Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	ELECTRICAL TECHNOLOGY
COURSE CODE	:	DAE 11003
PROGRAMME CODE	:	DAE
EXAMINATION DATE	:	JANUARY / FEBRUARY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **FOUR (4)** QUESTIONS **ONLY** FROM **FIVE (5)** QUESTIONS PROVIDED. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Give the difference between conductor, insulator and semiconductor in term of electrical properties and valence electrons.

(6 marks)

(b) Determine the resistance and tolerance value for the following 4-band resistors.

(i) Red, Violet, Orange, Silver

(2 marks)

(ii) Green, Blue, Green, Gold

(2 marks)

(c) An energy source forces a constant current of 2 A for 10 s to flow through a light bulb. If 2.3 kJ is given off in the form of light and heat energy, calculate the voltage drop across the bulb.

(5 marks)

(d) Determine whether the resistor in each circuit of **Figure Q1 (d)** has possibly been damaged by overheating.

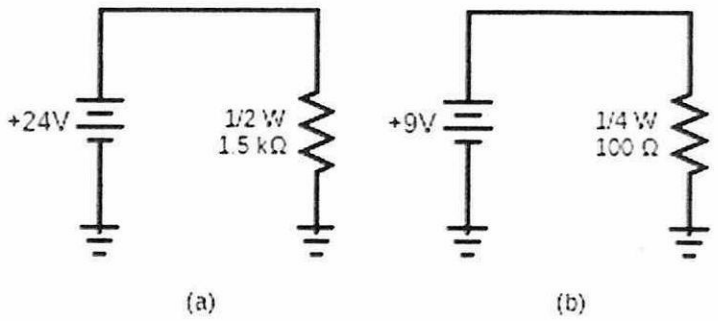

Figure Q1 (d)

(6 marks)

(e) A power supply has efficiency of 75%. If P_{IN} is 50 W, calculate:

(i) P_{OUT}

(2 marks)

(ii) P_{LOSS}

(2 marks)

Q2 (a) State the definition of Kirchhoff's Current Law and Kirchhoff's Voltage Law by giving an appropriate circuit diagram.

(5 marks)

(b) A series circuit consists of ½ W, ¼ W and 1/8 W resistors. The total resistance, R_T is 2400 Ω. If each of the resistors is operating in the circuit at its maximum power dissipation, calculate the current, I_T of the circuit.

(8 marks)

(c) Find R_1, R_2 and R_3 in **Figure Q2 (c)**.

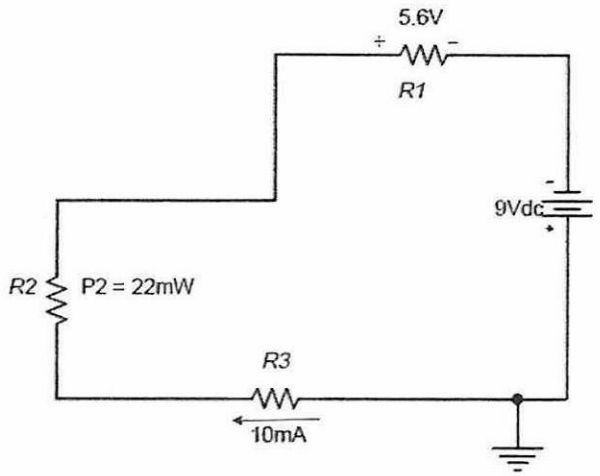

Figure Q2 (c)

(6 marks)

(d) A circuit with resistors and potential voltage of 15 V is connected to a fuse with 0.5 A as shown in **Figure Q2 (d)**. Justify the minimum value of the 100 Ω rheostat in the circuit could be adjusted before the 0.5 A fuse blows?

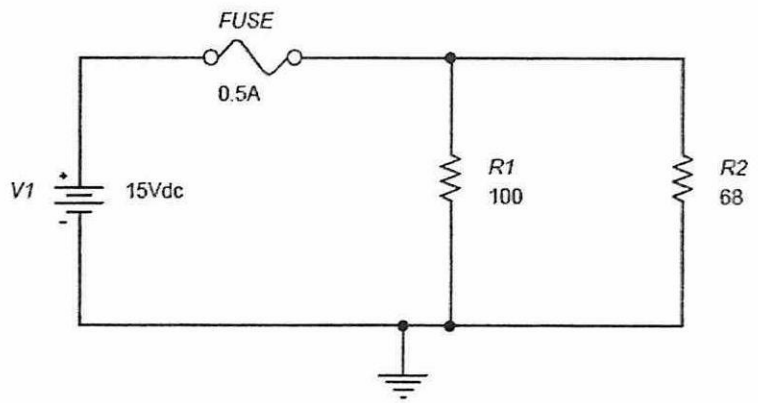

Figure Q2 (d)

(6 marks)

Q3 (a) Referring to **Figure Q3 (a);**

(i) Calculate the total resistance (R_T) when S_1 and S_2 are closed.

(3 marks)

(ii) Which switch should be closed to obtain the total resistance of the circuit equal 2 Ω?

(1 mark)

(iii) When $V_{AB} = 210$ V, calculate the value of voltage across one of the 4 Ω resistors if only the S2 switch is closed.

(5 marks)

(iv) If the current 4 A flows through the 5 Ω resistor in with all switches open, calculate the voltage between point A and B.

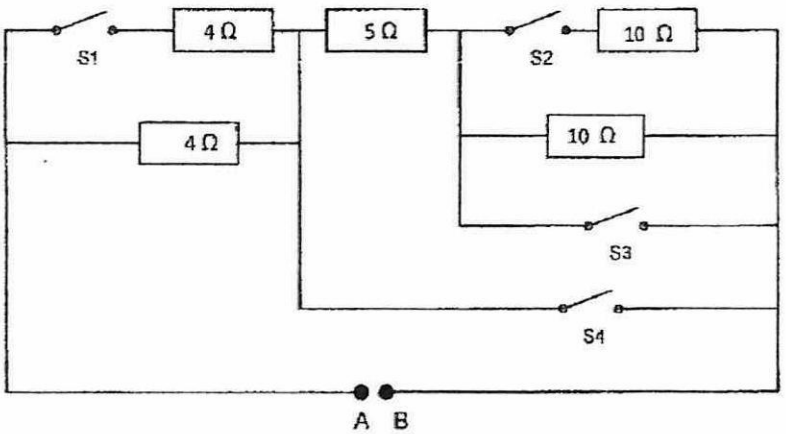

Figure Q3 (a)

(2 marks)

(b) A Wheatstone bridge circuit consists of four (4) resistors and a dc voltage source which look alike a 'diamond' configuration.

(i) Draw the Wheatstone bridge (complete with R_1, R_2, R_3, R_4, dc source and V_{out} terminals).

(3 marks)

(ii) Derive $R_1 = R_3 \left[\frac{R_2}{R_4}\right]$ under balance condition.

(3 marks)

(iii) Give **two (2)** conditions of the balanced Wheatstone bridge.

(2 marks)

(c) Referring to circuit in **Figure Q3 (c)**, calculate the total resistance (R_T) between terminals A and B.

(6 marks)

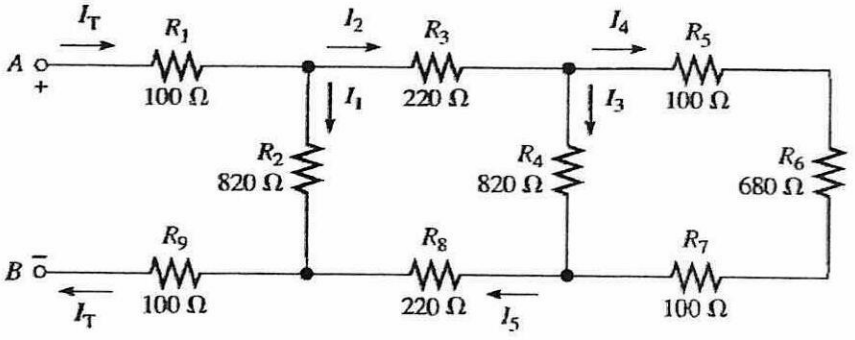

Figure Q3 (c)

Q4 (a) Define 'flux density', state the formula and its unit.

(3 marks)

(b) Referring to **Figure Q4 (b)(i)** and **Figure Q4 (b)(ii)**, redraw each of the figure and show the magnetic field lines.

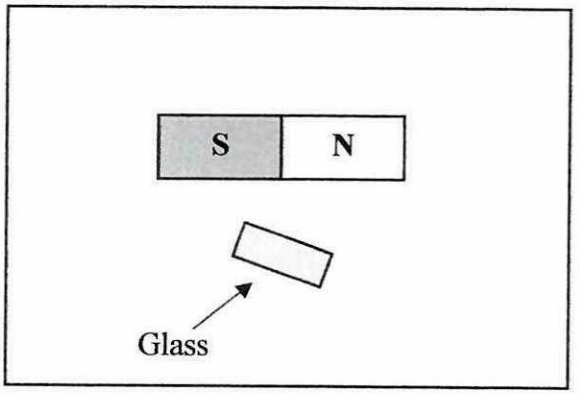

Figure Q4 (b)(i) (2 marks)

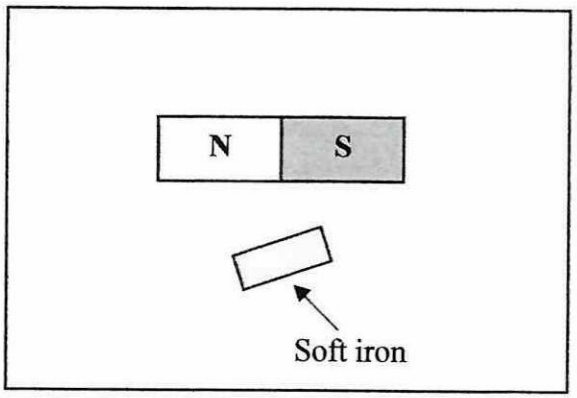

Figure Q4 (b)(i) (2 marks)

(c) There are 8 A current through a wire with 11 turns.

(i) Obtain the Magnetomotive Force (mmf)

(2 marks)

(ii) Obtain the reluctance of the circuit if the magnetic flux is 350 μWb.

(2 marks)

(d) Define 'RMS value' of a sine wave.

(2 marks)

(e) With the aid of diagram, illustrate a frequency sine wave of 6 Hz.

(2 marks)

(f) Determine the value of sine wave A in **Figure Q4 (f)** at each of the following times, measured from the positive-going zero crossing. Assume the frequency is 5 kHz.

i. 30 μs (5 Marks)

ii. 75 μs (5 Marks)

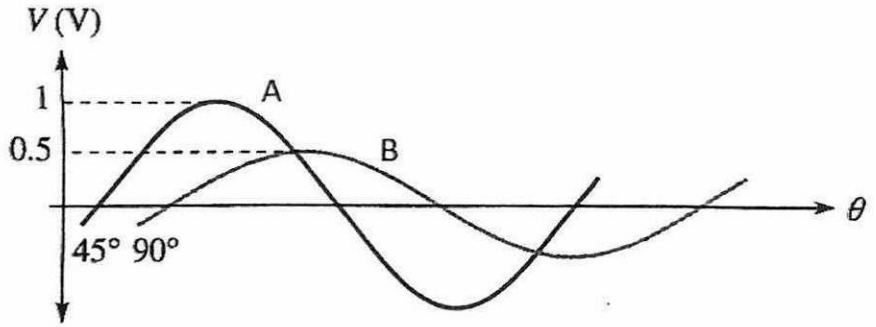

Figure Q4 (f)

Q5 (a) Draw a phasor diagram that represent the sine wave illustrated in **Figure Q5(a)**.

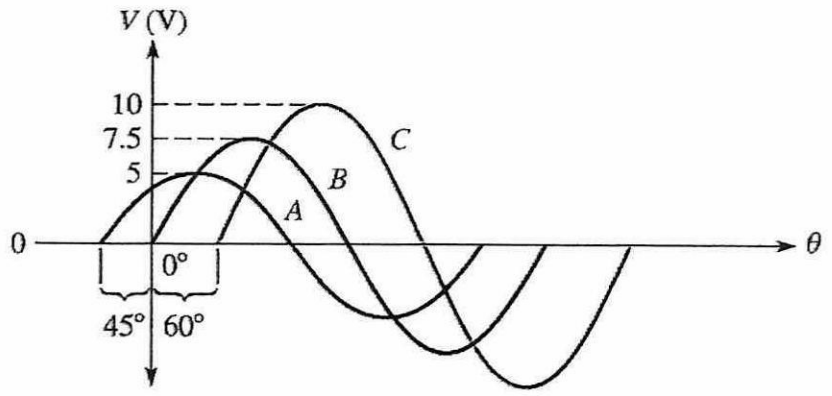

Figure Q5 (a).

(3 marks)

(b) Perform the following operations. Write your solution in rectangular form with three decimal places.

(i) $\dfrac{(25\angle 30° + 75\angle 45°)(50 - j10)}{(12 + j19)(35\angle 50°)}$

(2 marks)

(ii) $\dfrac{20\angle 65° - (18 - j30)}{15\angle 25°}$

(2 marks)

(iii) $\dfrac{100\angle 15°}{20 + j40} - j\left(\dfrac{1}{2} - j\dfrac{2}{3}\right)$

(2 marks)

(c) Explain **two (2)** significant difference between rectangular and polar form of a complex numbers.

(4 marks)

(d) Define transformer efficiency and the relevance formula involve.

(4 marks)

(e) A transformer is designed to have the following specification. The magnetic flux produced by a primary coil linking to secondary coil of the transformer is 375 μWb and total magnetic flux generated by primary coil is 500 μWb. The inductance of primary coil is 1 mH and secondary coil is 600 μH. The turn ratio of the transformer is 3:4. Calculate:

(i) Coefficient of coupling, k.

(2 marks)

(ii) Mutual Inductance, L_M.

(2 marks)

(iii) Secondary voltage of the transformer (V_{SEC}), when 120 VAC is applied to the primary winding.

(2 marks)

(iv) Secondary load current (I_{SEC}), when primary current of 90 mA is applied.

(2 marks)

- END OF QUESTIONS -