UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE IIOME)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	ELECTRIC CIRCUIT II
COURSE CODE	:	BEJ 10403
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JULY 2020
DURATION	:	4 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. **OPEN BOOK EXAMINATION** 3. SHOW ALL CALCULATIONS

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

Q1 (a) Capacitors in **Figure Q1(a)** has been charged up to its steady state condition. For each of the capacitors, C_1 and C_2:

(i) Find the voltage, V_1 and V_2.

(4 marks)

(ii) Find the charge, Q_1 and Q_2.

(2 marks)

(iii) Calculate the energy in each capacitor.

(4 marks)

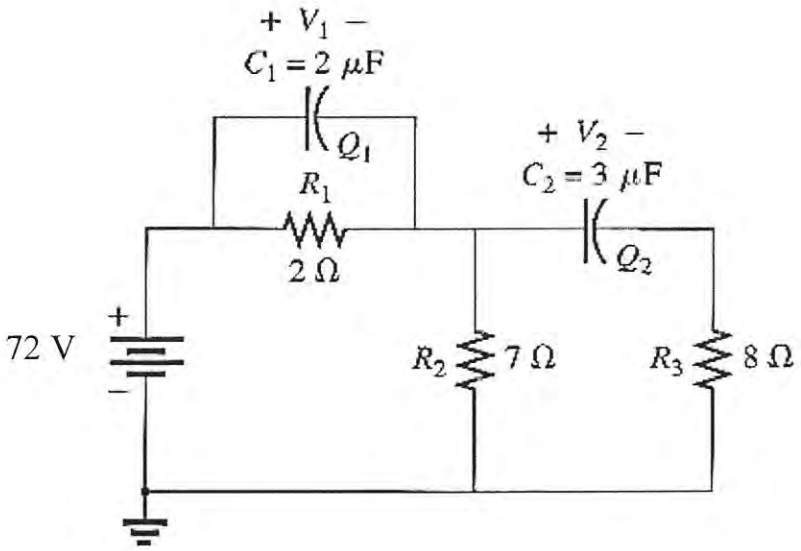

Figure Q1(a)

(b) Consider the circuit in **Figure Q1(b).** Assuming that the switch has been closed for a long time, then at $t = 0$ s, the switch is opened.

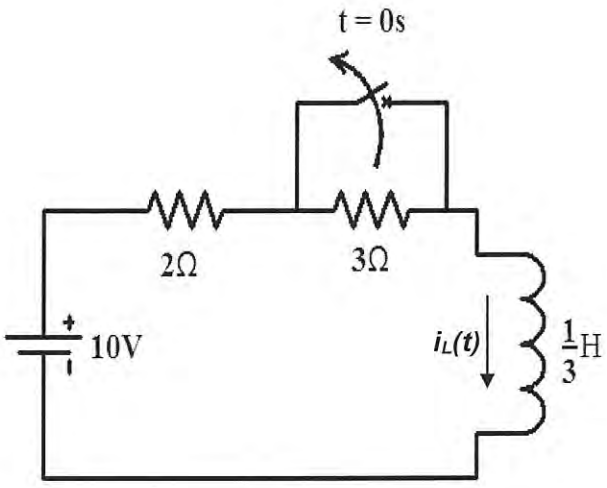

Figure Q1(b)

(i) Determine the current $i_L\ (t)$ for $t > 0$.

(9 marks)

(ii) Sketch the current response for $i_L\ (t)$ by considering it takes 5τ for the circuit to reach its final state.

(6 marks)

Q2 (a) **Figure Q2(a)** is an RLC circuit with R = 20 Ω, L = 4 H, and C = 50 mF. Assume the circuit is in steady state at t = 0^- before the switch is moved to position b at $t = 0$ s. Based on the circuit,

(i) determine the initial voltage and current, $v_C(0)$ and $i_L(0)$.

(3 marks)

(ii) identify the type of response for the output voltage, $v(t)$.

(3 marks)

(iii) solve the expression of $v(t)$ for $t > 0$ s.

(9 marks)

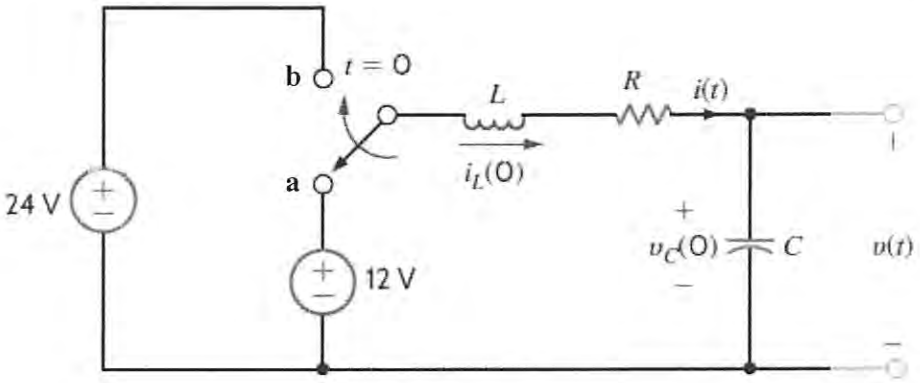

Figure Q2(a)

(b) In an experiment on a two-port network, the following observations are recorded:

$V_1 = 25$ mV and $I_2 = 5$ mA with port 1 open-circuited and $V_2 = 10$ V
$I_1 = 10$ mA and $I_2 = 1$ A with port 2 short-circuited and $V_1 = 20$ V

(i) Obtain the Z-parameter of the two-port network.

(8 marks)

(ii) Based on part **Q2(b)(i)**, determine whether the network is reciprocal or otherwise.

(2 marks)

Q3 (a) By assuming that the circuit in **Figure Q3(a)** operates at $\omega = 100$ rad/s;

(i) Find the input impedance, Z_{in} of the circuit.

(6 marks)

(ii) If an input voltage, $V_i = 10\cos(100t - 15°)V$ is applied to the circuit in **Figure Q3(a)**, determine the current in the circuit.

(3 marks)

(iii) Calculate the voltage, V_x. Give the answer in time domain.

(4 marks)

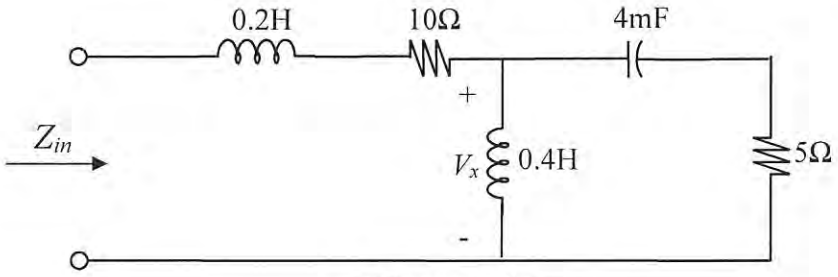

Figure Q3(a)

(b) Consider the circuit shown in **Figure Q3(b)**.

(i) Determine the Thevenin impedance, Z_{TH} seen from terminals *a-b* of the circuit. Show the related circuit diagram in your calculations.

(4 marks)

(ii) Calculate the Thevenin voltage, V_{TH} across terminals *a-b* of the circuit. Show the related circuit diagram in your calculations.

(4 marks)

(iii) Find the value of output current, I_o.

(4 marks)

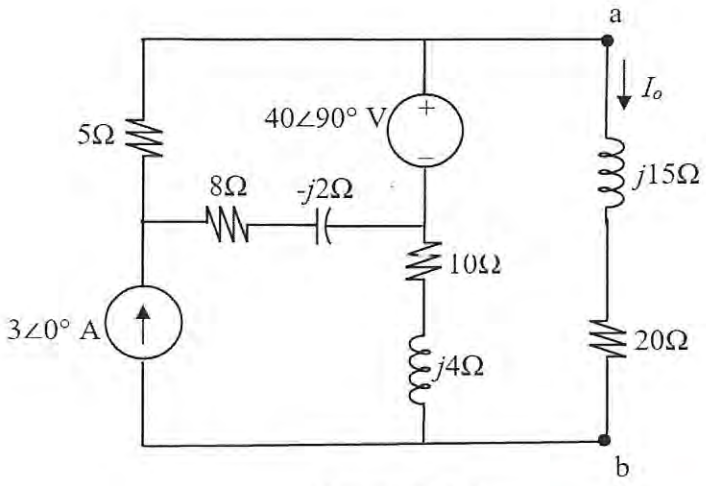

Figure Q3(b)

Q4 (a) Given a circuit in **Figure Q4(a)**;

(i) State the condition for maximum average power transfer to the load impedance, Z_L.

(2 marks)

(ii) Determine the load impedance, Z_L.

(4 marks)

(iii) Find the maximum average power.

(5 marks)

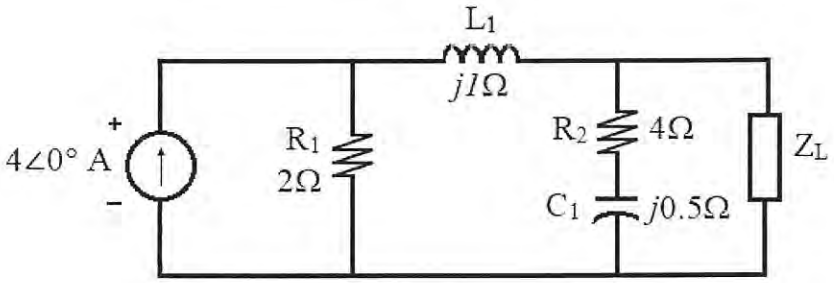

Figure Q4(a)

(b) An air conditioner operates at $240V_{rms}$ at a frequency of 60 Hz. It absorbs an average power of 9 kW at a lagging power factor, F_p of 0.75. The power triangle for a load system is shown in **Figure Q4(b)**.

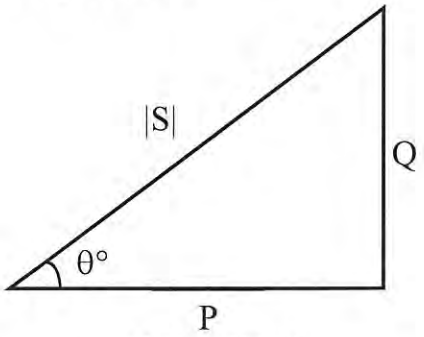

Figure Q4(b)

(i) Determine the complex power of the load.

(4 marks)

(ii) Determine the capacitive element required to raise the power factor to 0.88.

(7 marks)

(iii) Analyze the effect of power factor correction in part Q4(b)(ii) on the effective current, I_{rms}.

(3 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

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APPENDIX A

TRIGONOMETRIC EQUATIONS

$$\sin(x) = -\sin(x)$$

$$cos(-x) = \cos(x)$$

$$\tan(-x) = -\tan(x)$$

$$\sec x = \frac{1}{\cos x}, \qquad \csc x - \frac{1}{\sin x}$$

$$\tan x = \frac{\sin x}{\cos x}, \qquad \cot x = \frac{1}{\tan x}$$

$$\sin 2x + \cos 2x = 1$$

$$\sin(2x) = 2\sin x \cos x$$

$$\cos(2x) = \cos 2x - \sin 2x$$

$$\cos(2x) = 2\cos 2x - 1 = 1 - 2\sin 2x$$

$$sin(x \pm 90°) = \pm \cos x$$

$$cos(x \pm 90°) = \mp \sin x$$

$$sin(x \pm 180°) = \mp sin$$

$$cos(x \pm 180°) = \mp \cos x$$

$$cos^2 x + sin^2 x = 1$$

$$\sin(x \pm y) = \sin x\, cos\, y \pm \cos x\, sin\, y$$

$$\cos(x \pm y) = \cos x\, cos\, y \mp \sin x\, sin\, y$$

$$\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x \tan y}$$

$$2\sin x \sin y = \cos(x - y) - \cos(x + y)$$

$$2\sin x \cos y = \sin(x + y) + \sin(x - y)$$

$$2\cos x \cos y = \cos(x + y) + cos(x - y)$$

$$\cos x \cos y = \frac{1}{2}[\cos(x + y) + cos(x - y)]$$