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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ELECTRICAL AND ELECTRONIC TECHNOLOGY
COURSE CODE	:	BDA 14303
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	PART A: ANSWER **ONE(1)** QUESTION **ONLY** PART B: ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **TWELVE (12)** PAGES

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PART A:

Q1 (a) A 3-band resistor is marked as 1st band Brown, 2nd band Black and 3rd band Orange. Define its resistance and between what values does it lie?

(3 marks)

(b) Recall two (2) examples of passive electrical components.

(2 marks)

(c) A voltage of 20 V is required to cause a current of 2 A to flow in the resistor of resistance 10 Ω. Identify the voltage that is required to make the same current flow if the resistance was 40 Ω.

(3 marks)

(d) Solve V_{AB} by applying the Kirchhoff's second law, for the network shown in **Figure Q1 (d)**.

(5 marks)

(e) Referring to **Figure Q1 (e)**, use the Wye-Delta Transformation to solve the total resistance, R_T and the voltage Vo. Given the source current, I is 5 mA.

(12marks)

Q2 (a) Nodal analysis is a technique to find currents and voltage between nodes in a circuit. Explain the steps to conduct nodal analysis

(4 marks)

(b) With the assistance of a diagram, explain what is Thevenin Theorem?

(6 marks)

(c) Referring to a circuit in **Figure Q2 (c)**,

(i) Use Thevenin Theorem to analyze V_{TH} and R_{TH} at terminal AB.

(ii) Determine the value of current passed R_4.

(15 marks)

PART B:

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

(4 marks)

(b) Three capacitors have capacitances of 2, 4 and 8 μ F respectively. Find the total capacitance when they are connected;

(i) in series

(ii) in parallel

(4 marks)

(c) The switch in the circuit in **Figure Q3(c)** has been closed for a long time. It is opened at t = 0. Calculate the current $i_0(t)$ for t > 0.

(8 marks)

(d) The current, i (A) through a 0.1H inductor is $i(t) = 10t\, e^{-5t}$ A. Find the voltage, v (V) across the inductor and the energy, w (J) stored in it.

(9 marks)

Q4 (a) Explain what is meant by the RMS value of an alternating current and explain why the RMS value is usually more important than either the maximum or the mean value of the current.

(4 marks)

(b) Referring to **Figure Q4 (b)**, calculate the RMS value for a voltage defined as the following saw tooth function over an interval [0, 2T]:
(Given $V_{pk} = 200V$).

$$V(t) = \begin{cases} \frac{V_{pk}}{T}t, & for\ 0 < t < T \\ -V_{pk} + \frac{V_{pk}}{T}(t - T), & for\ T < t < 2T \end{cases}$$

(5 marks)

(c) Given a 50 Ω resistor (R), a 0.2 H inductor (L) and a 10 μF capacitor (C) are connected in series to a 5 Hz source (V). The RMS current, I_{RMS} in the circuit is 2 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) A Karnaugh map is a way of rearranging a truth table so that terms which can be simplified and are more easily identified. List four (4) main stages to creating a logic expression using a Karnaugh map.

(4 marks)

(b) Reduce the function specified in the truth table of **Table Q5 (b)** to its minimum sum-of-product (SOP) form using a Karnaugh map. Subsequently, draw the logic circuit using NAND gates only.

Table Q5 (b)

INPUTS A B C	**OUTPUT X**
0 0 0	1
0 0 1	1
0 1 0	0
0 1 1	1
1 0 0	1
1 0 1	1
1 1 0	0
1 1 1	1

(6 marks)

(c) In digital system, different gates are connected to perform different functions. Such circuits are called combinational logic circuit. **Figure Q5 (c)** shows a combinational logic circuit.

(i) Obtain the complete Boolean expression for X

(6 marks)

(ii) Using Boolean expression in **Q5 (c)(i)**, derive a truth table for the function X.

(6 marks)

(iii) Identify and draw the logic circuit for the simplified Boolean expression by using only a single logic gate that can be applied to replace the whole circuit.

(3 marks)

-END OF QUESTIONS –

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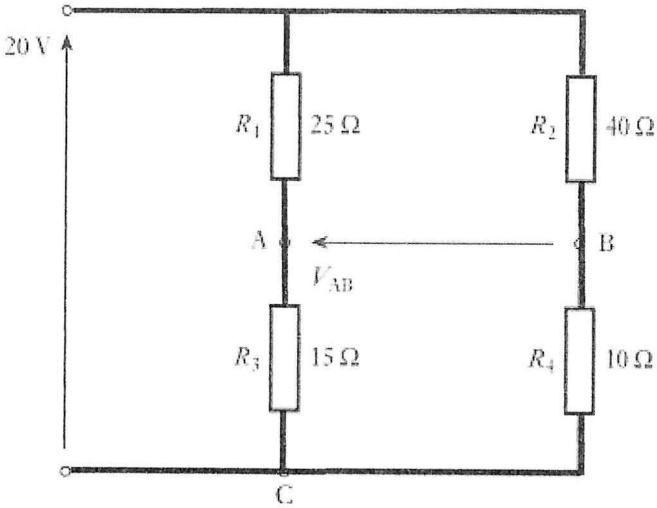

Figure Q1 (d)

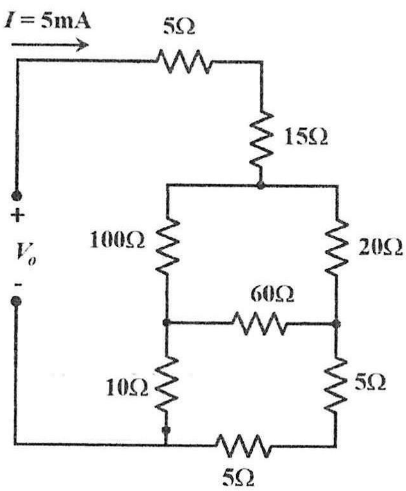

Figure Q1 (e)

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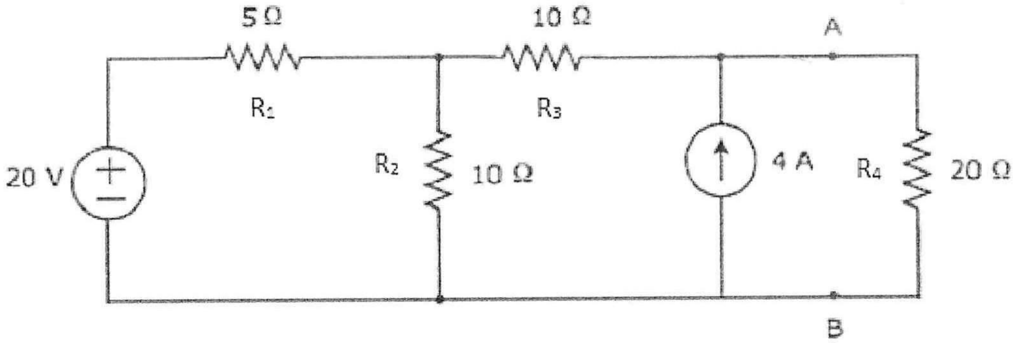

Figure Q2 (c)

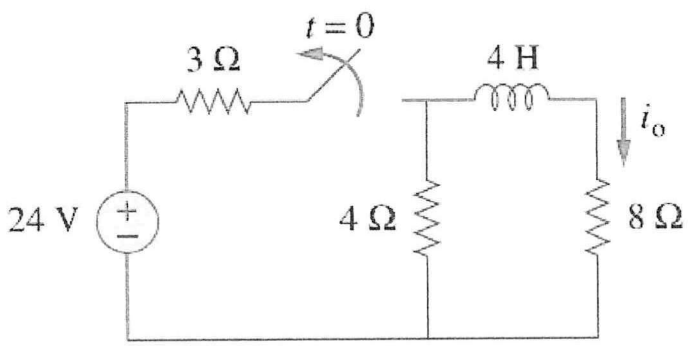

Figure Q3 (c)

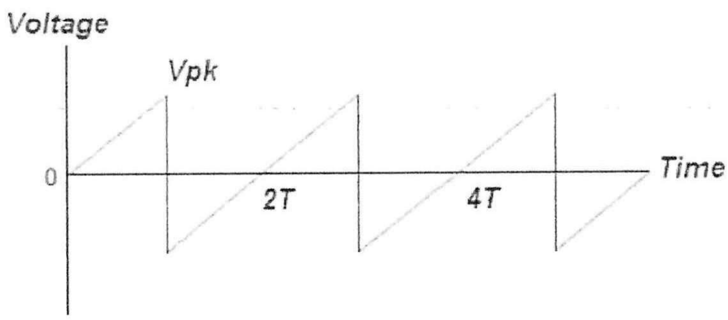

Figure Q4 (b)

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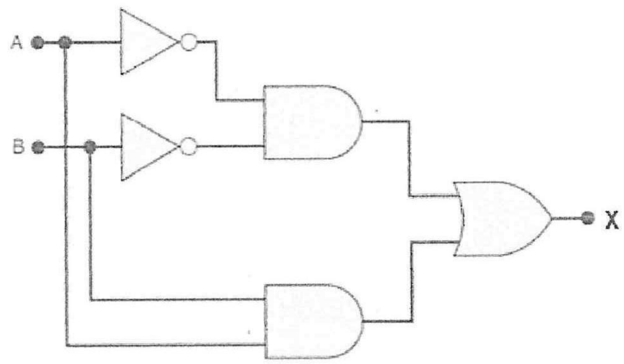

Figure Q5(c)

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LIST OF FORMULA

OHMS LAW

$$V = IR$$

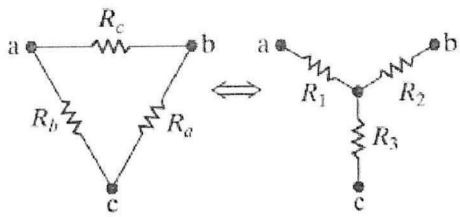
JOULE'S LAW

$$P = IV$$

KIRCHHOFF LAW

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

WYE-DELTA TRANSFORMATION

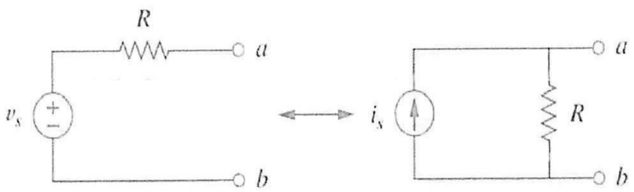


$$R_a = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1} \qquad R_1 = \frac{R_bR_c}{R_a + R_b + R_c}$$

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

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

SOURCE TRANSFORMATION



$$V_S = I_sR$$

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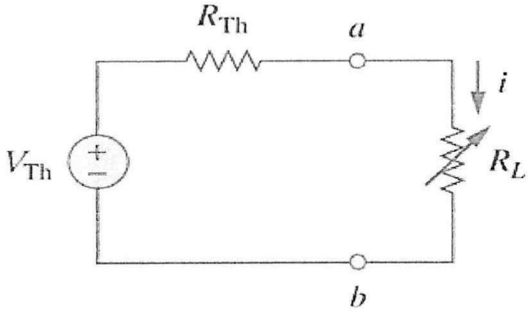
THEVENIN AND NORTON EQUIVALENT CIRCUIT

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

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

$$P_{max} = \frac{V_{TH}^{\ 2}}{4R_{TH}}$$ 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

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

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

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

TRANSFORMERS

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

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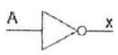
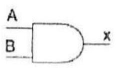
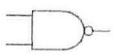
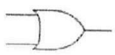
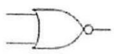
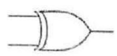
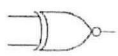
STANDARD RESISTOR VALUES AND COLOR

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

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