



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2010/2011**

**COURSE NAME** : **CIRCUIT THEORY**

**COURSE CODE** : **DAE 11103 / DEE 1223**

**PROGRAMME** : **1 DAE/DAL/DEE**

**EXAMINATION DATE** : **APRIL/MAY 2011**

**DURATION** : **3 HOURS**

**INSTRUCTIONS** : **PART A**  
**ANSWER ALL QUESTIONS**

**PART B**  
**ANSWER THREE (3)**  
**QUESTIONS ONLY**

**THIS QUESTION PAPER CONSISTS OF ELEVEN (11) PAGES**

**PART A**

**Q1** (a) A simplified circuit model for an industrial wiring system is shown in Figure Q1(a).

- (i) How many basic circuit elements are there in this model?
- (ii) How many nodes are there in the circuit?
- (iii) How many of the nodes connect to three or more basic elements?
- (iv) Identify the circuit elements that form a series pair.
- (v) Describe five closed paths in the circuit.

(7 marks)

(b) Consider the circuit shown in Figure Q1(b). What will be the reading on the ammeter?

(3 marks)

(c) The voltage and current at the terminals of a circuit element are zero for  $t < 0$ . For  $t \geq 0$  they are

$$v = 100e^{-500t} \text{ V}$$

$$i = 20 - 20e^{-500t} \text{ mA}$$

- (i) Find the power at  $t = 1 \text{ ms}$ .
- (ii) How much energy is delivered to the circuit element between 0 and 1 ms?

(5 marks)

**Q2** (a) Use nodal analysis to determine the node voltages  $V_A$  and  $V_B$  in the circuit of Figure Q2(a).

(7 marks)

(b) Use the mesh current method to find the power dissipated in the  $2 \Omega$  resistor for the circuit in Figure Q2(b).

(8 marks)

**Q3** Find the Norton equivalent for the circuit shown in Figure Q3 looking from terminal a-b.

(10 marks)

**PART B**

- Q4** (a) For the circuit shown in Figure Q4(a),
- (i) find the Thevenin equivalents at terminals a-b.
  - (ii) determine the value of load resistance that will draw the maximum power from the circuit.
  - (iii) calculate the maximum power.

(12 marks)

- (b) Use superposition principal to find  $i$  in Figure Q4(b).

(8 marks)

- Q5** (a) The charge on a  $2 \mu\text{F}$  capacitor is given by

$$q(t) = 10^{-6} \sin(10^5 t) \text{ C}$$

Find expressions for :

- (i) voltage
- (ii) current.

(5 marks)

- (b) Find the equivalent inductance from terminal a-b for the series-parallel combination shown in Figure Q5(b).

(5 marks)

- (c) The circuit shown in Figure Q5(c) is at steady state condition, determine :
- (i) the voltage,  $v$  and current,  $i$
  - (ii) the energy stored in the inductor.

(10 marks)

- Q6** (a) The switch in the circuit in Figure Q6(a) has been closed for a long time. At  $t = 0$ , it is opened. Find  $v(t)$  for  $t \geq 0$ .

(10 marks)

- (b) In the circuit shown in Figure Q6(b), both switches operate together; that is, they open or close at the same time. The switches are closed a long time before opening at  $t = 0$ .

- (i) Find  $v(t)$  for  $t \geq 0$
- (ii) Calculate the energy dissipated in the  $12 \text{ k}\Omega$  resistor 2 ms after the switches open.

(10 marks)

- Q7** (a) Consider the phasors shown in Figure Q7(a). The frequency of each signal is  $f = 200 \text{ Hz}$ . Write a time-domain expression for each voltage in the form  $V_m \cos(\omega t + \theta)$ . State the phase relationships (lead or lag) between pairs of these phasors. ( $V_1$  and  $V_2$ ), ( $V_1$  and  $V_3$ ) and ( $V_2$  and  $V_3$ ).

(10 marks)

- (b) Calculate  $v_o$  in the circuit of Figure Q7(b).

(10 marks)

- Q8** (a) Determine the complex power for the following cases:

- (i)  $P = 269 \text{ W}$ ,  $Q = 150 \text{ VAR}$  (capacitive)
- (ii)  $Q = 2000 \text{ VAR}$ ,  $\text{pf} = 0.9$  (leading)
- (iii)  $S = 600 \text{ VA}$ ,  $Q = 450 \text{ VAR}$  (inductive)

(10 marks)

- (b) Refer to the circuit shown in Figure Q8(b).

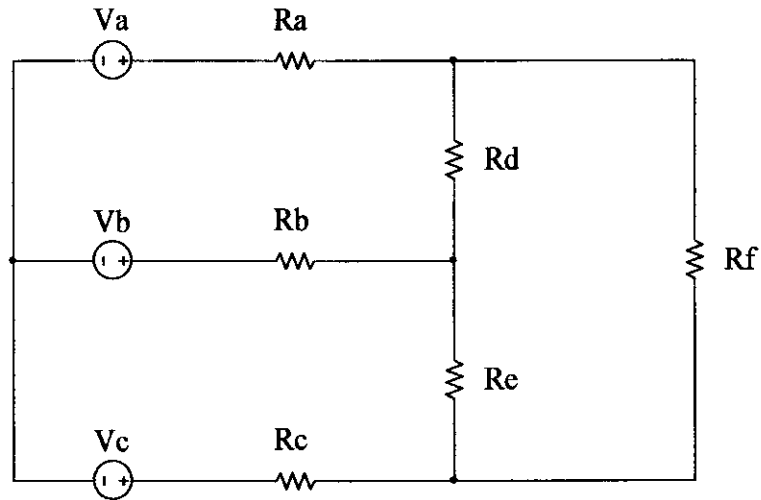
- (i) What is the power factor?
- (ii) What is the average power dissipated?
- (iii) What is the value of the capacitance that will give a unity power factor when connected to the load?

(10 marks)

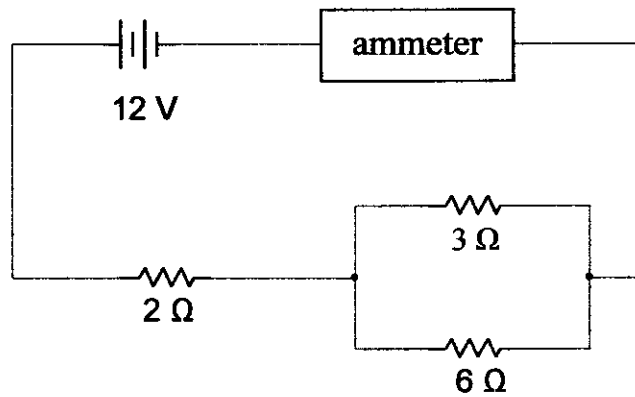
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**FIGURE Q1(a)**

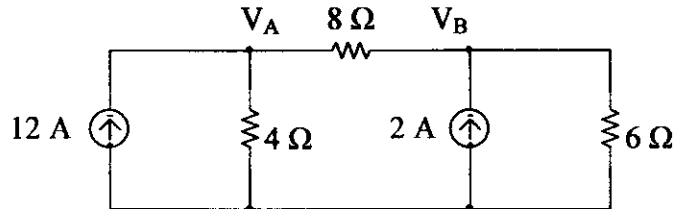


**FIGURE Q1(b)**

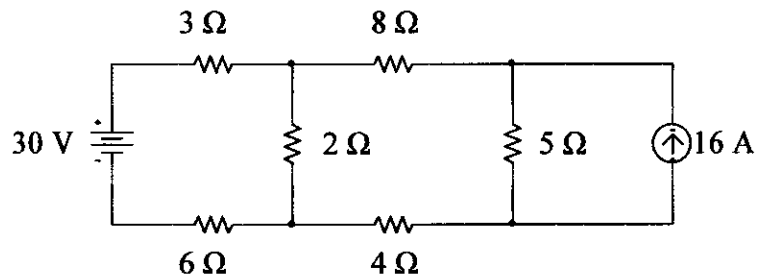
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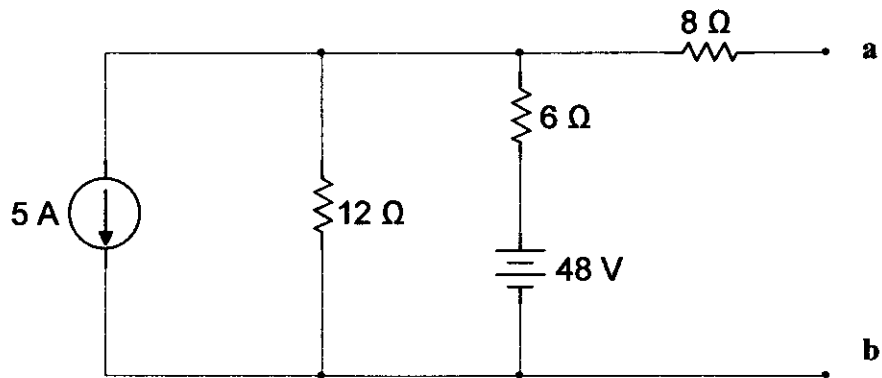
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**FIGURE Q2(a)**



**FIGURE Q2(b)**

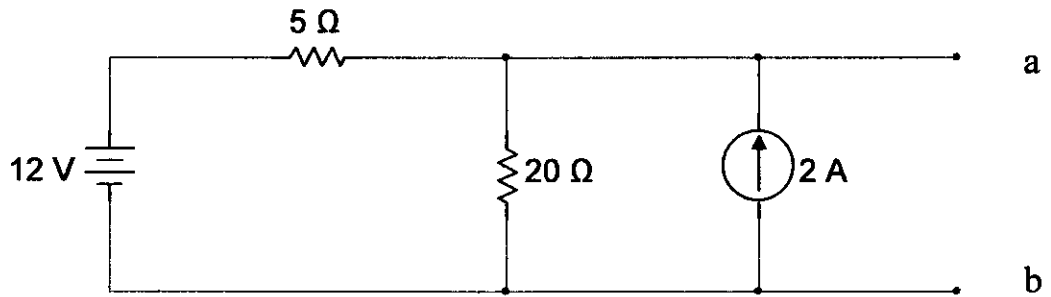


**FIGURE Q3**

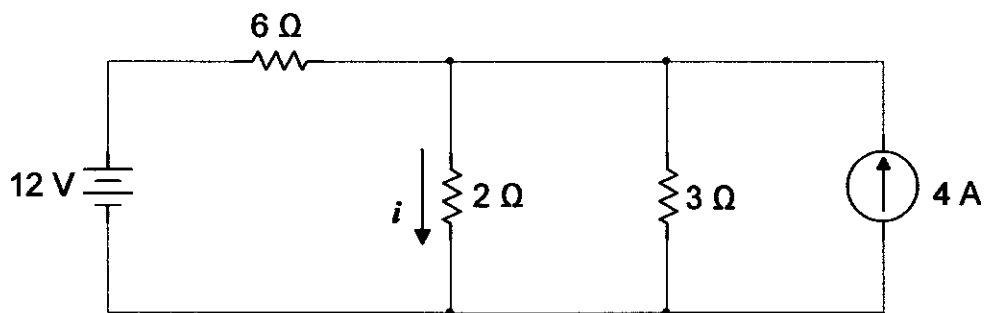
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**FIGURE Q4(a)**

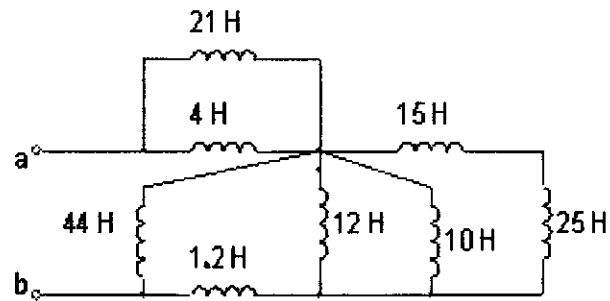


**FIGURE Q4(b)**

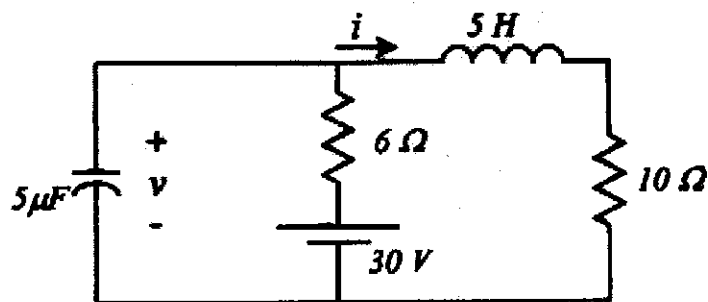
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**FIGURE Q5(b)**



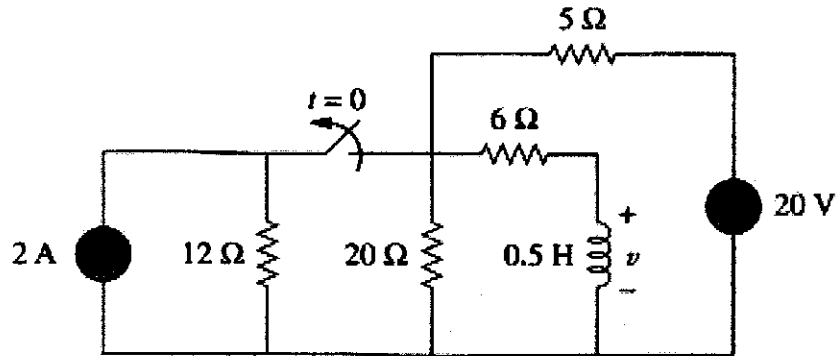
**FIGURE Q5(c)**



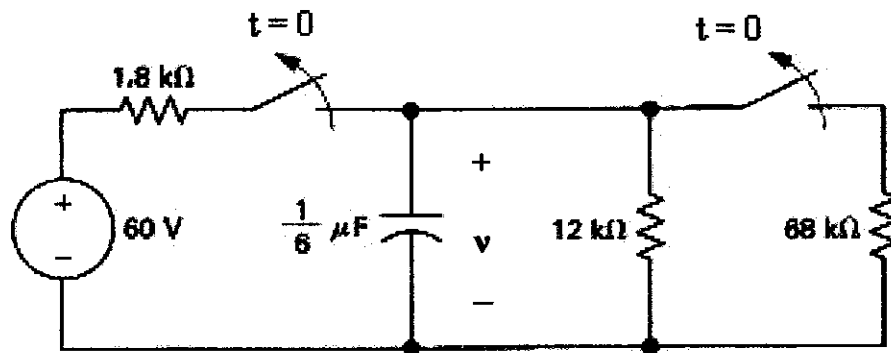
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**FIGURE Q6(a)**

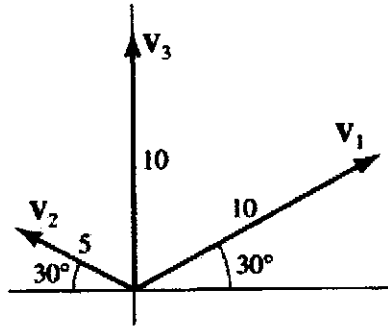


**FIGURE Q6(b)**

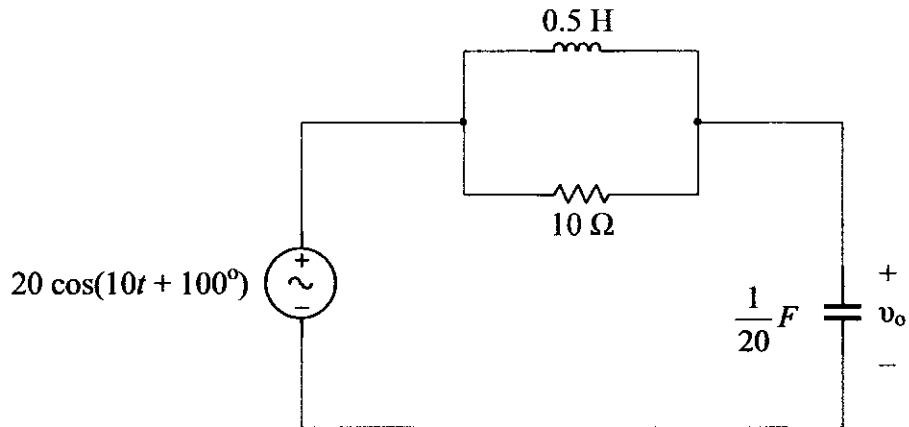
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**FIGURE Q7(a)**

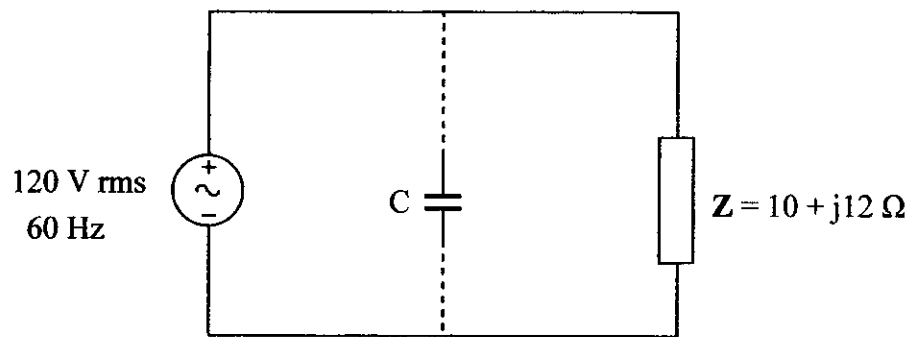


**FIGURE Q7(b)**

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**FIGURE Q8(b)**