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EXAMINATION FOR AUTHORISATION A

Paper 1: Theory
Date: 31st January 2023
Time: 9:00 – 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. State which electrical quantities the following units are related to:
- i. Ampere (1 mark)
 - ii. Volt (1 mark)
 - iii. Candela (1 mark)
- b. Define the Watt and the Kilowatt hour. (4 marks)
- c. What will it cost to light a house having a load of 17, 650 watts at 2c5 per unit for a month of 30 days if the total load is used 6 hours per day? (3 marks)
- d. A 25 Candela power lamp gives a definite illumination at a distance of 1.6 m. Determine the distance from a 20 Candela power lamp at which the illumination is 1.25 as great. (10 marks)
2. a. State Ohm's law as applied to a direct current (D.C.) circuit. (3 marks)
- b. A circuit consists of three resistors of 12 Ω , 16 Ω and 48 Ω in parallel, in series with a fourth resistor R_x . The resistors combination is connected to a 60 volts supply and after taking some measurements it was noted that the power dissipated in the 12 Ω resistance was found to be 48 W.
- i. Draw a circuit showing the resistors combination. (3 marks)
- Calculate:
- ii. the current taken by each resistor (6 marks)
 - iii. the value of the fourth resistor R_x (4 marks)
 - iv. the Power dissipated by the whole circuit. (4 marks)
3. 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 minutes 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°C. (6 marks)

4. A two-core copper cable 150mm long supplies a load of 44 KW at 240 V D.C. The cross-sectional area of each core of the cable is 120 mm².
- a. Calculate the voltage drop in the cable. (10 marks)
 - b. Find the size of copper cable of the same length which is needed to reduce the voltage drop to one-half of the value found in (a). (10 marks)

Take the resistivity of copper as 17.5 $\mu\Omega$ mm.

5. a. Explain the effect of the capacitance increase or decrease when capacitors are connected in series or parallel combination. (4 marks)
- b. If two capacitors having capacitances of 6 μF and 10 μF respectively are connected in series across a 200 V supply, find
- i. the p.d. across each capacitor (6 marks)
 - ii. the charge on each capacitor. (4 marks)
- c. An 8 μF capacitor is connected in series with a 0.5 M Ω resistor across a 200 V D.C. supply. Calculate:
- i. the time constant (3 marks)
 - ii. the initial charging current. (3 marks)
6. A coil of resistance 10 Ω and inductance 135 mH is connected in series with a 100 μF capacitor across a 300 V, 50 Hz supply.
- a. Draw a well labelled diagram for this configuration. (3 marks)
- Determine the following:
- b. the current flowing in the circuit (5 marks)
 - c. the phase difference between the supply voltage and current (3 marks)
 - d. the voltage across the coil and its phase angle (5 marks)
 - e. the voltage across the capacitor. (4 marks)

END OF EXAMINATION PAPER