Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	CIRCUIT THEORY
COURSE CODE	:	DAE 11103
PROGRAMME CODE	:	DAE
EXAMINATION DATE	:	JUNE / JULY 2019
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN SECTION A AND **TWO (2)** QUESTIONS IN SECTION B.

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

SECTION A:

Q1 (a) The voltage, v across a device and the current, i through it are;

$$v(t) = 5 \cos 2t \text{ V}, \quad i(t) = 10\,(1-e^{-0.5t})\text{ A}$$

(i) Calculate the total charge in the device at $t = 2$s

(3 marks)

(ii) Determine the power consumed by the device at $t = 2$s

(3 marks)

(b) State the definition of Kirchhoff's Current Law.

(2 marks)

(c) Consider the circuit shown in **Figure Q1 (c)**.

(i) Determine the equivalent resistance, R_{ab} of the circuit.

(7 marks)

(ii) If a voltage source of 5V is connected to the terminal a-b, use voltage divider rule to find the voltage drop across 20 Ω and 30 Ω resistors.

(5 marks)

Q2 (a) In the circuit of **Figure Q2(a)**, determine v and i using nodal analysis.

(10 marks)

(b) In the circuit of **Figure Q2(b)**, apply mesh analysis to find the voltage V_x.

(10 marks)

Q3 (a) Define the maximum power transfer theorem.

(2 marks)

(b) For the circuit in **Figure Q3(b)**,

(i) Obtain the Norton and Thevenin equivalent circuits at terminals a-*b*.

(10 marks)

(ii) Calculate the current, i_o through $R_L = 8\ \Omega$.

(3 marks)

(iii) Find R_L for maximum power deliverable to R_L.

(2 marks)

(iv) Determine the maximum power delivered to R_L.

(3 marks)

SECTION B:

Q4 (a) The voltage across a 5μF capacitor is given as:

$$v(t) = 50 \sin 500t \; V$$

Calculate current, $i(t)$ through it.

(3 marks)

(b) If the current through a 2 mH inductor is $i(t) = 20e^{-20t} \; A$, find the voltage across the inductor and the energy stored in it.

(5 marks)

(c) Three capacitors, $C_1 = 4\mu F$, $C_2 = 12\mu F$ and $C_3 = 28\mu F$, are connected in parallel across a 120 V DC source. Determine:

(i) the total capacitance.

(3 marks)

(ii) the charge on each capacitor.

(3 marks)

(iii) the total energy stored in the parallel combination of the capacitors.

(3 marks)

(iv) the total capacitance if the capacitors C_1, C_2 and C_3 are connected in series across the source.

(3 marks)

Q5 (a) For the circuit in **Figure Q5 (a)**, given that:

$$v = 150e^{-50t} \quad V$$
$$i = 30e^{-50t} \quad A$$

(i) Find the value of L and R.

(6 marks)

(ii) Determine the time constant, τ.

(2 marks)

(iii) Calculate the initial energy in the inductor.

(4 marks)

(b) Assume that the switch in the circuit shown in **Figure Q5 (b)** has been in position ***x*** for a long time, and at $t = 0$ it moves to position ***y***. Find $i(t)$ for both $t < 0$ and $t > 0$.

(8 marks)

Q6 (a) If $R = 10\ \Omega$, $L = 5$ H, and $C = 2$ mF in **Figure Q6 (a)**, find

(i) Damping factor, α

(2 marks)

(ii) Resonant frequency, ω_o

(2 marks)

(iii) Natural frequencies, s_1 and s_2

(2 marks)

(iv) State the type of natural response that the circuit have.

(1 marks)

(b) For the circuit in **Figure Q6 (b)**, calculate the value of R needed to have a critically damped response.

(5 marks)

(c) The natural response of a series RLC circuit is

$$i(t) = 10e^{-500t} + 12e^{-800t}\ mA, \qquad t \geq 0.$$

If $R = 200\ \Omega$, find the value of L and C.

(8 marks)

- END OF QUESTIONS –

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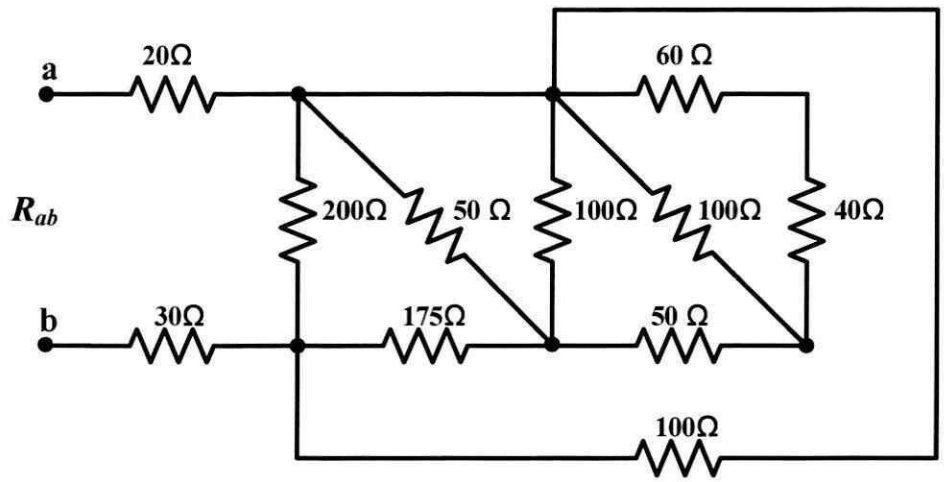

Figure Q1(c)

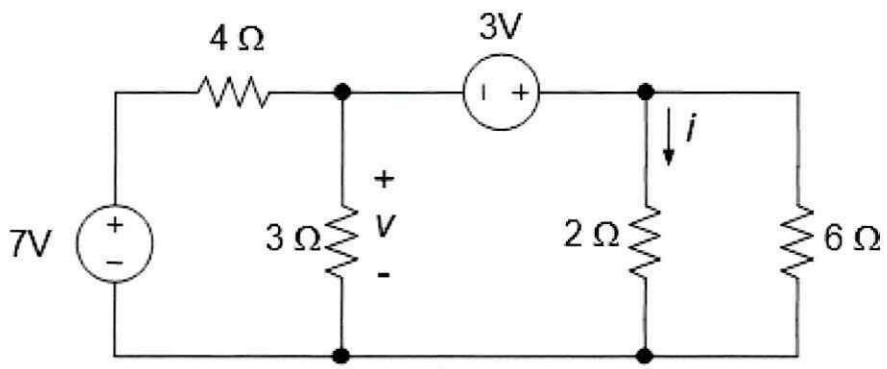

Figure Q2(a)

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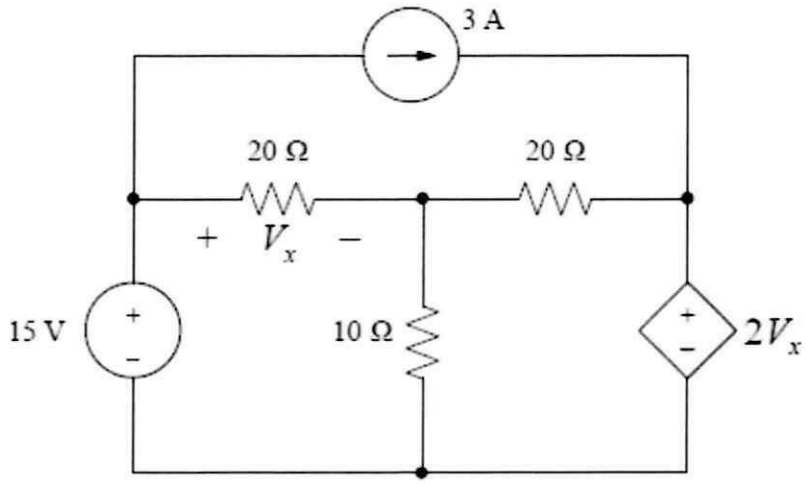

Figure Q2(b)

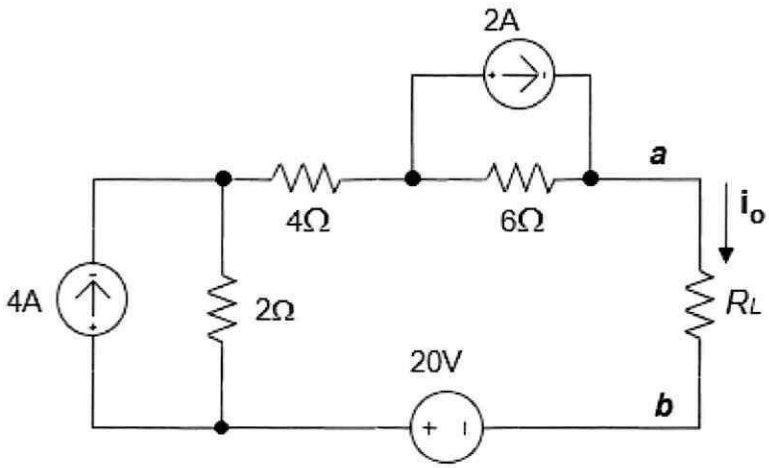

Figure Q3(b)

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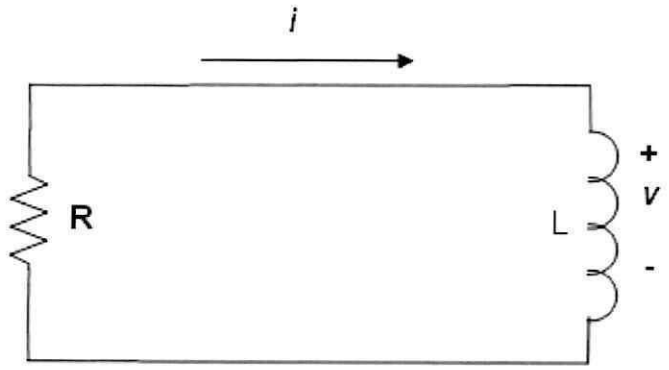

Figure Q5(a)

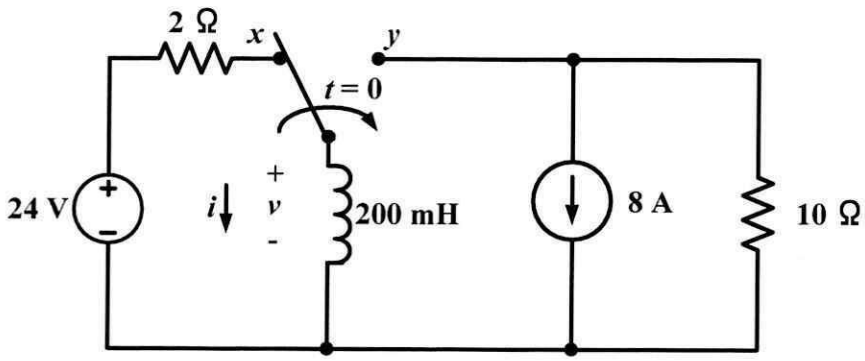

Figure Q5(b)

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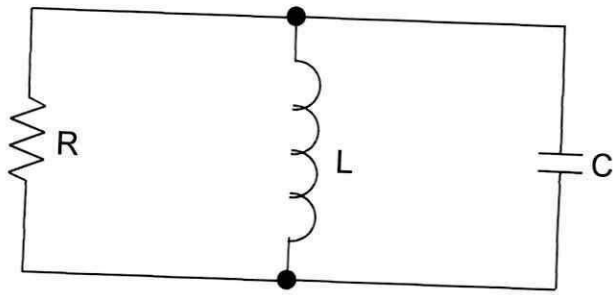

Figure Q6(a)

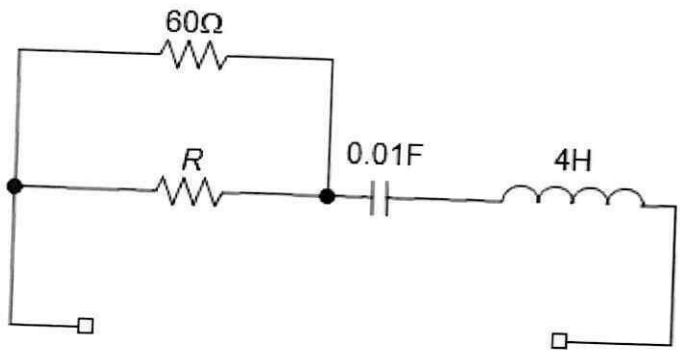

Figure Q6(b)