Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	ELECTRICAL AND ELECTRONIC TECHNOLOGY
COURSE CODE	:	BDU 10803
PROGRAMME CODE	:	BDC/BDM
EXAMINATION DATE	:	JANUARY/FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	**SECTION A:** ANSWER **ALL** QUESTIONS. **SECTION B:** ANSWER **ALL** QUESTIONS. **SECTION C:** ANSWER **ONLY TWO (2)** QUESTIONS.

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

SECTION A: Answer **all** questions. Each question carries 1 mark.

1. A material in which there are no free charge carries is known as:
- a. a conductor
- b. an insulator
- c. a semiconductor
- d. an inductor

2. Conventional current flow is.
- a. always from negative to positive
- b. in the same direction as electron movement
- c. in the opposite direction of electron movement
- d. not related to electron movement

3. The correct symbol and unit for electric charge:
- a. Symbol: Q, Unit: C
- b. Symbol: C, Unit: F
- c. Symbol: C, Unit: V
- d. Symbol: C, Unit: Q

4. There are five currents that flow in and out of node A. If the amount of currents I_1, I_2, and I_3 that flow out from the node are 6 A, 8 A and 12 A, respectively; and the amount that enters the node is $I_4 = 15$ A, the unknown current, I_5, will be:
- a. 11 A flowing towards the node
- b. 17 A flowing away from the node
- c. 41 A flowing out from the node
- d. 26 A flowing towards the node

5. A 5-A current charging a dielectric material will not accumulate a charge after 10 s.
- a. The above statement is true
- b. The above statement is true false

6. An aircraft cabin has 110 passenger reading lamps each rated at 10 W, 28 V. What is the maximum load current imposed by these lamps?
- a. 25.5 A
- b. 39.3 A
- c. 308 A
- d. 0.36 A

7. A network has 12 branches and 8 independent loops. How many nodes are there in the network?
- a. 19
- b. 17
- c. 5
- d. 4

8. An AC waveform in an aircraft has a period of 4ms. Which one of the following gives its frequency?
   a. 25 Hz
   b. 250 Hz
   c. 4 kHz
   d. 100 Hz

9. When the AC voltage across a capacitor is kept constant and the frequency is increased, the current through the capacitor will:
   a. increase
   b. be zero
   c. decrease
   d. remain the same

10. In an electrical AC circuit, a capacitor will cause the
   a. voltage to lag the current by 90°
   b. voltage to lag the current by 180°
   c. voltage to lead the current by 90°
   d. voltage to lead the current by 180°

11. A logic 1 is present at the output of a two input NOR gate. Which one of the following is true?
   a. both of its inputs must be at logic 1
   b. both of its inputs must be at logic 0
   c. one of more of its inputs must be at logic 1

12. The function of a NOT logic gate within a circuit is to:
   a. ensure the input signal is DC only
   b. ensure the input signal is AC only
   c. invert the input signal such that the output is always of the opposite state
   d. ensure the output signal is of the same state as the input signal

13. There is a force of attraction between two current-carrying conductors when the current in them is:
   a. in opposite directions
   b. in the same direction
   c. of different magnitude
   d. of the same magnitude

14. The capacitance of a capacitor is the ratio of:
   a. charge to p.d. between plates
   b. p.d between plates to the plate spacing
   c. p.d. between plates to thickness of dielectric
   d. p.d. between plates to charge

15. The current through a resistor in a linear network is 2 A when the input source voltage is 10 V. If the voltage is reduced to 1 V and the polarity is reversed, the current through the branch is:

a. -2 A
b. -0.2 A
c. 0.2 A
d. 20 A

16. The source is supplying the maximum power to the load when the load resistance is not equal to the source resistance.

a. The above statement is true
b. The above statement is true false

17. The Norton resistance and the Thevenin resistance are similar.

a. The above statement is true
b. The above statement is true false

18. A combination of inductors in parallel is similar to resistors in parallel.

a. The above statement is true
b. The above statement is true false

19. A 5 H inductor changes its current by 3 A in 0.2 s. The voltage produced at the terminals of the inductor is:

a. 3 V
b. 8.888 V
c. 75 V
d. 1.2 V

20. Which of the following is not a right way to express the sinusoid A cos ωt

a. A cos $2\pi ft$
b. A cos $\omega(t - T)$
c. A cos$(2\pi t/T)$
d. A sin $(\omega t - 90°)$

SECTION B: Answer **all** questions.

Q1 (a) **Figure Q2(a)** shows a circuit that consists of 4 resistors is connected to 24 V voltage source and 4 A current source. Examine the circuit and determine the Thevenin equivalent at terminals *a-b*. Sketch the equivalent circuit to support your answer.

(10 marks)

(b) Principle of superposition is known as one of the methods to analyze a circuit. Examine the circuit shown in **Figure Q2(b)** using superposition principle to obtain the value of I_o. Justify your work by providing appropriate sketches on the circuit.

(10 marks)

Q2 (a) The gate network shown in **Figure Q5(a)** has three inputs, A, B and C.

(i) Find an expression for the output Z

(ii) Consider the rules in Boolean Algebra and suggest a minimize expression for this network.

(9 marks)

(b) The truth table given in **Table Q5(b)** shows the functions F(A,B,C) and G(A,B,C). Examine the given values and then:

(i) Construct a logic expression corresponding to the functions F(A,B,C)

(ii) Find the minimum expression for F(A,B,C)

(iii) Construct F(A,B,C) with logic gates

(11 marks)

SECTION C: Answer **only two (2)** questions.

Q3 (a) The resistance of an electrical conductor is contributed by a several factors.

(i) Explain the effect on resistance if the cross-sectional area of a conductor is doubled.

(ii) If a 5 m length of wire installed in an aircraft has a resistance of 600 ohm, determine the resistance of the same wire when the length is 9 m.

(5 marks)

(b) Examine the circuit given in **Figure Q3(b)**. The circuit is designed with $V_1 = 20\,V$, $V_2 = 6\,V$, $V_6 = 12\,V$, and $V_8 = 10\,V$ and the rest of the branch voltages are not specified.

(i) Identify the number of nodes that can be found in the circuit

(ii) Find the unknown branch voltages

(8 marks)

(c) Consider the circuit shown in **Figure Q3(c)**. Rearrange the circuit and determine the equivalent resistance, R_{ab}

(7 marks)

Q4 (a) A circuit with multiple capacitors can be reduced to a single capacitor. Examine the circuit shown in **Figure Q4(a)** and find the equivalent capacitance. Sketch the equivalent circuit in every step of your work to support your answer.

(8 marks)

(b) A coil that has negligible resistance and inductance on 700 mH is connected in series with a 100 Ω resistor to a 250 V, 40 Hz supply. Draw the circuit with appropriate labels and then calculate:

(i) the inductive reactance of the coil

(ii) the impedance of the circuit

(iii) the current in the circuit

(iv) the p.d. across each component

(v) the circuit phase angle

(12 marks)

Q5 (a) A source-free RC circuit is given in **Figure Q5(a).** Given:

$$v = 10e^{-4t}\ \text{V and } i = 0.2\ e^{-4t}\ \text{A}, \quad t > 0$$

Examine the given values, then:
(i) Find the values of R and C in the circuit
(ii) Determine the time constant
(iii) Determine the initial energy in the capacitor

(8 marks)

(b) A switch shown in **Figure Q5(b)** is used to enable the door warning indicator in an aircraft. If the switch has been closed for a long time and it only opens at $t = 0$, find v_o when $t > 0$.

(6 marks)

(c) Differentiate between the brushed and brushless DC motors based on the following characteristics: efficiency, maintenance, and noise generation.

(6 marks)

– END OF QUESTIONS –

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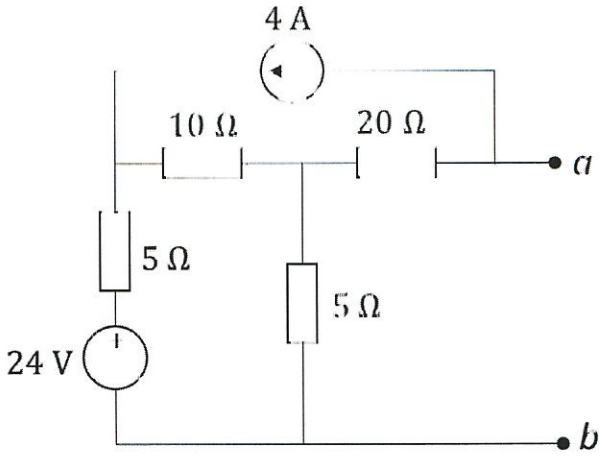

Figure Q1(a)

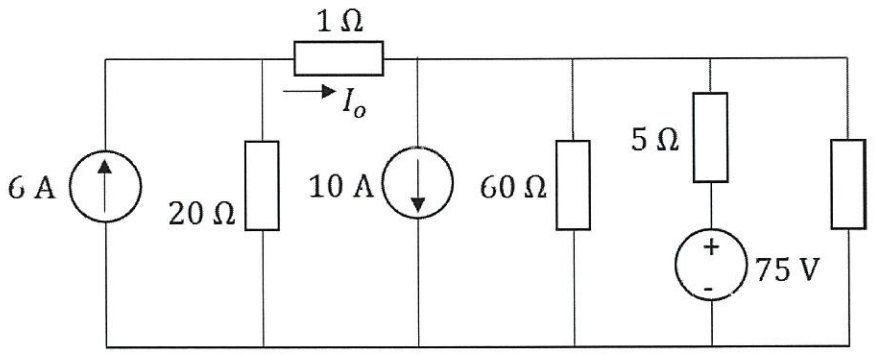

Figure Q1(b)

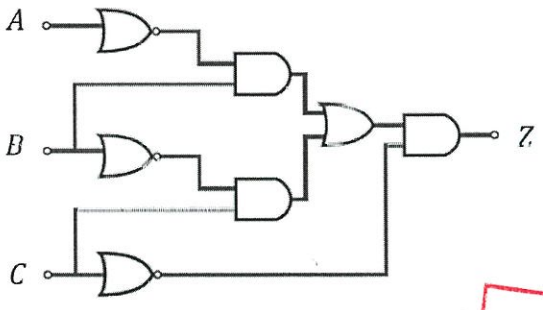

Figure Q2(a)

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A	B	C	$\bar{F}$ (A, B, C)	$\bar{G}$ (A, B, C)
0	0	0	1	0
0	0	1	0	0
0	1	0	0	0
0	1	1	0	1
1	0	0	1	0
1	0	1	1	1
1	1	0	0	1
1	1	1	1	1

Table Q2(b)

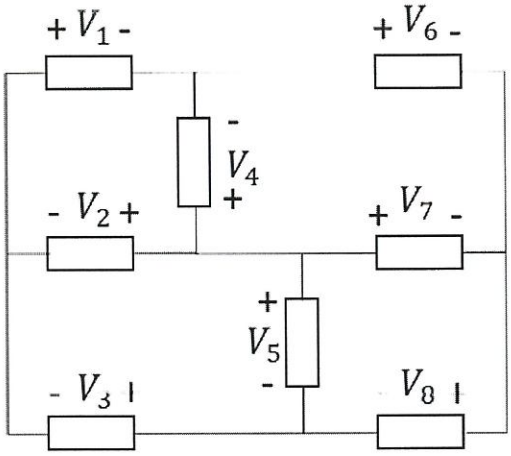

Figure Q3(b)

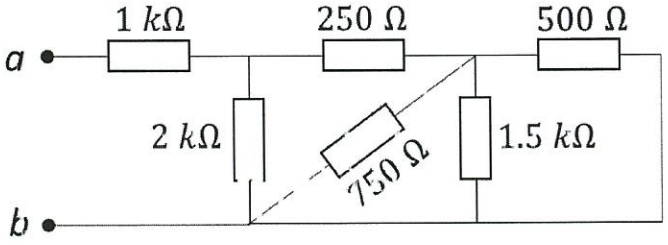

Figure Q3(c)

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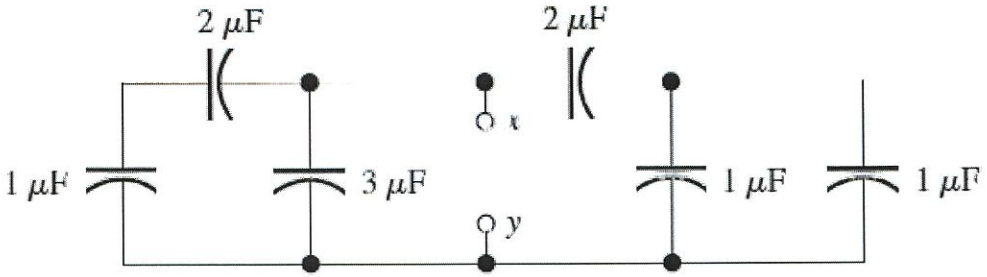

Figure Q4(a)

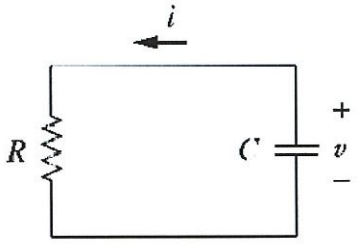

Figure Q5(a)

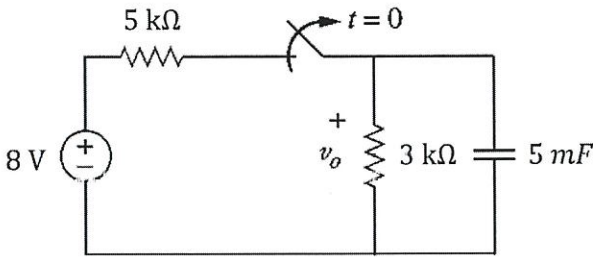

Figure Q5(b)

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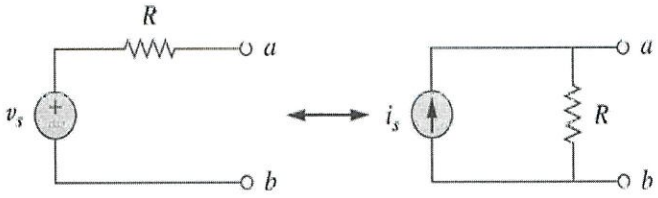
SOURCE TRANSFORMATION



$$V_S = I_s R$$

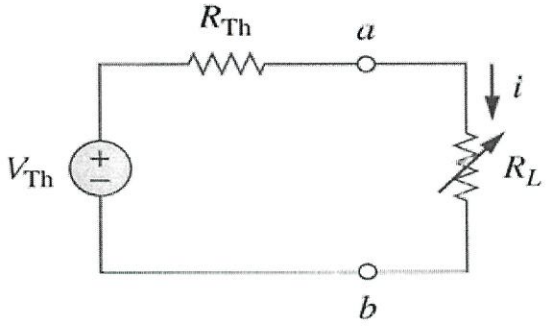
THEVENIN AND NORTON EQUIVALENT CIRCUIT

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

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

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

MAXIMUM POWER TRANSFER



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

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CAPACITOR AND INDUCTOR

$$C = \frac{\varepsilon A}{d}$$

$$i = C\frac{dv}{dt}$$

$$L = \frac{N^2 \mu A}{l}$$

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

$$t = RC$$

$$v(t) = \frac{1}{C}\int_{\infty}^{t} i(t)dt + v(t_0)$$

$$w = \frac{1}{2}Cv^2$$

$$v = L\frac{di}{dt}$$

$$w = \frac{1}{2}Li^2$$

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

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

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

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

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

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

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