



6. (a) Explain with the aid of diagrams the method of reversing the direction of rotation of each of the following type of motor:
- i. Three-phase induction motor
  - ii. Single phase capacitor start motor
  - iii. A d.c. shunt motor
  - iv. A universal motor
- (8 marks)**
- (b) Briefly describe what type of motor enclosure is required for the following conditions:
- i. possibility of falling liquids
  - ii. poor ventilation in the working area
  - iii. motor is to be placed external
  - iv. flammable gases present
- (8 marks)**
- (c) What factors may be considered when ordering an electric motor? **(4 marks)**

## EXAMINATION FOR AUTHORISATION B

**Paper 2: Electrical Installation Technology**

**Date: 4 February 2021**

**Time: 15:00 – 18:00 (Three hours)**

**END OF EXAMINATION PAPER**

This examination paper contains six questions. Candidates are requested to answer any FIVE (5) questions. Candidates are also requested to include all their work in the booklet provided. Every answer should include all workings, any necessary diagrams and formulae. Use a fresh page for each different question. Each question carries 20 marks.

1. The electric load of a small factory consists of the following:
- i. A 50kW three phase motor having an efficiency of 85% at a power factor of 0.8
  - ii. Two by 8kW motors at an efficiency of 80% at a power factor of 0.8
  - iii. Fifty lighting points for 60 Watt filament lamps
  - iv. Ten discharge lamps each rated at 1 kW
  - v. Six ring circuits each feeding 10 single phase socket outlets
  - vi. Four single phase instant water heaters each rated at 2.5kW

Assuming a three-phase supply of 415V / 240V and that all single phase loads are distributed between the phases so as to balance the installation as much as possible, calculate total current demand for the main switchboard indicating your assumed diversity factor if required.

Draw a single line diagram of the main switchboard indicating the current rating of each main switch or MCB. State any assumption made. **(20 marks)**

2. (a) Define the term Maintenance Work at a factory. **(3 marks)**
- (b) List the safety precautions to be taken before commencement of maintenance on electric motors. **(4 marks)**
- (c) Analyse the following situations and indicate in each case how they may be minimized or eliminated. Where applicable include diagrams in your answers:
- (i) Current leakage to earth from a current carrying conductor. **(3 marks)**
  - (ii) A newly connected a.c. induction motor fails to start rotating while a humming noise is heard from inside it. **(3 marks)**
  - (iii) Low power factor in an installation. **(4 marks)**
  - (iv) Arcing at contacts brushes of a series universal motor. **(3 marks)**

3. (a) (i) Electric motors are usually classified by the type of enclosure used. List four types of enclosures. **(4 marks)**
- (ii) Describe any two of the listed enclosures in 3 (a) (i) above and give one application for each type. **(8 marks)**
- (b) With the aid of a circuit diagram explain the operation of a capacitor start single-phase induction motor. **(4 marks)**
- (c) With the aid of a circuit diagram show how the rotation of this motor can be reversed. **(4 marks)**

4. (a) Describe, using a diagram if necessary, a Non-pressure type water heater. Where is this type of heater used? **(6 marks)**
- (b) Describe, using a diagram if necessary, a Pressure-type water heater. Where is this type of heater used? **(6 marks)**
- (c) Make a neat diagram, showing the installation of a pressure-type water-heater in the ground floor bathroom of a two-storied building. Cold water supply is from a storage tank on the roof of the house. Hot water outlets are also required also in first floor bathroom.

Your drawings should show:

- i. the cold-water pipes to the tank and heater
  - ii. the hot-water pipes to sinks and bath
  - iii. the vent-pipe to the tank
  - iv. the electrical conduit layout and associated electrical fittings. **(8 marks)**
5. (a) A soldered socket (lug) is used to terminate a 35 mm<sup>2</sup> p.v.c. insulated cable before it is fixed to a busbar. Make a neat sketch of the socket and a short length of the cable, showing how the work is finished off. Label the parts and the materials used. **(8 marks)**
- (b) Describe the procedure for sweating the lug to the 35 mm<sup>2</sup> cable. **(8 marks)**
- (c) List the requirements of the finished lug to satisfy the IET Regulations. **(4 marks)**