
EXAMINATION: AUTHORISATION B

July 2015

Paper I (Theory)

Time Allowed: 3 Hrs

**WRITE ALL YOUR WORK ON THE ANSWER BOOK PROVIDED
EVERY ANSWER SHOULD INCLUDE ALL WORKINGS, NECESSARY
DIAGRAMS AND FORMULAE.**

START EACH ANSWER ON A FRESH PAGE.

Answer any **FIVE** Questions

1. Referring to the Resistance and Resistivity
- (a) The resistance of an electrical conductor depends on four factors. List these four factors. (8 marks)
- (b) Explain the resistance relationship for each factor. With the aid of examples describe what is meant by resistivity and highlight its importance. (4 marks)
- (c) A piece of wire of cross-sectional area 2 mm^2 has a resistance of 300Ω . Find,
(i) the resistance of a wire of the same length and material if the cross-sectional area is 5 mm^2 (4 marks)
(ii) the cross-sectional area of a wire of the same length and material of resistance 750Ω . (4 marks)
- Note: the coefficient of proportionality, $k = R \times \text{CSA}$ (of wire)
- (d) The insulation resistance measured between the cross section of a certain twin cable of 110m long is $1020\text{M}\Omega$. Calculate the insulation resistance of a 44 m of the same cable. (4 marks)
2. A four pole 440 Volts, 80 h.p. DC shunt motor has a full load efficiency of 90%. The armature is wave wound with 470 conductors. Total resistance of armature and interpoles is 0.1 ohm and the shunt field resistance is 220 ohms. The flux per pole is 40 mWb.
- Calculate for full load.
- (a) Speed (10 marks)
- (b) Useful torque in Nw-m. (10 marks)
3. (a) Explain clearly all the technical benefits obtained from power factor improvement of electrical loads operating at low lagging power factor. (6 marks)
- (b) An industrial consumer takes a load of 400kW at a power factor of 0.7 lagging from a three phase 400V 50Hz supply. The consumer wishes to increase the load by a further 80kW without increasing the kVA demand. Calculate:
- i) The new power factor (p.f.) at which the load must operate. (4 marks)
- ii) The kVAr rating of the capacitor bank. (4 marks)
- iii) The capacitance of each unit if the capacitors are connected
a. in star (3 marks)
b. in delta. (3 marks)

4. (a) i) What are semi-conductors? Give two examples of semi-conductors. (3 marks)
- ii) Using diagrams explain the principle and construction of a semi-conductor junction diode. (5 marks)
- iii) Draw the wave-form of a half-wave rectifier. (1 mark)
- iv) Draw the wave form of a full wave rectifier. (1 mark)
- (b) Draw a circuit diagram of a full-wave rectified DC supply using two diodes and a centre-tapped transformer. (5 marks)
- (c) Draw a circuit diagram of a full-wave rectified DC supply using the Bridge Rectifier method. (5 marks)
5. (a) Describe with the aid of a diagram how torque is developed in a three-phase induction motor. (4 marks)
- (b) The power supplied to a three-phase induction motor is 32kW and the stator losses are 1200W. If the slip is 5%, determine:
- i) The rotor copper loss. (3 marks)
- ii) The total mechanical power developed by the rotor. (3 marks)
- iii) The output power of the motor if the friction and windage losses are 750W. (3 marks)
- iv) The efficiency of the motor, neglecting the rotor iron loss. (3 marks)
- (c) Explain how the power factor (p.f.) of such a motor may be improved. (4 marks)
6. (a) Three identical coils, each of resistance 16Ω and inductance 38mH are connected
- i) in star and
- ii) in delta to a 415V, 50 Hz, three-phase supply.
Determine the total power dissipated in each case. (12 marks)
- (b) Highlight the main differences between star and delta connections. (4 marks)
- (c) What are the advantages of a three phase system over a single phase system? (4 marks)

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