Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	CIRCUIT THEORY
COURSE CODE	:	DAE 11103
PROGRAMME CODE	:	DAE
EXAMINATION DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	3 HOURS
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;

$$v(t) = 7 \cos 5t \text{ V}, \quad i(t) = 10\,(1-e^{-0.5t})\text{ A}$$

(i) Calculate the total charge in the device at $t = 3$s (3 marks)

(ii) Determine the power consumed by the device at $t = 3$s (3 marks)

(b) State the definition of Kirchhoff's Voltage 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 mesh analysis. (10 marks)

(b) In the circuit of **Figure Q2(b)**, apply nodal analysis to find the voltage across each resistor. (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 $R_L = 10\ \Omega$. (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 6μF capacitor is given as:

$$v(t) = 60 \sin 600t \; V$$

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, $C_1 = 5\mu F$, $C_2 = 15\mu F$ and $C_3 = 25\mu F$, are connected in parallel across a 150 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

(3 marks)

(ii) Resonant frequency, ω_o

(3 marks)

(iii) Natural frequencies, s_1 and s_2

(3 marks)

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

(2 marks)

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

(9 marks)

- END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2019/2020 PROGRAMME: DAE
COURSE NAME : CIRCUIT THEORY COURSE CODE: DAE 11103

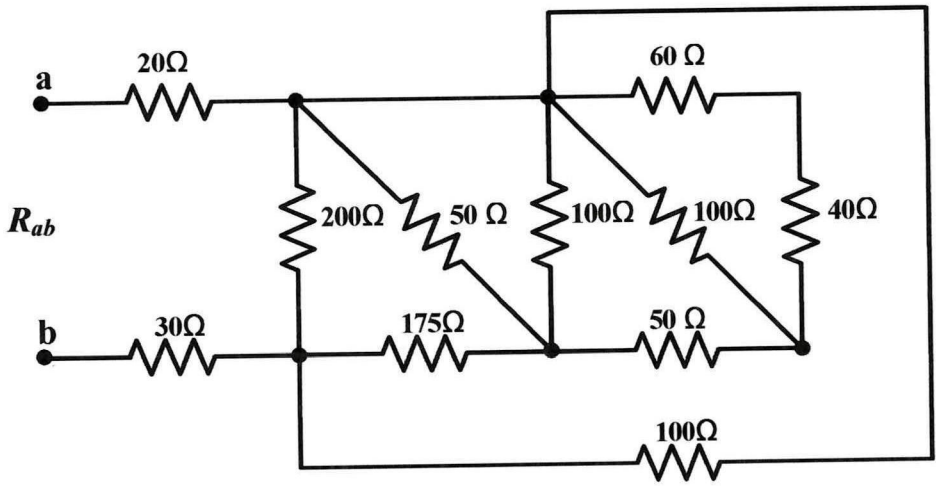

Figure Q1(c)

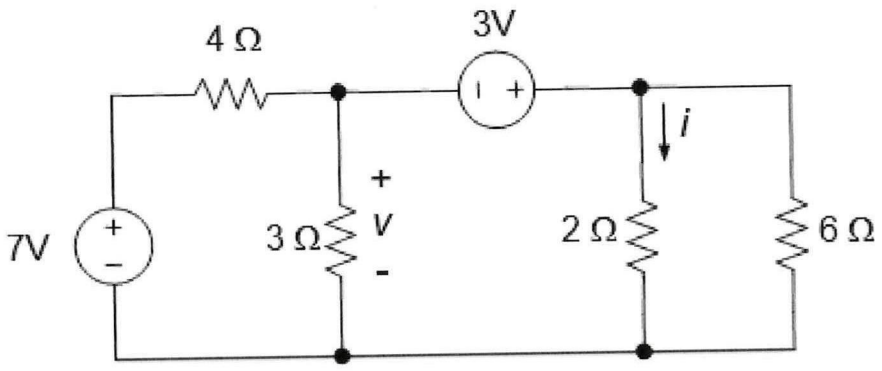

Figure Q2(a)

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2019/2020 PROGRAMME: DAE
COURSE NAME : CIRCUIT THEORY COURSE CODE: DAE 11103

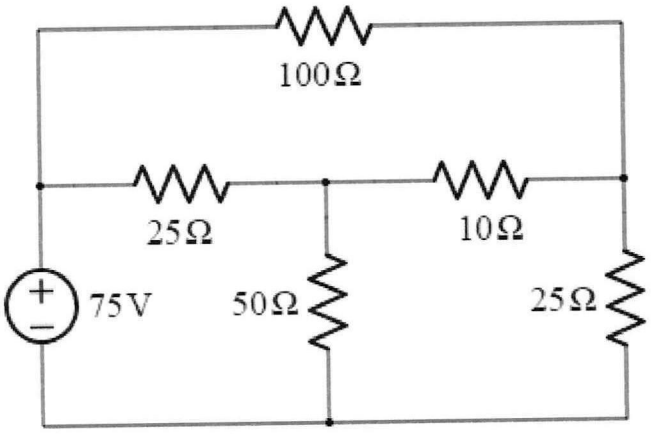

Figure Q2(b)

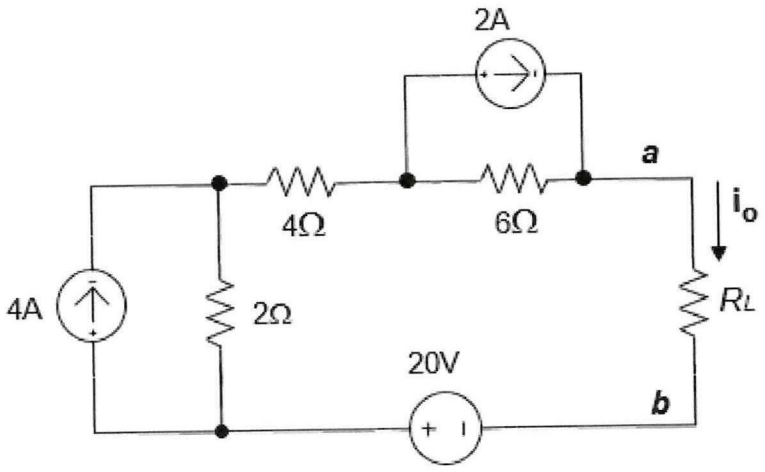

Figure Q3(b)

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2019/2020 PROGRAMME: DAE
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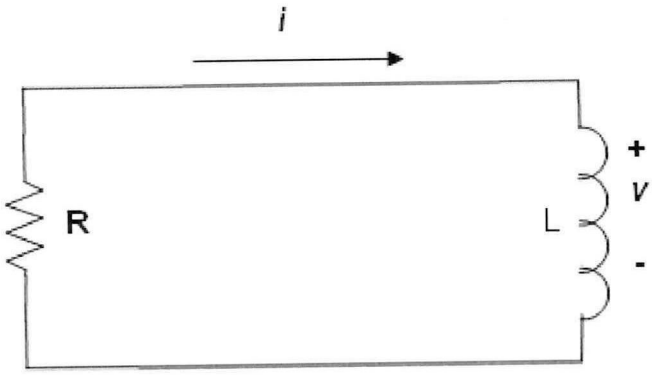

Figure Q5(a)

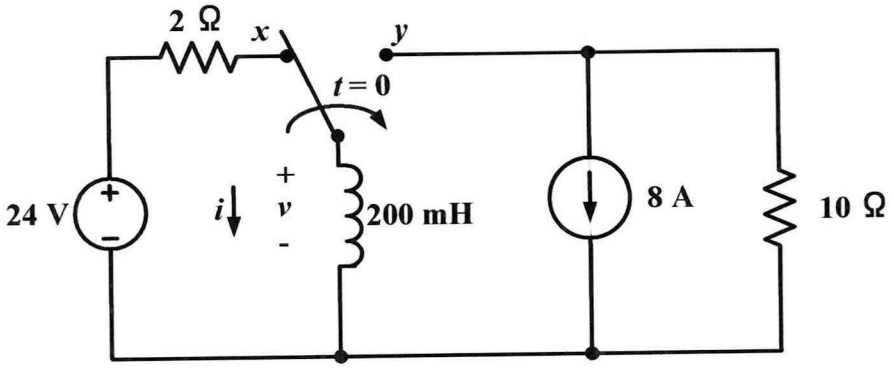

Figure Q5(b)

FINAL EXAMINATION

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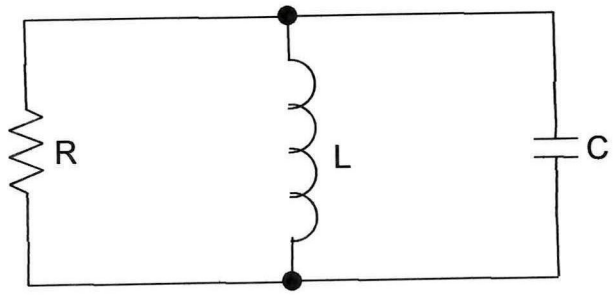

Figure Q6(a)

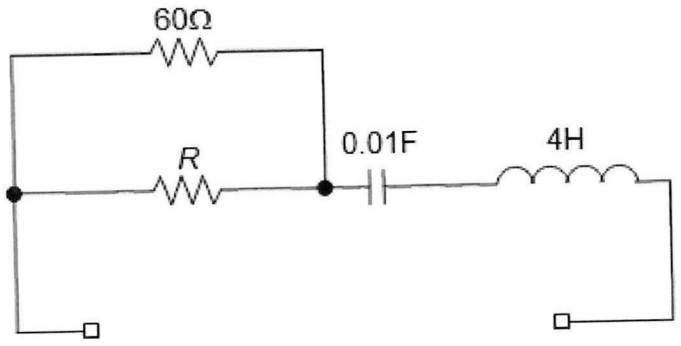

Figure Q6(b)