

**WRITE ALL YOUR WORK IN 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

1a) Explain and compare the difference between Power Factor correction at the Main Distribution Board against Power Factor correction for individual loads in industrial electrical systems. (6 marks)

b) An old three phase induction motor is installed in a factory. The motor has a capacitor bank connected to its terminals. No data is visible on the capacitors; hence some tests were carried out. The following results were obtained:

The motor running without the capacitor bank, the line current was 15A at a lagging power factor of 0.65.

The motor running with the capacitor bank, the line current was 11.5A.

The measured voltage between phases was 400V, 50Hz.

Calculate:

- i) The reactive power of the capacitor bank. (4 marks)
- ii) The capacitance per phase of the capacitor bank when it is connected in STAR. (4 marks)
- iii) The capacitance per phase of the capacitor bank when it is connected in DELTA. (4 marks)
- iv) The overall power factor with the capacitor bank in circuit. (2 marks)

2. An adjustable resistor is connected in series with a capacitor of 25 micro farad. The current taken is 0.8 amperes, when connected across a 50 Hz supply.

- a) Find the voltage drop across the capacitor. (5 marks)
- b) Find the value of the resistor if the supply voltage is twice the voltage drop across capacitor. (5 marks)
- c) Find the power in the circuit. (5 marks)
- d) Find the power factor. (5 marks)

3a) Explain briefly the following:-

- i) Stator losses; (2 marks)
- ii) Rotor losses; (2 marks)
- iii) Friction & winding losses; (2 marks)
- iv) Slip speed. (2 marks)

b) An induction motor is required to be coupled with a water pump. The motor power input to a 4-pole, three phase 400Volts, 50Hz is 20kW. The stator losses are 1.5kW; the friction and winding losses are 2.5kW. The speed at the pump shaft is 1400 rev/min. Find:

- i) The percentage slip. (2 marks)
- ii) The rotor copper loss; (4 marks)
- iii) The mechanical power developed at the pump shaft; (4 marks)
- iv) The overall efficiency. (2 marks)

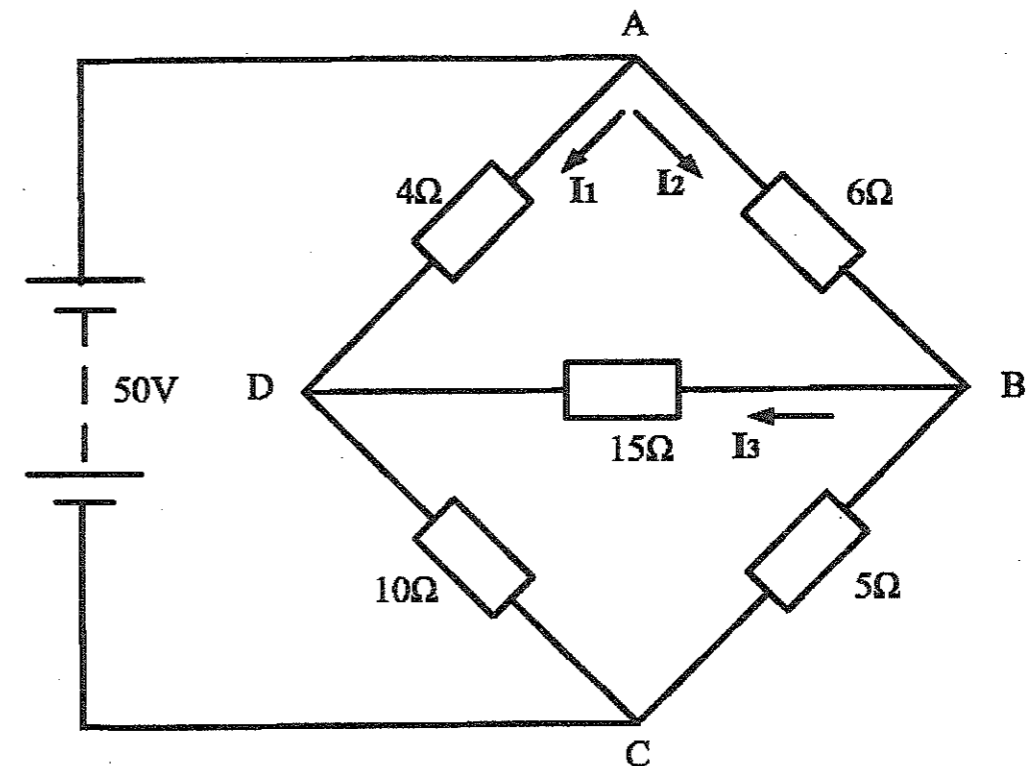
4a) A D.C. motor is running at no-load with a speed of 900 rev/min. When the load is applied to the motor, the armature current is 20Amps and the terminal voltage is constant at 440V. Assume the armature resistance 0.2Ω and the armature reaction is to be neglected. Calculate the speed when the load is applied to the motor. (10 marks)

b) A D.C. shunt generator supplies a load of 20kW at 230Volts. Two conductors having a total resistance of 0.04Ω are used to supply the load. The generator armature resistance is 0.04Ω and the resistance of the shunt field winding is 80Ω . Find:-

- i) The terminal voltage (5marks)
- ii) The e.m.f. generated (5 marks)

5. Given the circuit diagram below calculate:

- i) The current I_1 and its direction (4 marks)
- ii) The current I_2 and its direction (4 marks)
- iii) The current I_3 and its direction (4 marks)
- iv) The total current supplied by the battery (1 mark)
- v) The total resistance of the circuit (4 marks)
- vi) The voltage across the 15Ω resistor (2 marks)
- vii) The total power (1 mark)



6. A synchronous motor taking 40 kW is working in parallel with a load of 80 kW having a p.f. of 0.75 lagging. The p.f. of the combined load is 0.9 lagging.

Calculate:

- a) The p.f. of the motor. (10 marks)
- b) The reactive KVA of the motor. (10 marks)

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**EXAMINATION FOR THE ISSUE OF A LICENCE TO ACT AS
WIREMAN - LICENCE 'B'**

July 2013

Paper I (Theory)

Time Allowed: 3 Hrs