



END OF EXAMINATION PAPER

Examination for Authorisation B

Paper 2: Electrical Installation Technology

Date: 6 February 2020

Time: 09:00 – 12:00 (Three hours)

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. a) Using sketches describe three types of bearings used on electric motors. **(6 marks)**
- b) With the aid of a diagram show how a bearing is kept in place on the shaft of a motor. **(4 marks)**
- c) Describe the following types of motor enclosures. State in each case the situations for which they are suitable:
 - i. open type **(2 marks)**
 - ii. screen protected **(2 marks)**
 - iii. drip-proof **(2 marks)**
 - iv. pipe or duct ventilated **(2 marks)**
 - v. totally enclosed. **(2 marks)**
2. a) Draw a diagram showing all the connections of a three-phase wound-rotor starter and motor. **(8 marks)**
- b) Draw diagrams to show how the reversal of rotation of the following DC motors can be obtained:
 - i. DC series motor **(2 marks)**
 - ii. DC shunt motor **(2 marks)**
 - iii. DC compound motor. **(2 marks)**
- c) Show by means of diagrams the following methods of measuring the power in a three-phase and neutral circuit:
 - i. the one-watt meter method **(2 marks)**
 - ii. the two-watt meters method **(2 marks)**
 - iii. the three-watt meters method. **(2 marks)**
3. a) With the aid of a circuit diagram explain the sequence of incoming supply of a three-phase system. **(5 marks)**
- b) Explain why it is important to balance a three-phase system as much as possible. **(5 marks)**
- c) Describe two methods of protection against electric shock on a construction site. **(5 marks)**
- d) Compare the advantages and disadvantages of single and three-phase systems. **(5 marks)**

4. a) Explain the following terms:
 - i. transformer core losses
 - ii. hysteresis losses
 - iii. eddy current losses
 - iv. copper losses. **(12 marks)**
- b) The primary winding of a delta-star, 50 VA transformer is supplied with a 100 Volt, 50Hz three-phase supply. If the transformer has 500 turns on the primary and 100 turns on the secondary winding, calculate the secondary side voltages and currents. **(8 marks)**
5. A three-phase electric motor is directly coupled to a pump which is to be installed near a well. The pump will be used to transfer water from the well to an adjacent tank so that water will be stored in this tank.
 - a) Make a list of the material required for the electrical installation for such a pump. **(6 marks)**
 - b) What type of cable do you suggest for the electrical installation of the pump motor if the pump will be installed fixed outside and there exist a danger of cable being hit by agricultural tools? **(3 marks)**
 - c) What type of electrical protective devices do you suggest for the installation of such a system? **(4 marks)**
 - d) Draw a circuit diagram showing the control circuit for such a pump motor. In the drawing include a float switch having two sets of contacts which will be used to automatically switch ON and OFF the motor pump when the water in the tank is at its lowest and highest level respectively. The motor protection needs also to be shown in the diagram. **(7 marks)**
6. a) Draw a diagram and describe the operation of a direct on-line starter for a three-phase induction motor. **(6 marks)**
- b) Explain how an induction motor is protected against:
 - i. overloads **(2 marks)**
 - ii. short circuits **(2 marks)**
 - iii. earth faults **(2 marks)**
 - iv. loss of supply **(2 marks)**
 - v. direction of rotation **(2 marks)**
- c) Explain why an induction motor does not trip on overload on starting, even though the starting current is several times the full load current. **(4 marks)**

Total: 100 marks