UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	ELECTRIC CIRCUIT ANALYSIS II
COURSE CODE	:	BEF 12503
PROGRAMME	:	BEF
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS FROM **PART A** AND ANY **ONE (1)** QUESTION FROM **PART B**

THIS PAPER CONSISTS OF **TEN (10)** PAGES

PART A (Answer ALL Questions)

Q1 (a) Describe briefly the relationship between the instantaneous voltage drops across the inductor with the current flowing through it. Write its instantaneous voltage and instantaneous current equations.

(5 marks)

(b) The current *i*(t) flowing through the inductor of 10 mH. If the instantaneous voltage waveform across the inductor terminal is shown in Figure Q1(b) and assuming the initial current *i*(0) = 0, find;

(i) The piecewise equation of the voltage, *v*(t)

(5 marks)

(ii) The current, *i*(t) and sketch the waveform

(5 marks)

(iii) The power, *p*(t) stored in the inductor and sketch the waveform

(5 marks)

(iv) The energy, *e*(t) induced in the inductor and sketch the waveform

(5 marks)

Q2 (a) Define briefly the natural response and step response of supplying energy in a circuit.

(4 marks)

(b) A capacitor of 25 μF is being charged through 5 kΩ and 1 kΩ resistors from 180 V(dc) source as shown in Figure Q2(b). The switch *A* is at position *B* for a long time and goes to position C at t = 0 s. Given the general equation of current is $i(t) = Ae^{-t/\tau}$. By applying step response analysis, determine:

(i) The current flowing at $t = 0^+$

(4 marks)

(ii) The Current drop rate at $t = 0^+$

(3 marks)

(iii) The Capacitor voltage rise rate at $t = 0^+$

(3 marks)

(iv) The Resistor voltage drop rate at $t = 0^+$

(3 marks)

(v) The Time taken by capacitor voltage to reach 100 V

(4 marks)

(vi) The Energy stored by the capacitor when it is fully charged

(4 marks)

Q3 (a) Plot the appropriate waveforms and diagrams for the following functions in time-domain and phasor-domain forms, respectively.

(i) $v(t) = 1\cos(\omega t + 45^{\circ})$ (ii) $v(t) = 1\cos(\omega t + 225^{\circ})$ (iii) $v(t) = 1\cos(\omega t - 315^{\circ})$

(9 marks)

(b) A circuit is shown in Figure Q3(b) is connected with a source, $V(rms)$ = 240 V, 50 Hz frequency and having phase angle –300 °.

(i) Sketch the appropriate phasor-domain circuit

(2 marks)

(ii) Calculate the total circuit impedance

(2 marks)

(iii) Calculate the currents of I_1, I_2 and I_3 in phasor-domain and time-domain forms, respectively

(6 marks)

(iv) Find the voltages across inductor, V_1 and capacitor, V_2 in phasor-domain and time-domain forms, respectively

(4 marks)

(v) Sketch the appropriate current and impedance diagrams, respectively in phasor-domain

(2 marks)

PART B (Answer any ONE (1) Question)

Q4 (a) Sketch the response signal for *overdamped, critically damped* and *underdamped* of a RLC circuit.

(6 marks)

(b) A series RLC circuit is shown in Figure Q4(b). The switch is assumed at position *A* for a long time and move to position *B* when $t > 0$. Applying step response analysis on the circuit,

(i) Sketch the equivalent circuit at $t < 0$

(2 marks)

(ii) Evaluate the initial voltage, $v(0)$ across the capacitor at $t < 0$

(2 marks)

(iii) Sketch the equivalent circuit at $t > 0$

(2 marks)

(iv) Determine the damping factor, α

(2 marks)

(v) Obtain the resonance frequency, ω_0

(2 marks)

(vi) Find the roots characteristic s_1 and s_2

(2 marks)

(vii) Determine the steady state value of voltage across the capacitor, $v(\infty)$

(3 marks)

(viii) Evaluate the complete response of $v(t)$ at $t > 0$

(4 marks)

Q5 (a) Explain the concept of *i-v* relations in phasor domain if a circuit consists of purely R, purely L and purely C respectively. Include any appropriate equations and diagrams to support the explanation.

(12 marks)

(b) A circuit shown in Figure Q5(b) consists of supply voltage, $V(rms) = 240$ V with phase angle 340° and the frequency is 50 Hz. The circuit is connected with an inductor element, $L = 10$ mH.

(i) Determine the voltage across the inductor in phasor-domain and time-domain

(3 marks)

(ii) Determine the current flowing through the inductor in phasor-domain and time-domain

(4 marks)

(iii) Sketch the resulting phasor diagrams of Q5(b)(i) and Q5(b)(ii)

(6 marks)

Q6 (a) Figure Q6(a) shows a general impedance relationship network. From the general network, describe all individual passive elements in phasor-domain. Include any appropriate equations and diagrams to support the explanation.

(12 marks)

(b) The sinusoidal voltage source in the circuit as depicted in Figure Q6(b) is developing a voltage equal to 22.36 cos (5000t + 26.565°) V.

(i) Find the Thevenin impedance, Z_{TH} with respect to the terminal a-b

(2 marks)

(ii) Find the Thevenin voltage, V_{TH} with respect to the terminal a-b

(2 marks)

(iii) Draw the Thevenin equivalent circuit

(3 marks)

(iv) If the terminal a-b is connected with a capacitor element 10 uF, find the new circuit impedance and sketch the new impedance and voltage diagrams in phasor domain

(6 marks)

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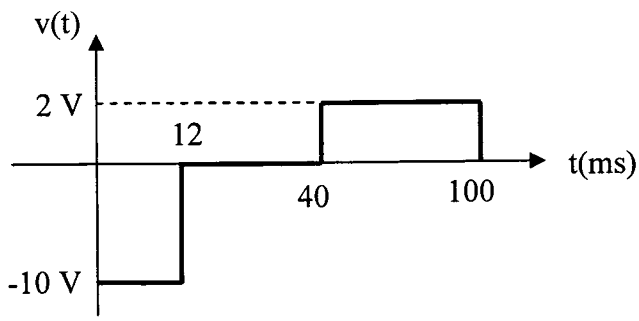

FIGURE Q1(b)

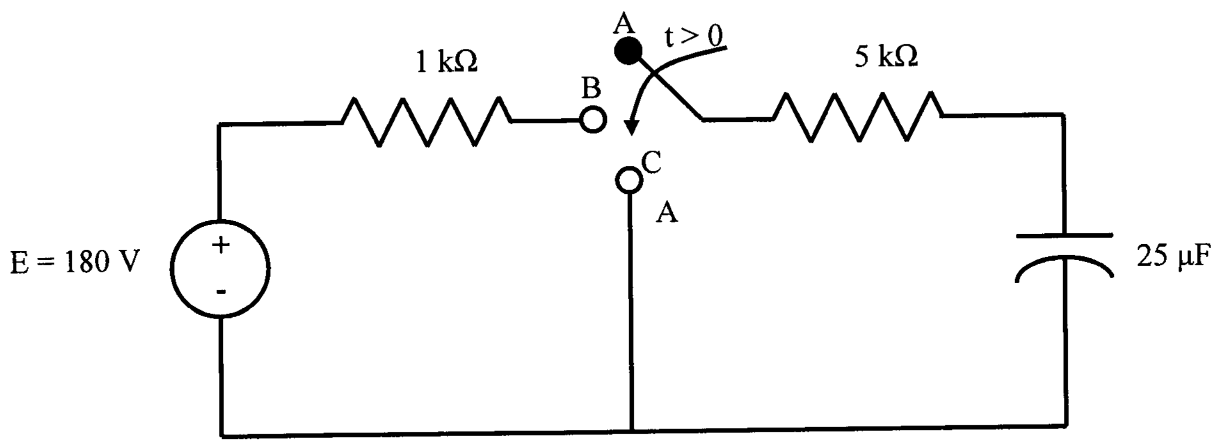

FIGURE Q2(b)

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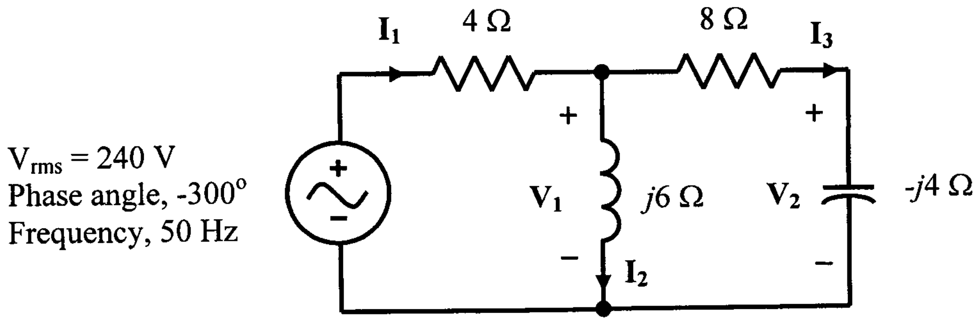

FIGURE Q3(b)

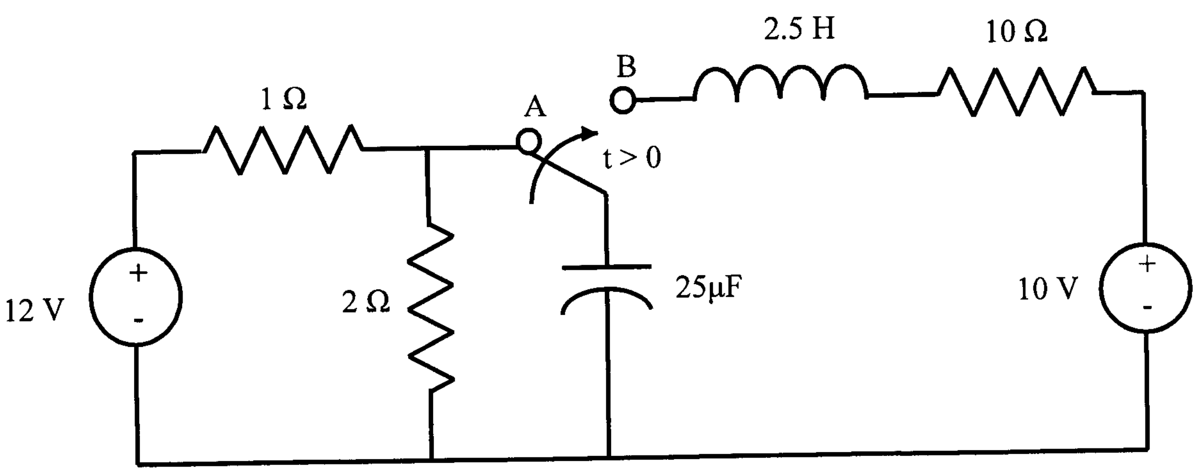

FIGURE Q4(b)

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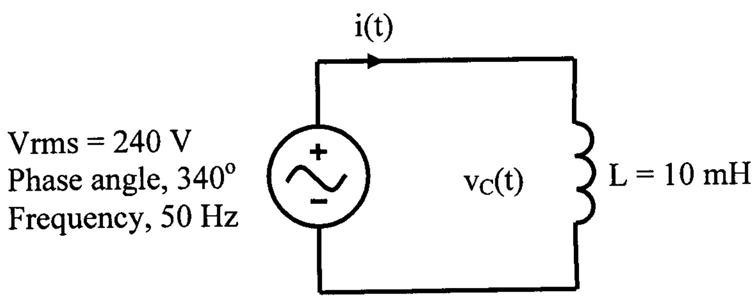

FIGURE Q5(b)

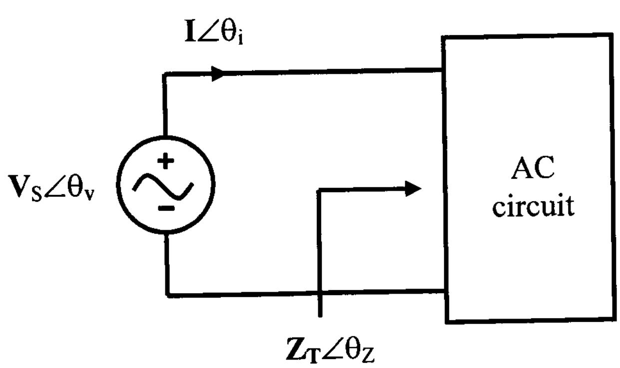

FIGURE Q6(a)

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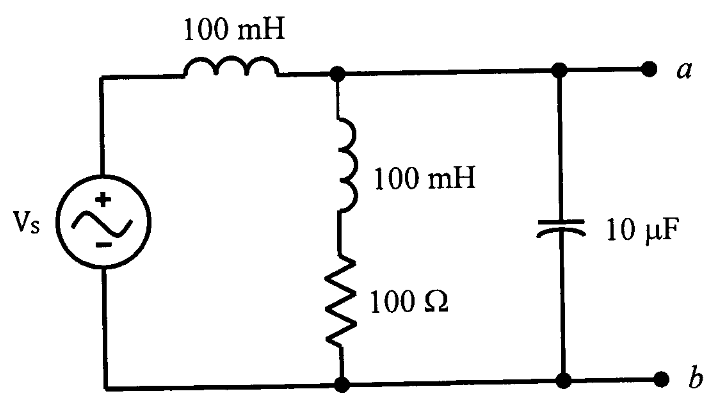

FIGURE Q6(b)

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Formulas :

$$\tau = RC$$

$$i(t) = I_o e^{-\frac{t}{RC}}$$

$$y = e^{\frac{t}{\tau}}$$

$$\ln(y) = \ln\left(e^{\frac{t}{\tau}}\right)$$

$$\frac{t}{\tau} = \ln(y)$$

$$s_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_o^2}$$

$$\alpha = \frac{R}{2L}$$

$$\omega_o = \frac{1}{\sqrt{LC}}$$

$$v(t) = V_s + A_1 e^{S_1 t} + A_2 e^{S_2 t}, \textit{ Over damped}$$

$$v(t) = V_s + (A_1 t + A_2)e^{-\alpha t}, \textit{ Critically damped}$$

$$v(t) = V_s + e^{-\alpha t}(A_1 \cos\omega_d t + A_2 \sin\omega_d t), \textit{ Under damped}$$

$$\omega_d = \sqrt{\omega_o^2 - \alpha^2}$$