Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	ELECTRICAL AND ELECTRONIC TECHNOLOGY
COURSE CODE	:	BNJ 10903
PROGRAMME CODE	:	BNG/BNH/BNK/BNL/BNM
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) Analyse the circuit shown in **Figure Q1(a)** and determine V_x.

(5 marks)

(b) Determine the equivalent resistance of the circuit shown in **Figure Q1(b)**. Hence calculate I_x and power dissipated in any of the 5 Ω resistor.

(8 marks)

(c) Analyse circuit in **Figure Q1(c)** and determine the voltage v_o using either Mesh or Superposition analysis.

(7 marks)

Q2 (a) The voltage across a 4 μF capacitor is

$$v(t) = \begin{cases} 5000t, & 0 < t < 2\text{ ms} \\ 20 - 5000t, & 2 < t < 6\text{ ms} \\ -40 + 5000t, & 6 < t < 8\text{ ms} \end{cases},$$

as shown in **Figure Q2(a)**.

(i) Determine and plot the capacitor current.

(7 marks)

(ii) Calculate the capacitor energy and power at $t = 3$ ms.

(3 marks)

(b) An inductor is an electrical component designed to store energy in its magnetic field.

(i) Give an example of inductor application in an automobile.

(1 mark)

(ii) Name and describe the example of the devices that uses the phenomenon of mutual induction.

(2 marks)

(c) Consider the circuit in **Figure Q2(c)**. Under DC conditions, calculate

(i) i, v_c, and i_L.

(4 marks)

(ii) The energy stored in the capacitor and inductor.

(3 marks)

Q3 (a) Determine the reluctance of a piece of Mu-metal of length 150 mm when the relative permeability is 4000. Calculate the absolute permeability of the Mu-metal.

(4 marks)

(b) A coil of 300 turns is wound uniformly on a ring of non-magnetic material. The ring has a mean circumference of 40 cm and a uniform cross-sectional area of 4 cm^2. If the current in the coil is 5 A, calculate:

(i) the magnetic field strength
(ii) the flux density
(iii) the total magnetic flux in the ring

(6 marks)

(c) A transformer can change electrical energy of a given voltage into electrical energy at a different voltage level. It consists of two coils arranged in such a way that the magnetic field surrounding one coil cuts through the other coil.

(i) Sketch the basic transformer structure. Identify and label the core, primary winding and secondary winding.

(4 marks)

(ii) An ideal transformer is rated at 2400/120 V, 9.6 kVa, and has 50 turns on the secondary side. Calculate the turn ratio, the number of turns on the primary side and the current rating for the primary and secondary winding.

(6 marks)

Q4 (a) From sinusoidal voltage equation

$$v(t) = 2\sin(50t + 1.57)\ \text{V},$$

determine :

(i) the peak voltage
(ii) the frequency
(iii) the period
(iv) the rms value
(v) phase angle

(5 marks)

(b) Determine the input impedance of the circuit shown in **Figure Q4(b)**. Hence calculate I_x.

(7 marks)

(c) Derive the nodal equations of the network shown in **Figure Q4(c)**.

(6 marks)

(d) State **TWO (2)** characteristics of AC system.

(2 marks)

Q5 (a) Describe the function of the electronic devices below:

(i) Diode
(ii) Sensor
(iii) Power inverter

(6 marks)

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

(i) Obtain the complete Boolean expression for Z.

(6 marks)

(ii) Using the Boolean expression for Z, build a truth table for the circuit and evaluate Z for each input combination.

(8 marks)

- END OF QUESTIONS –

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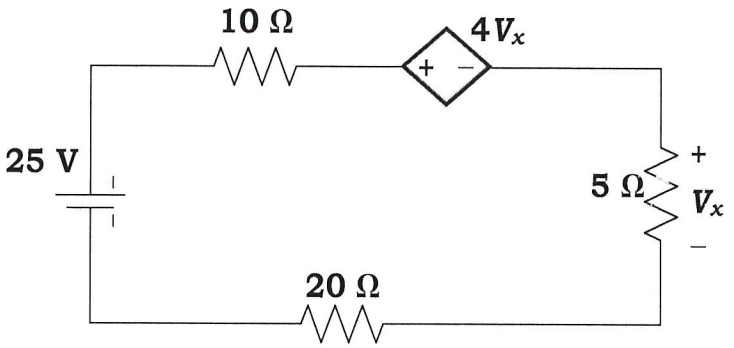

Figure Q1(a)

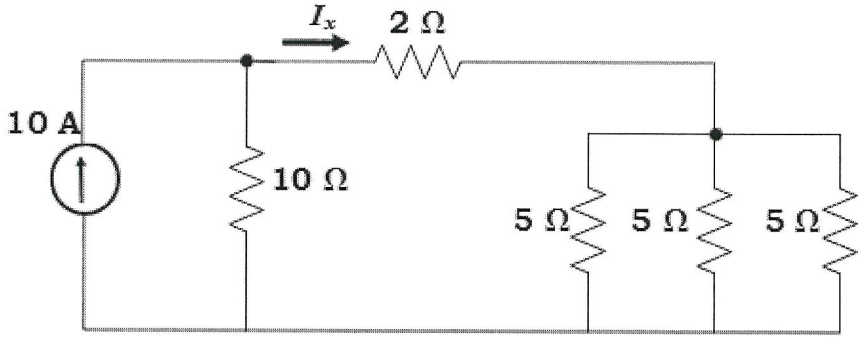

Figure Q1(b)

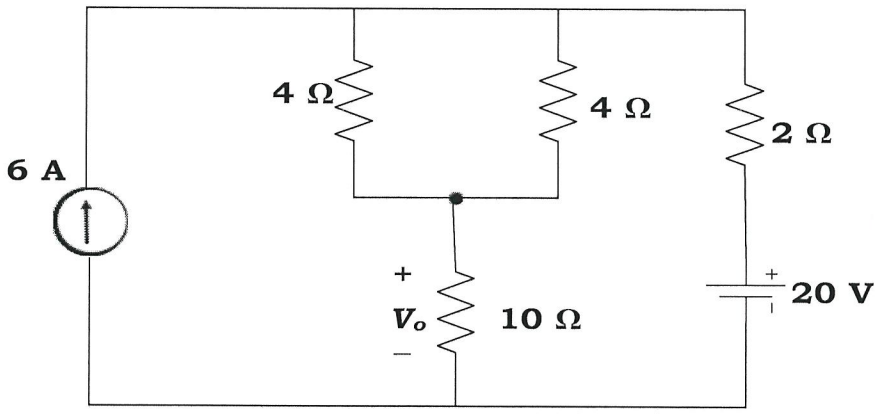

Figure Q1(c)

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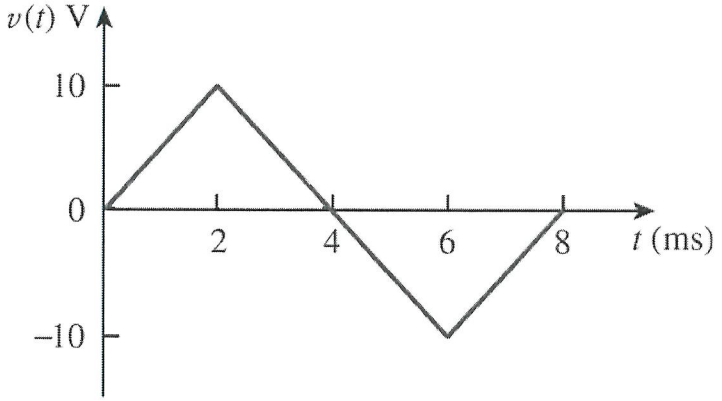

Figure Q2(a)

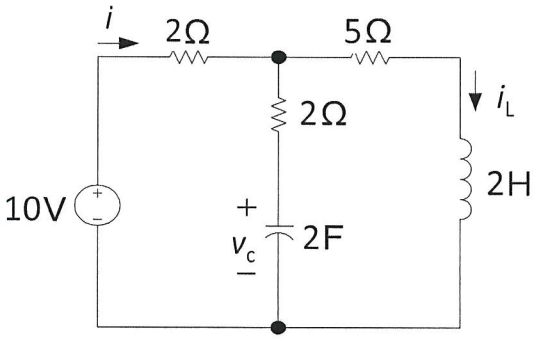

Figure Q2(c)

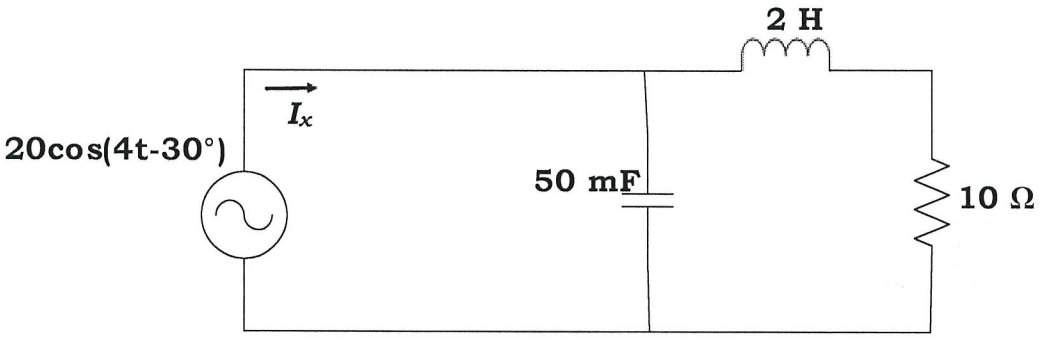

Figure Q4(b)

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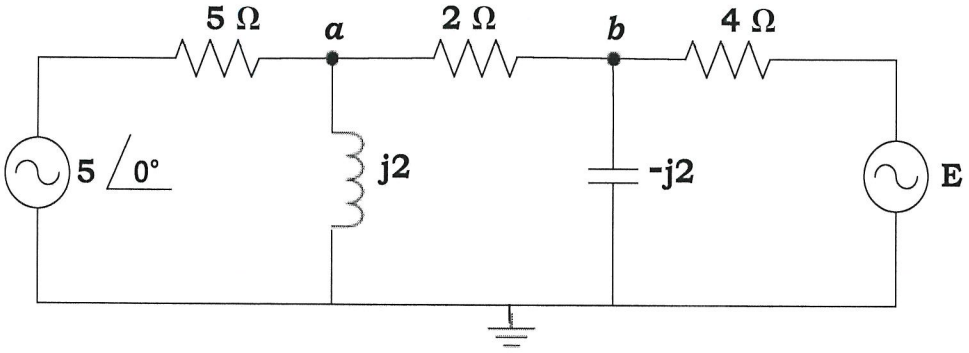

Figure Q4(c)

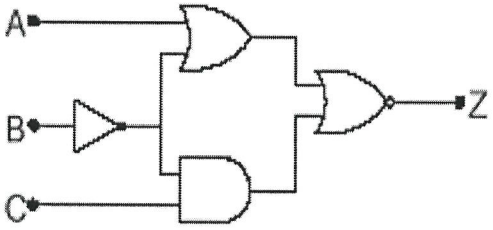

Figure Q5(b)

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LIST OF FORMULA

CAPACITOR AND INDUCTOR

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

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

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

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

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

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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LOGIC GATES

Name	*Graphic symbol*	*Algebraic function*	*Truth table*
AND		$x = A \cdot B$ or $x = AB$	A B | x 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1
OR		$x = A + B$	A B | x 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 1
Inverter		$x = A'$	A | x 0 | 1 1 | 0
Buffer		$x = A$	A | x 0 | 0 1 | 1
NAND		$x = (AB)'$	A B | x 0 0 | 1 0 1 | 1 1 0 | 1 1 1 | 0
NOR		$x = (A + B)'$	A B | x 0 0 | 1 0 1 | 0 1 0 | 0 1 1 | 0
Exclusive-OR (XOR)		$x = A \oplus B$ or $x = A'B + AB'$	A B | x 0 0 | 0 0 1 | 1 1 0 | 1 1 1 | 0
Exclusive-NOR or equivalence		$x = (A \oplus B)'$ or $x = A'B' + AB$	A B | x 0 0 | 1 0 1 | 0 1 0 | 0 1 1 | 1