system in homes and buildings, though costlier.

Q17. Which wiring systems are used in industries?

Ans: Surface conduit wiring (GI conduit), armoured cable wiring (laid on trays or buried), cable trays and ladders, busbar trunking (bus ducts), and overhead or rising main systems to feed heavy machines.

Q18. On what factors is the choice of a wiring system based?

Ans: Safety, durability, cost, appearance, expected load, ease of repair and extension, the environment (dampness, dust, heat, chemicals) and the applicable rules.

4. Grading of Cables and Wires

Q19. What is meant by grading of cables and wires?

Ans: Classifying them by the working voltage they can safely withstand, which decides the insulation level. Common grades: 250 V, 660 V and 1100 V (low tension); 3.3 kV to 33 kV (high tension); above 33 kV (extra high tension).

Q20. How are wires graded by size?

Ans: By conductor diameter or area: SWG numbers for small wires (higher SWG means thinner wire), and cross-sectional area in sq mm for cables, e.g. 1.0, 1.5, 2.5, 4 and 6 sq mm.

Q21. Name the types of cables used for different voltage levels.

Ans: Belted cables up to 11 kV, screened cables (H-type, SL-type) for about 22 kV to 66 kV, and pressure cables (oil-filled or gas-filled) for higher voltages.

Q22. What should be checked when selecting a wire or cable?

Ans: The ISI/BIS mark, conductor material (copper or aluminium), insulation type, voltage grade, size, flame-retardant quality and the manufacturer's current rating.

5. Current Rating

Q23. What is the current rating of a cable?

Ans: The maximum current a cable can carry continuously without its temperature rising enough to damage the insulation.

Q24. On what factors does the current rating depend?

Ans: Conductor size and material, insulation type (PVC allows about 70 deg C, XLPE about 90 deg C), ambient temperature, method of laying (in conduit, on tray or buried) and the grouping of several cables together, which lowers the rating.

Q25. A 2 kW heater (unity power factor) runs on a 230 V single-phase supply. Find the current and suggest a suitable cable size.

Ans: I = P / V = 2000 / 230 = approx. 8.7 A. A 1.5 sq mm copper wire is usually used for lighting circuits and 2.5 sq mm for power circuits, so choose 2.5 sq mm here. Always confirm with the manufacturer's rating chart.

6. Testing of Installation by Megger

Q26. What is a megger? State its working principle.

Ans: A megger is an instrument that measures very high resistance, especially insulation resistance, in megohm. It has a hand-driven (or battery electronic) DC source of 500 V, 1000 V, 2500 V or 5000 V and a moving-coil ohmmeter with a current coil and a pressure coil.

Q27. Why is insulation resistance testing done?

Ans: To confirm that insulation between live conductors and between conductors and earth is good, so that leakage current, electric shock and fire are prevented. It is done on new installations and periodically on old ones.

Q28. Explain the procedure for testing an installation with a megger.

Ans: Switch off the main supply, remove lamps and appliances, and switch on all switches. First check the megger (open circuit reads infinity, short circuit reads zero). Then measure between (1) phase and neutral and (2) phase/neutral and earth, turning the handle at a steady speed and noting the reading.

Q29. What is the minimum acceptable insulation resistance?

Ans: As per current IEC/IS practice, at least 1 megohm for circuits up to 500 V, tested at 500 V DC. Older Indian rules used 50 megohm divided by the number of points. Follow the standard prescribed in your syllabus.

Q30. State the precautions while using a megger.

Ans: Isolate the supply and disconnect appliances and electronic devices before testing, use the correct test voltage, do not touch the terminals or conductors during the test, and discharge the circuit or cable after the test because it may hold a charge.