UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE	:	ELECTRICAL CIRCUIT THEORY
COURSE CODE	:	BEE 1113 / BEX 10103
PROGRAMME	:	BEE
EXAMINATION DATE	:	APRIL / MAY 2011
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE** (5) QUESTIONS ONLY.

THIS PAPER CONSISTS OF NINE (9) PAGES

Q1 (a) An electric current is the rate of change of charge and measured in amperes (A).

(i) With the help of diagram, describe how does current exist and flow in conductor.

(4 marks)

(ii) If the current flowing through an element is given by:

$$i(t) = \begin{cases} 3t \text{ A}, & 0 < t < 6 \text{ s} \\ 18 \text{ A}, & 6 < t < 10 \text{ s} \\ -12 \text{ A}, & 10 < t < 15 \text{ s} \\ 0 \text{ A}, & t > 15 \text{ s} \end{cases}$$

Plot the charge stored in the element over $0 < t < 20$ μs.

(5 marks)

(b) A close look at the circuit in **Figure Q1(b)** reveal that there are two closed paths, the one on the left with the current i_s and the one on the right with the current i_o.

(i) Use Kirchhoff's laws and Ohm's law to find the voltage Vo.

(4 marks)

(ii) Show that your solution is consistent with the constraint that the total power developed in the circuit equals the total power dissipated.

(7 marks)

Q2 (a) Given the circuit in **Figure Q2(a)**, find

(i) the values of i_a, i_b and V_o

(4 marks)

(ii) the power dissipated in each resistor.

(5½ marks)

(iii) the power delivered by the 50 V source.

(1½ marks)

(b) For the circuit in **Figure Q2(b)**, find value of R and the power supplied by the 250 V source.

(9 marks)

Q3 (a) Use source transformations to find the voltage, V_o in the circuit shown in **Figure Q3(a)**. Hence, determine the power developed by the 250 V voltage source and the power developed by the 8 A current source.

(10 marks)

(b) **Figure Q3(b)** shows a network with three independent sources and the current, i flows through 3 Ω resistor. Apply the superposition theorem to this network in order to determine the value of i.

(10 marks)

Q4 (a) For the circuit shown in **Figure Q4(a),**

(i) find the value of R that result in maximum power being transferred to the terminals a-b.

(4 marks)

(ii) calculate the maximum power that can be delivered to R.

(7 marks)

(b) Obtain and draw the Thevenin and Norton equivalent circuits at terminals a-b for the circuit shown in **Figure Q4(b).**

(9 marks)

Q5 (a) The initial values of i_1 and i_2 in the circuit shown in **Figure Q5(a)** are +3 and -5 A, respectively. The voltage at the terminals of the parallel inductors for $t \geq 0$ is $-30e^{-5t}$ mV.

(i) If the parallel inductors are replaced by a single inductor, what is its inductance?

(2 marks)

(ii) What is the initial current and its reference direction in the equivalent inductor?

(3 marks)

(iii) Use the equivalent inductor to find i(t).

(2 marks)

(iii) Find $i_1(t)$ and $i_2(t)$. Verify that the solutions for $i_1(t)$, $i_2(t)$ and i(t) satisfy Kirchhoff 's current law.

(5 marks)

(b) An uncharged 0.2 μF capacitor is driven by a triangular current pulse. The current pulse is described below. Derive the expression for the capacitor voltage and power for each of the four intervals needed to describe the current.

$$i(t) = \begin{cases} 0, & t \leq 0; \\ 5000t \text{ A}, & 0 \leq t \leq 20\ \mu s; \\ 0.2 - 5000t \text{ A}, & 20 \leq t \leq 40\ \mu s; \\ 0, & t \geq 40\ \mu s. \end{cases}$$

(8 marks)

Q6 (a) For the network in **Figure Q6(a)**, the initial current is 0.1 mA and the switch is closed at t = 0.

(i) Find the expression of inductor current at t > 0.

(3 marks)

(ii) Plot the graph of inductor currents based on the expression obtained in part Q6(a)(i).

(2 marks)

(iii) Find current i_R for t > 0.

(1 mark)

(iv) Describe what will happen to current i_R at t > 0 if the value of R_2 is increased.

(2 marks)

(b) The switch in the circuit shown in Figure **Q6(b)** has been in position *x* for a long time. At t = 0, the switch is moved to position *y*.

(i) Calculate the initial value of V_c. Hence, determine the final value of V_c.

(2 marks)

(ii) Find the time constant, τ of the circuit when the switch is in position *y*.

(1 mark)

(iii) State the expression for $V_c(t)$ when $t \geq 0$ and for $i(t) \geq 0^+$?

(3 marks)

(iv) Determine how long after the switch is in position *y* does the capacitor voltage equal zero.

(2 marks)

(v) Plot V_c and i versus t .

(4 marks)

Q7 (a) Find the roots of the characteristic equation that overns the transient behavior of the voltage shown in **Figure Q7(a)** if R = 200 Ω, L = 50 mH and C = 0.2 μF. Will the response be overdamped, underdamped or critically damped? What value of R causes the response to be critically damped?

(10 marks)

(b) The switch in the circuit of **Figure Q7(b)** has been at position A for a long time. At t = 0, the switch moved to position B. Determine

(i) the value of $V_C(t)$ for t < 0

(2 marks)

(ii) the expression for $V_C(t)$ for t > 0

(8 marks)

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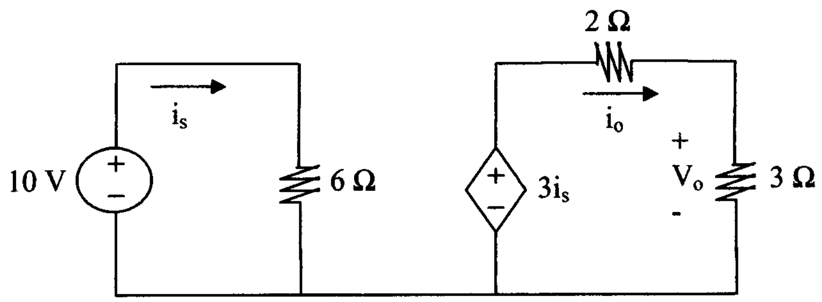

Figure Q1(b)

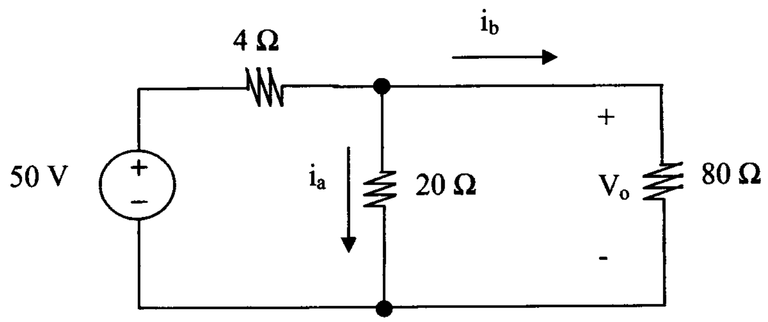

Figure Q2(a)

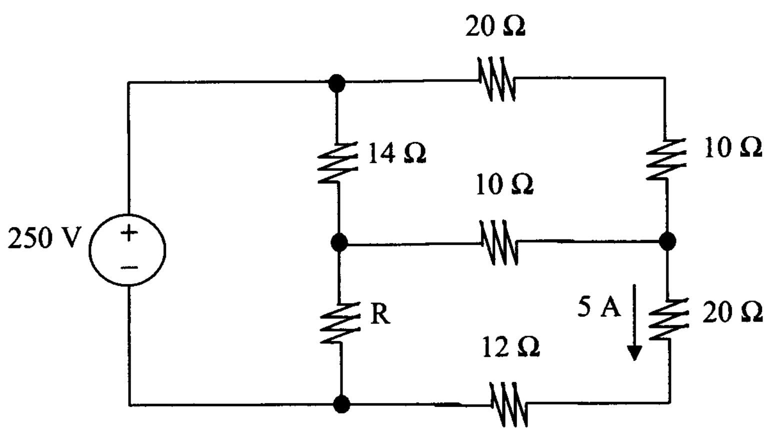

Figure Q2(b)

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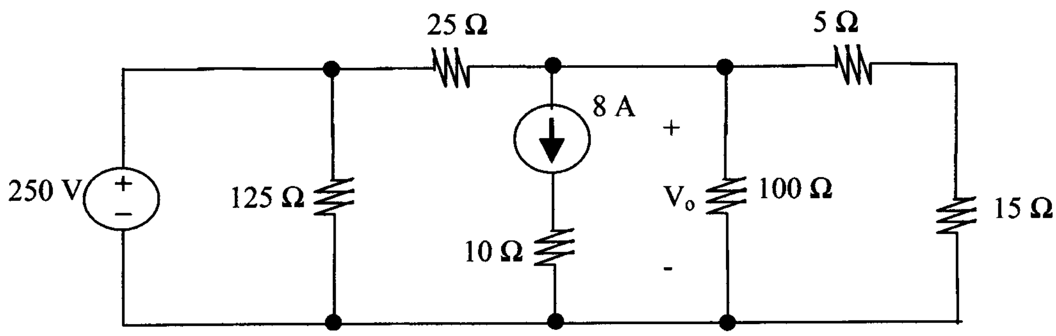

Figure Q3(a)

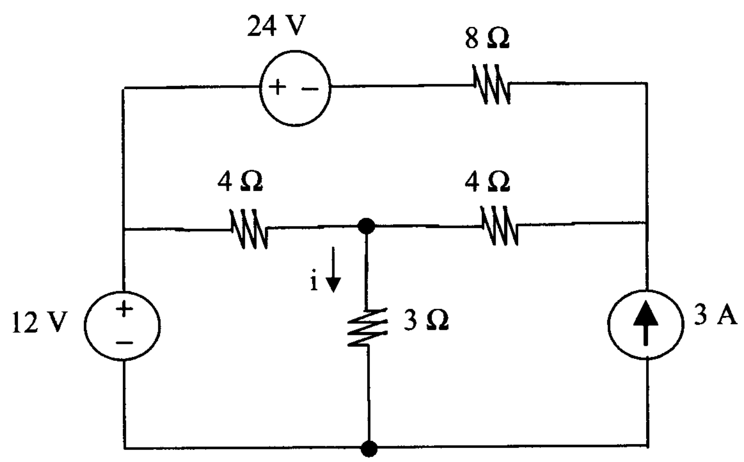

Figure Q3(b)

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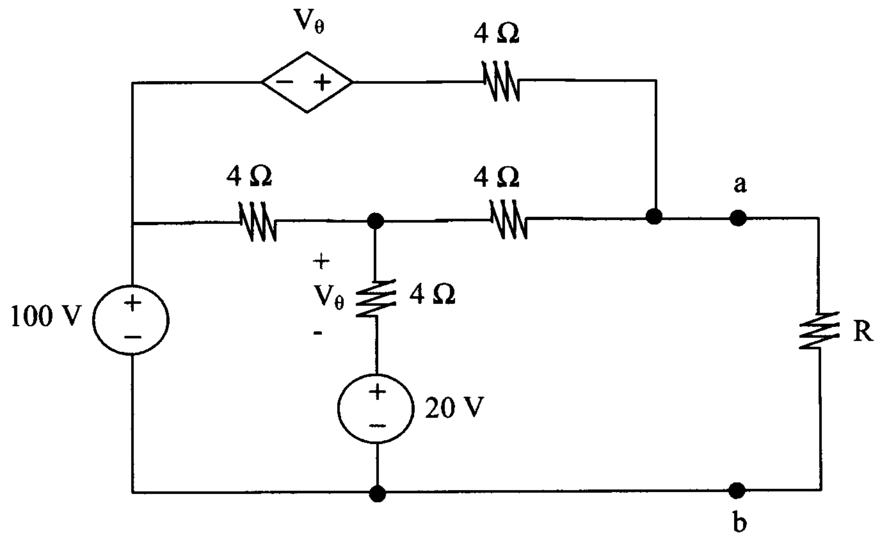

Figure Q4(a)

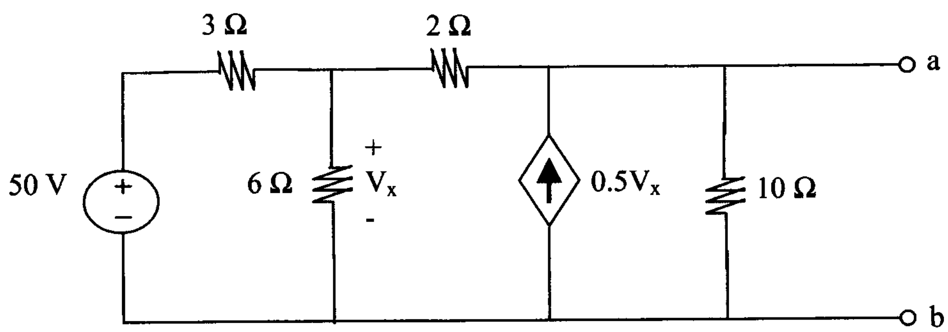

Figure Q4(b)

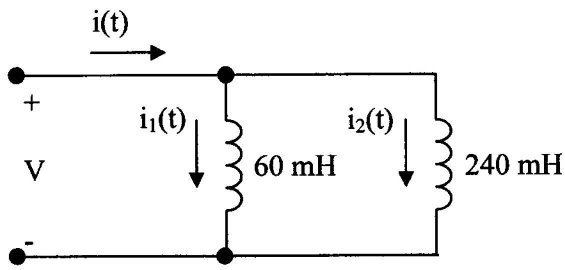

Figure Q5(a)

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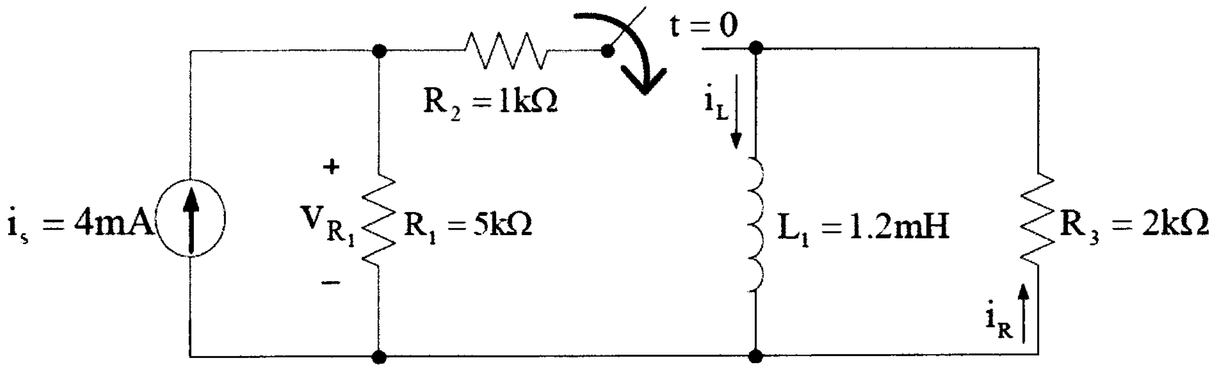

Figure Q6(a)

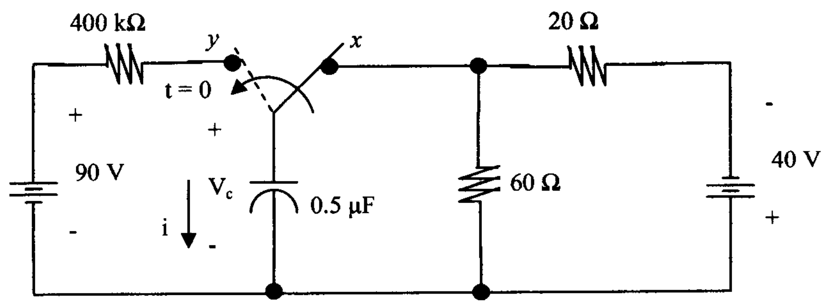

Figure Q6(b)

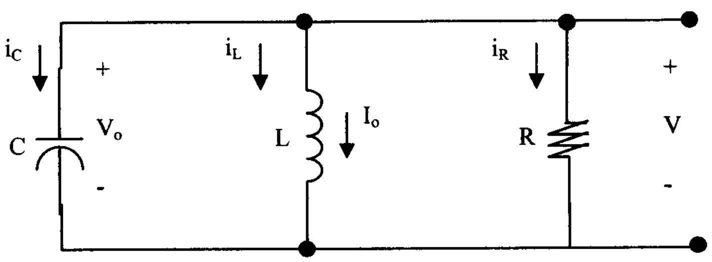

Figure Q7(a)

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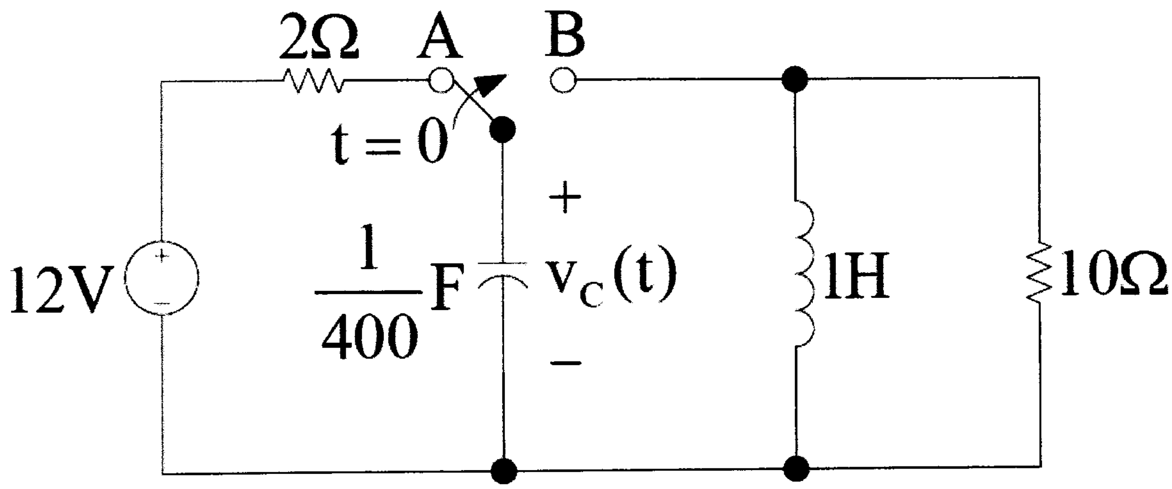

Figure Q7(b)