
EXAMINATION: AUTHORISATION A

Paper I (Theory)

Time Allowed - 3Hrs

July 2018

END OF PAPER

**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.

Choose any **FIVE** questions.

1. (a) Calculate the resistance of 100 metres of 120 mm² single core mineral-insulated cable if the resistivity of copper = 1.78×10^{-8} ohm metre. **(10 marks)**
 (b) Calculate the cross-sectional area of an aluminium cable 50 metres long which has a resistance of 0.067 ohm if the resistivity of aluminium is 2.84×10^{-8} . **(10 marks)**
2. (a) An electric water heater is 80% efficient and consumes energy at the rate of 2000 J/s. If the water heater initially contains 10 litres of water at 12°C, what will be the temperature of the water after 10 min of heating? Take the specific heat of water as 4187J/Kg/°C and 1 litre of water has a mass of 1 kg. **(14 marks)**
 (b) A small storage heater contains 8 litres of water at a temperature of 10°C. How much heat energy must be provided to raise the water temperature to 90°C? The specific heat of water is 4187 J/kg K. **(6 marks)**
3. (a) Explain the meaning of the following terms as applied to an illumination scheme:
 - Utilisation factor, **(2 marks)**
 - Maintenance factor, **(2 marks)**
 - Spacing to Mounting Height ratio **(2 marks)**
 (b) An office measuring 25m by 45m requires an illumination at desk level of 440 lux. The lighting fittings selected to illuminate the office contains 80W fluorescent tubes. The manufacture catalogue specifies that when the fittings are new, each fitting provides 4800 lumens. The mounting height of the fittings above desk level will be 2.5m. Assuming a Utilisation factor of 0.6 and a Maintenance factor of 0.85. Calculate:
 - i. The number of lighting fitting required to illuminate the office **(5 marks)**
 - ii. The annual cost of electricity if the lighting fittings are used on average 5 days a week and 12 hours daily. Assume that the office is supplied from a single phase supply and that the cost of electricity is 17 cents per kWh. **(9 marks)**

4. A moving-coil instrument gives full-scale deflection with a current of 1.2 mA and its coil has a resistance of 40Ω. Determine:
 - (a) The value of the multiplier required to produce a voltmeter reading up to 50 Volts. **(10 marks)**
 - (b) The value of the shunt required to convert the instrument to an ammeter reading up to 10 Amperes. **(10 marks)**
5. (a) Explain what is meant by the following terms when related to alternating current circuit:
 - Inductive reactance **(2 marks)**
 - impedance **(2 marks)**
 (b) A coil of resistance 5Ω and inductance of 120 mH is connected in series with a capacitor of 100 μF across a 300Volts 50Hz supply.
 Draw the circuit showing the circuit configuration **(2 marks)**
 Calculate:
 - i. The current flowing in the circuit **(4 marks)**
 - ii. The phase difference between the supply voltage and the current **(4 marks)**
 - iii. The voltage across the coil **(3 marks)**
 - iv. The voltage across the capacitor **(3 marks)**
6. (a) What does the standard known as BS 7671 (2018) cover? What is it commonly known as? **(2 marks)**
 (b) Define Ohm's Law. **(3 marks)**
 (c) Define the following terms:
 - i. Resistance **(2 marks)**
 - ii. Impedance **(2 marks)**
 - iii. Inductive Reactance **(2 marks)**
 - iv. Capacitive Reactance **(2 marks)**
 (d) A simple series circuit consists of a single resistor of 5 Ω and a single inductor of 47.75 mH connected in series to a 230Volts, 50Hz, a.c. supply.
 - i. Draw the circuit diagram **(2 marks)**
 - ii. Determine the total circuit impedance **(3 marks)**
 - iii. Determine the single phase current in the circuit **(2 marks)**