Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	ELECTRICAL AND ELECTRONIC TECHNOLOGY
COURSE CODE	:	BDU 10803
PROGRAMME CODE	:	BDC/BDM
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWERS **FOUR (4)** QUESTIONS ONLY 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK** 3. STUDENTS **PROHIBITED** CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1 (a) Explain the definition of the following terms in electricity:

(i) Voltage

(2 marks)

(ii) Load

(2 marks)

(b) There are several factors that may affect the resistance of an electrical conductor. By considering these factors, suggest two (2) ways to ensure the resistance of a resistor is maintained at a low level.

(6 marks)

(c) A simple battery test circuit is designed to have a voltage source of 12 V and three (3) resistors: R_1 (1200 mΩ), R_2 (550 Ω) and R_3 (1.2 kΩ). Identify:

(i) the total resistance, R_T
(ii) the current
(iii) the voltage each resistor
(iv) the power in each resistor

(9 marks)

(d) Resistors of 20 Ω, 20 Ω and 30 Ω are connected in parallel.

(i) Determine the resistance that must be added in series with the combination to obtain a total resistance of 10 Ω.
(ii) Sketch the complete circuit.
(iii) If the complete circuit expends a power of 0.36 kW, find the total current flowing.

(6 marks)

Q2 (a) Explain the steps required to obtain the solution in electric circuits by mesh analysis.

(4 marks)

(b) Mesh analysis can be used to solve for the unknown in the circuit shown in **Figure Q2(a)**. Construct equation for each mesh and find the current I_o.

(8 marks)

(c) As shown in **Figure Q2(b)**, a 120 Ω resistor (R1), a 360 Ω resistor (R2) and a 240 Ω resistor (R3) are connected to a 28 V voltage source (Vs1) and a 12 V voltage source (Vs2). Using nodal analysis, determine the current flows in R2 and the power consumption of R3.

(6 marks)

(d) As shown in **Figure Q2(c),** a 3Ω resistor (R1), a 6Ω resistor (R2) and a 5Ω resistor (R3) are connected to a 10V voltage source (V_{S1}). Using Thevenin's Theorem, calculate the value of V_{Th} and the R_{Th} of the circuit.

(7 marks)

Q3 (a) Both the capacitor and inductor are passive elements. Explain the difference between a capacitor and an inductor.

(4 marks)

(b) Calculate the equivalent capacitance and inductance by simplifying the circuit in **Figure Q3(b)** to a single capacitor and a single inductor.

(5 marks)

(c) The circuit as shown in **Figure Q3(c)** is under DC condition. Analyze the circuit and determine V_c, i_L and the energy stored in the capacitor and inductor.

(8 marks)

(d) The switch in the circuit in **Figure Q3(d)** has been closed for a long time. It is then opened at $t = 0$. Analyze the circuit and calculate the capacitor voltage $v(t)$ for $t > 0$.

(8 marks)

Q4 (a) Illustrate the following AC fundamental terms below using a voltage waveform as function of time.

(i) Peak to peak value

(2 marks)

(ii) Peak amplitude

(2 marks)

(b) Calculate the RMS value and the average value of the voltage wave shown in **Figure Q4(b).**

(5 marks)

(c) Examine the circuit shown in **Figure Q4(c)**. A 150 Ω resistor (R), a 0.5 H inductor (L) and a 100 μF capacitor (C) are connected in series to a 50 Hz source (V). The RMS current, I_{RMS} in the circuit is 10 A.

(i) Determine the RMS voltage across the resistor, inductor and capacitor

(6 marks)

(ii) Determine the RMS voltage across the RLC combination

(4 marks)

(iii) Sketch the phasor diagram for this circuit

(6 marks)

Q5 (a) (i) With simple sketches, illustrate the working principles of DC motor.

(5 marks)

(ii) State three (3) differences between AC and DC motor.

(3 marks)

(b) (i) Construct a truth table for the logical functions at the points P, Q and R in the logic diagram of **Figure Q5(b)(i)**. Identify a single logic gate that can be applied to replace the whole circuit.

(5 marks)

(ii) Derive the Boolean expression for the logic circuit shown in **Figure Q5(b)(ii)**.

(6 marks)

(iii) Construct the logic circuit based on the Boolean expression.

$$Q = (A \cdot B \cdot C) + A \cdot \left(\overline{B} + \overline{C}\right)$$

(6 marks)

-END OF QUESTION-

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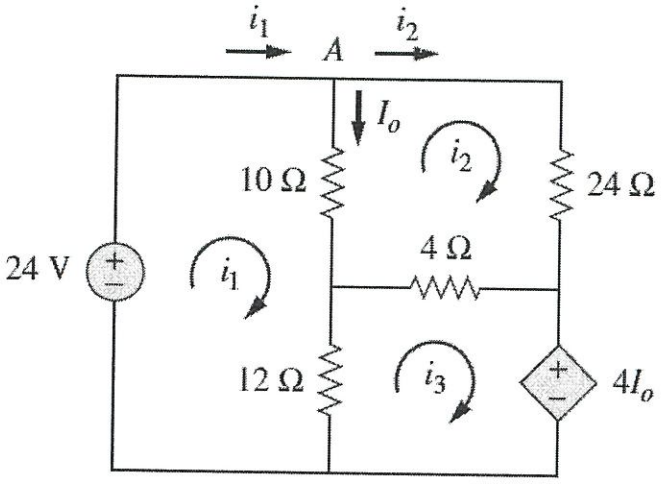

Figure Q2(a)

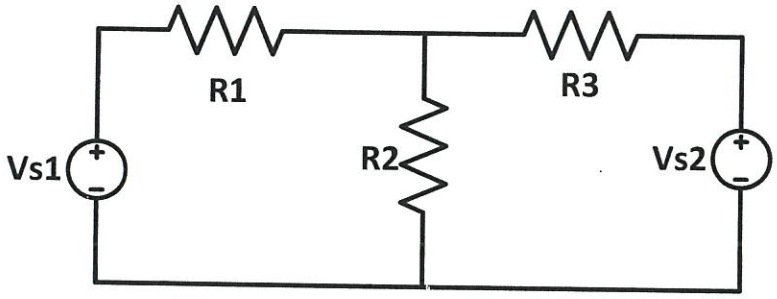

Figure Q2(b)

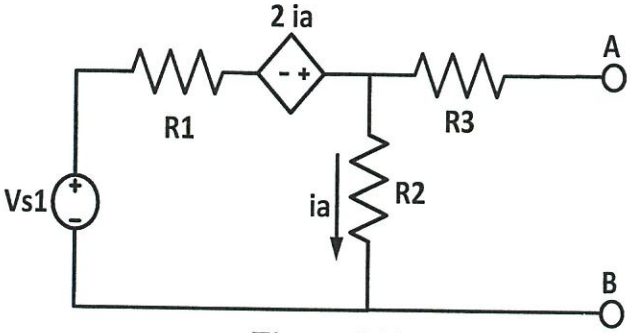

Figure Q2(c)

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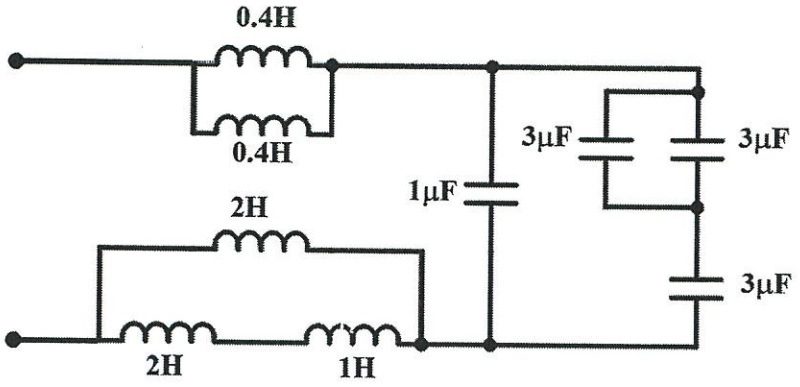

Figure Q3(b)

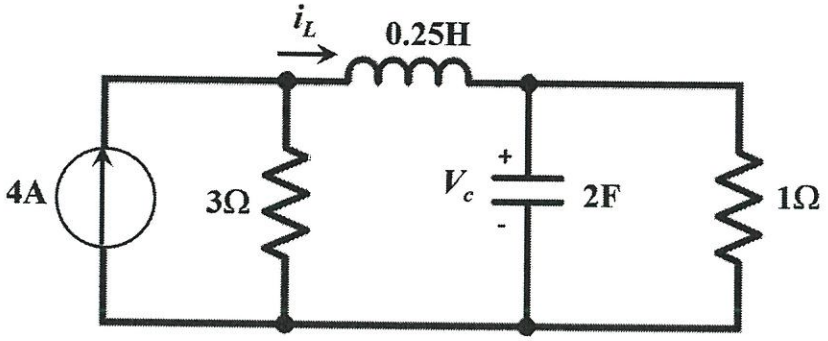

Figure Q3(c)

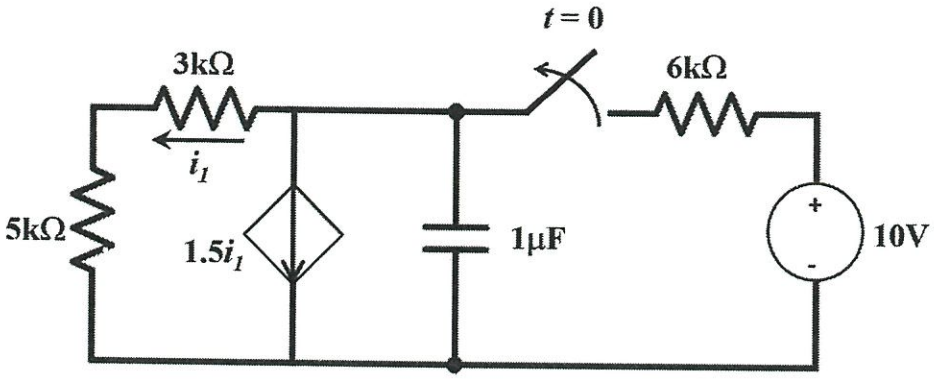

Figure Q3(d)

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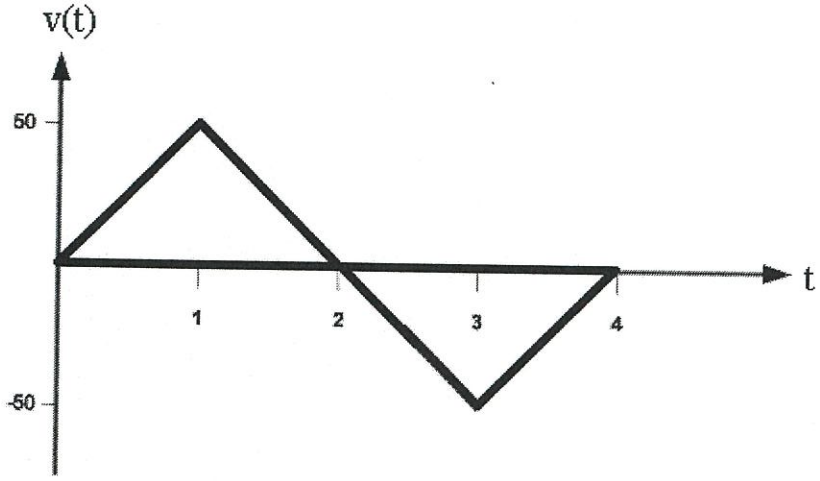

Figure Q4(b)

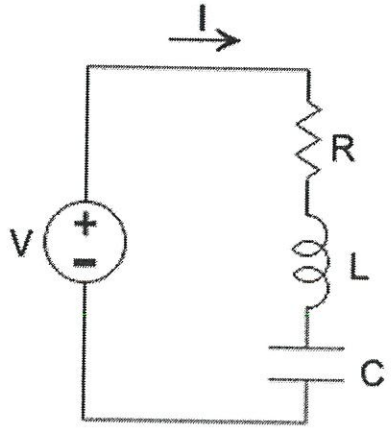

Figure Q4(c)

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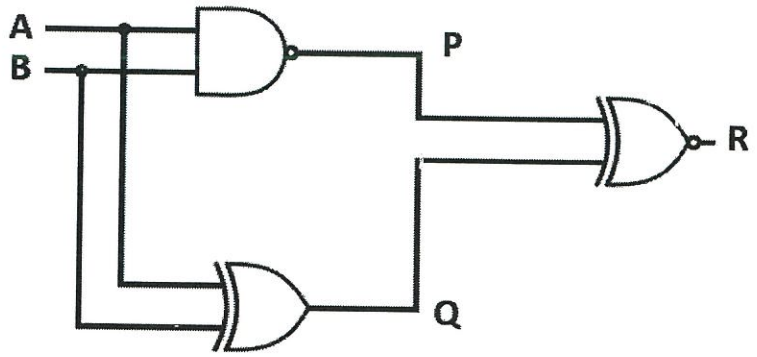

Figure Q5(b)(i)

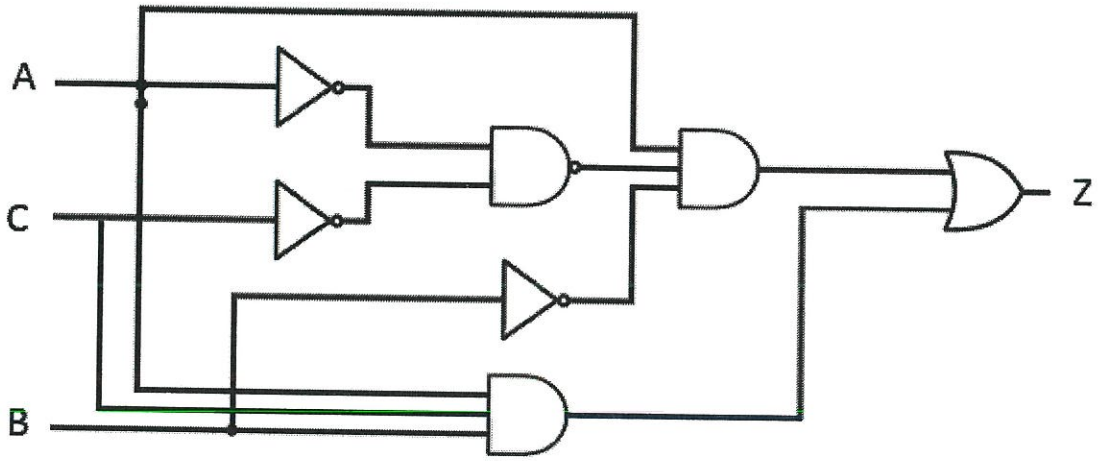

Figure Q5(b)(ii)

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LIST OF FORMULA

OHMS LAW

$$V = IR$$

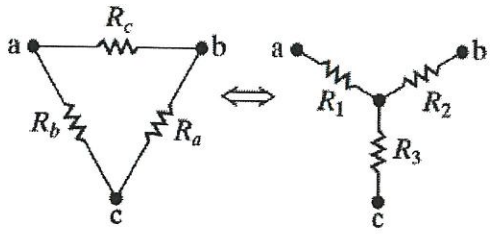
JOULE'S LAW

$$P = IV$$

KIRCHHOFF LAW

$$\sum_{k=1}^{n} i_k = 0 \qquad \sum_{v=1}^{n} v_k = 0$$

WYE-DELTA TRANSFORMATION

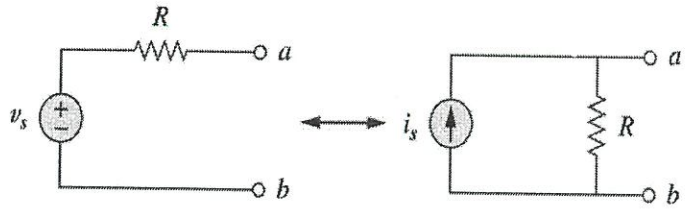


$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1} \qquad R_1 = \frac{R_bR_c}{R_a + R_b + R_c}$$

$$R_b = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_2} \qquad R_2 = \frac{R_cR_a}{R_a + R_b + R_c}$$

$$R_c = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_3} \qquad R_1 = \frac{R_aR_b}{R_a + R_b + R_c}$$

SOURCE TRANSFORMATION



$$V_S = I_sR$$

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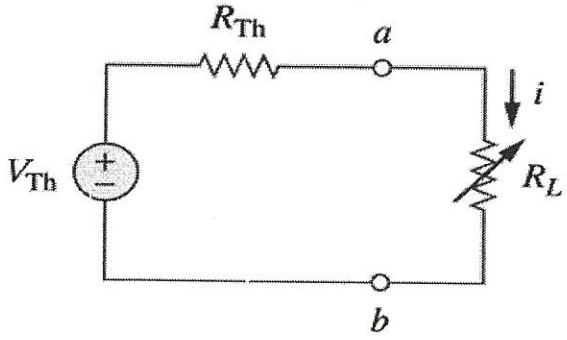
THEVENIN AND NORTON EQUIVALENT CIRCUIT

$$R_{TH} = R_N \qquad I_N = \frac{V_{TH}}{R_{TH}}$$

$$P = i^2 R_L = \left(\frac{V_{TH}}{R_{TH} + R_L} \right)^2 R_L \qquad \text{When } R_L \neq R_{TH}$$

$$P_{max} = \frac{V_{TH}^{\ 2}}{4R_{TH}} \qquad \text{When } R_L = R_{TH}$$

MAXIMUM POWER TRANSFER



$$P = i^2 R_L = \left(\frac{V_{TH}}{R_{TH} + R_L} \right)^2 R_L$$

CAPACITOR AND INDUCTOR

$$C = \frac{\varepsilon A}{d} \qquad v(t) = \frac{1}{C}\int_{-\infty}^{t} i(t)dt + v(t_0)$$

$$i = C\frac{dv}{dt} \qquad w = \frac{1}{2}Cv^2$$

$$L = \frac{N^2 \mu A}{l} \qquad v = L\frac{di}{dt}$$

$$i = \frac{1}{L}\int_{t_0}^{t} v(t)dt + i(t_0) \qquad w = \frac{1}{2}Li^2$$

$$\tau = RC \qquad \tau = \frac{L}{R}$$

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PHASOR REALTIONSHIP

$$v(t+T)=v(t)$$

$$f=\frac{1}{T}$$

$$z=x+jy=r\angle\phi=r(\cos\phi+j\sin\phi)$$

ALTERNATING CURRENT POWER CALCULATION

$$P(t)=v(t)i(t)$$ Instantaneous power

$$P=\frac{1}{2}\mathrm{Re}[VI^*]=\frac{1}{2}V_mI_m\cos(\theta_v-\theta_i)$$ Average power

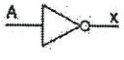
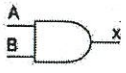
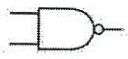
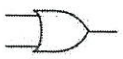
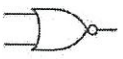
$$i_{RMS}=\sqrt{\frac{1}{T}\int_0^T i^2dt}$$

$$P_{RMS}={I_{RMS}}^2R=\frac{{V_{RMS}}^2}{R}$$

TRANSFORMERS

$$\frac{V_P}{V_S}=\frac{N_P}{N_S}$$

LOGIC GATES

Name	NOT	AND	NAND	OR	NOR	XOR	XNOR
Alg. Expr.	$\overline{A}$	AB	$\overline{AB}$	$A+B$	$\overline{A+B}$	$A\oplus B$	$\overline{A\oplus B}$
Symbol							

Truth Table

A	X
0	1
1	0

B	A	X
0	0	0
0	1	0
1	0	0
1	1	1

B	A	X
0	0	1
0	1	1
1	0	1
1	1	0

B	A	X
0	0	0
0	1	1
1	0	1
1	1	1

B	A	X
0	0	1
0	1	0
1	0	0
1	1	0

B	A	X
0	0	0
0	1	1
1	0	1
1	1	0

B	A	X
0	0	1
0	1	0
1	0	0
1	1	1