Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2014/2015

| | | |
|---|---|---|
| COURSE NAME | : | CIRCUIT THEORY |
| COURSE CODE | : | DAE 11103 |
| PROGRAMME | : | 1 DAE |
| EXAMINATION DATE | : | DECEMBER 2014 / JANUARY 2015 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | PART A<br>ANSWER **ALL** QUESTIONS<br><br>PART B<br>ANSWER **TWO (2)** QUESTIONS ONLY |

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

**PART A**

**Q1** (a) A telephone wire has a current of 20 μA flowing through it. How long does it take for a charge of 15 C to pass through the wire?

(5 marks)

(b) Find current $I$, in the circuit of **Figure Q1(b)**.

(10 marks)

(c) A 30 W incandescent lamp is connected to a 120 V source and is left burning continuously in an otherwise dark staircase. Determine the current through the lamp and the energy of operating the light for a year in kWh.

(5 marks)

**Q2** (a) By using nodal analysis, find $V_o$ and the power dissipated in the 1 Ω resistor in the circuit of **Figure Q2(a)**.

(10 marks)

(b) For the bridge network in **Figure Q2(b)**, find $i_o$ using mesh analysis.

(10 marks)

**Q3** (a) Apply Thevenin's theorem to determine $V_0$ in the circuit of **Figure Q3(a)** and sketch the Thevenin's equivalent circuit with related values.

(10 marks)

(b) Find the Norton equivalent with respect to terminals *a-b* in the circuit shown in **Figure Q3(b)**.

(10 marks)

**PART B**

**Q4** (a) For the circuit in **Figure Q4(a)**, determine the voltage and energy stored in each capacitor.

(8 marks)

(b) The voltage across a 200-mH inductor is given by;

$$v(t) = 3t^2 + 2t + 4 \text{ V for } t > 0.$$

Determine the current $i(t)$ through the inductor. Assume that $i(0) = 1$ A.

(6 marks)

(c) Under steady-state dc conditions (the inductor acts like a short circuit, while the capacitor acts like an open circuit), find $i$ and $v$ in the circuit in **Figure Q4(c)**.

(6 marks)

**Q5** (a) For the circuit in **Figure Q5(a)**;

$v = 120e^{-50t}$ V and $i = 30e^{-50t}$ A, $t > 0$

(i) Find $L$ and $R$.

(4 marks)

(ii) Determine the time constant.

(2 marks)

(iii) Calculate the initial energy in the inductor.

(2 marks)

(iv) Calculate fraction of the initial energy dissipated in 10 ms.

(2 marks)

(b) The switch in **Figure Q5(b)** has been in position $a$ for a long time. At $t = 0$ it moves to position $b$. Calculate $i(t)$ for all $t > 0$.

(10 marks)

**Q6** (a) Find the amplitude, phase, period, and frequency of the sinusoid.

$$v(t) = 12\cos(50t + 10^\circ)$$

(5 marks)

(b) Let $\mathbf{X} = 8\angle 40^\circ$ and $\mathbf{Y} = 10\angle -30^\circ$. Evaluate the following quantities and express your results in polar form.

(i) $\mathbf{(X + Y)X^*}$
(ii) $\mathbf{(X - Y)^*}$

(5 marks)

(c) Calculate the instantaneous voltage across the 2 μF capacitor when the current through it is;

$$i = 4\sin(10^6 t + 25^\circ)\ \text{A}$$

(5 marks)

(d) Determine $\mathbf{Z_T}$ and $\mathbf{I}$ in the circuit of **Figure Q6(d)**.

(5 marks)

**Q7** (a) For the entire circuit in **Figure Q7(a)**, calculate:

(i) The power factor

(4 marks)

(ii) The average power delivered by the source

(2 marks)

(iii) The reactive power

(2 marks)

(iv) The apparent power

(2 marks)

(v) The complex power

(2 marks)

(b) An 880-VA, 220-V, 50-Hz load has a power factor of 0.8 lagging. Determine the value of parallel capacitance that will correct the load power factor to unity?

(8 marks)

**- END OF QUESTION -**

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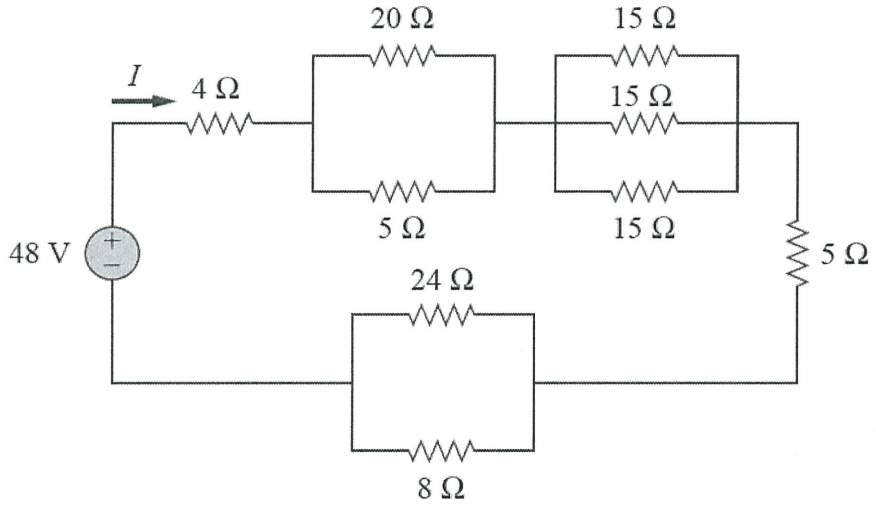


**FIGURE Q1(b)**

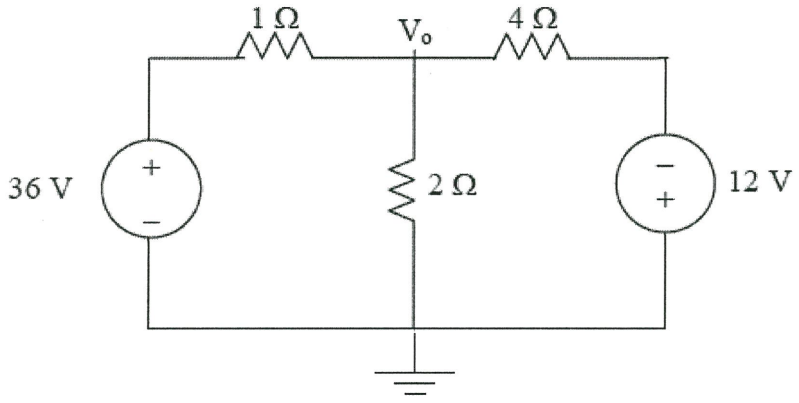


**FIGURE Q2(a)**

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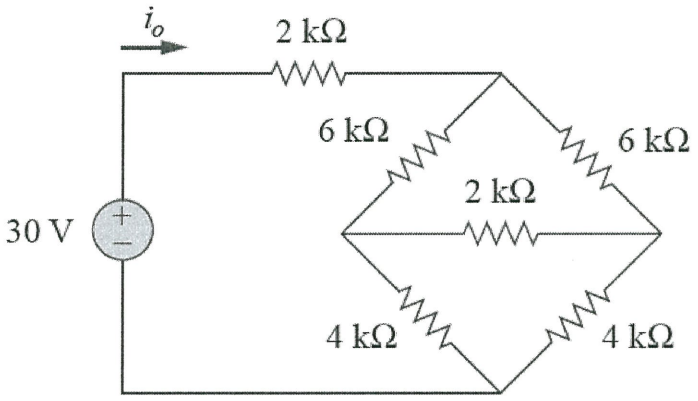


**FIGURE Q2(b)**

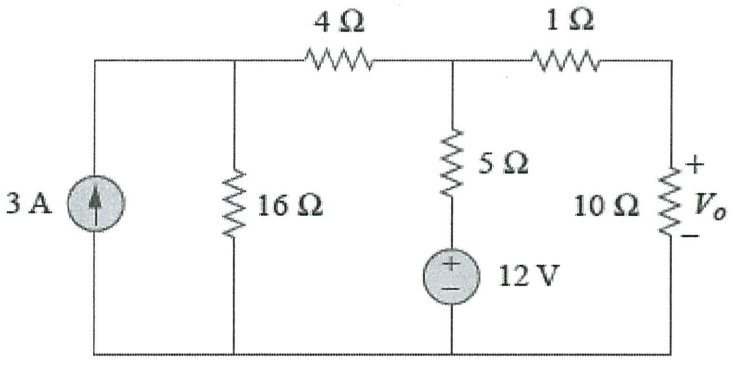


**FIGURE Q3(a)**

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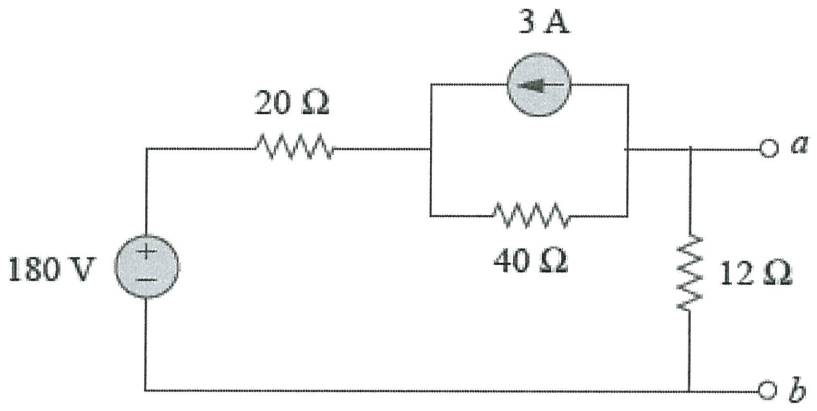


**FIGURE Q3(b)**

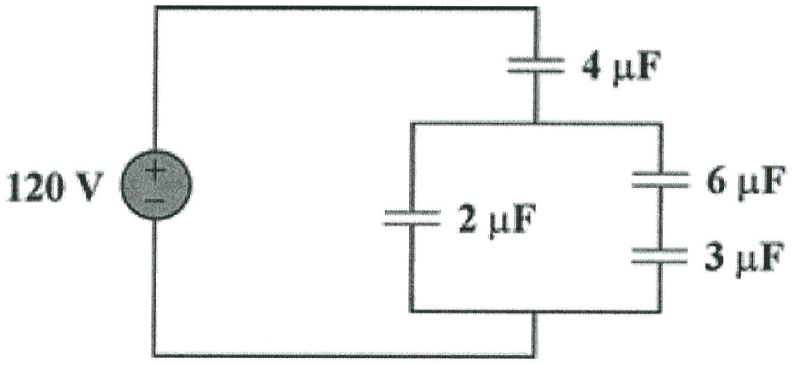


**FIGURE Q4(a)**

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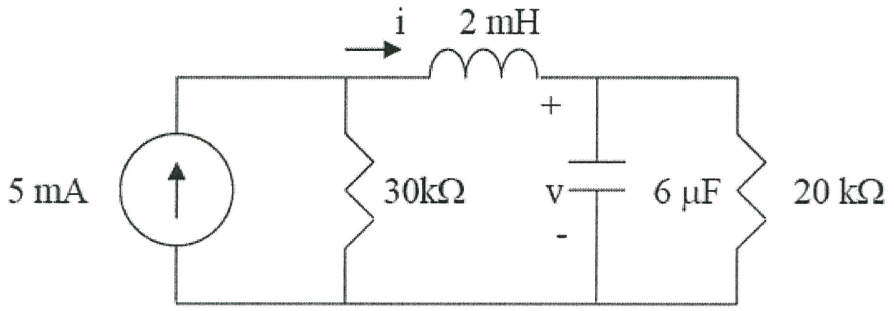


**FIGURE Q4(c)**

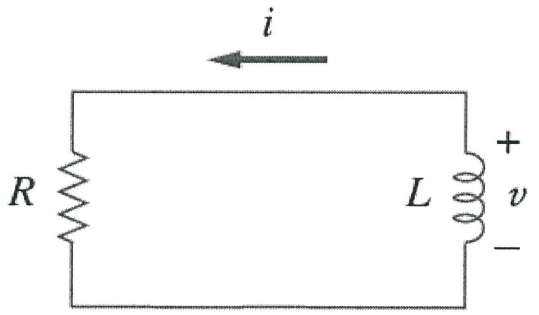


**FIGURE Q5(a)**

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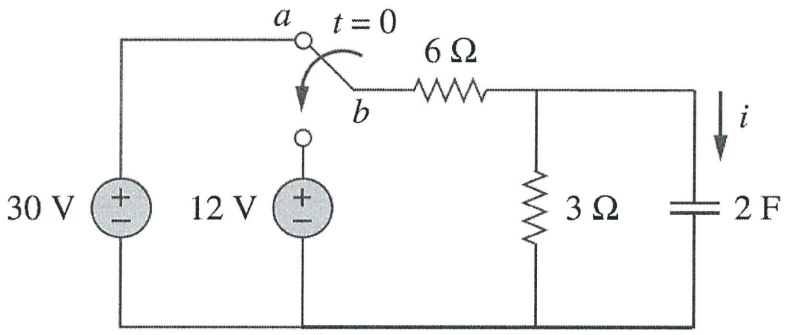


**FIGURE Q5(b)**

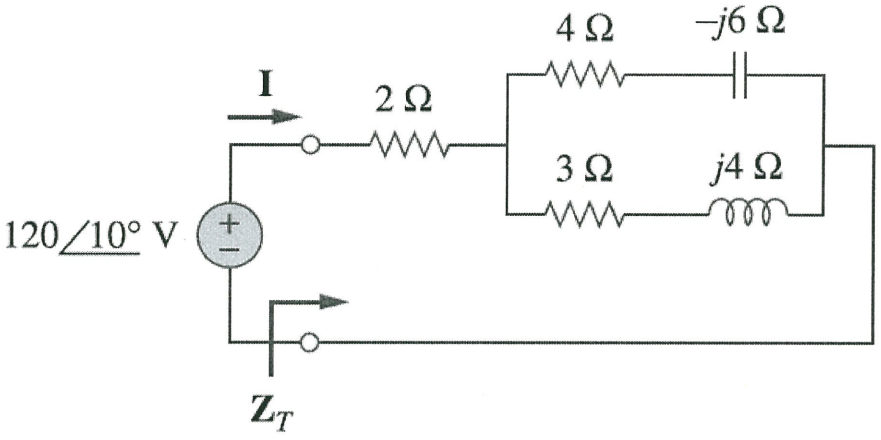


**FIGURE Q6(d)**

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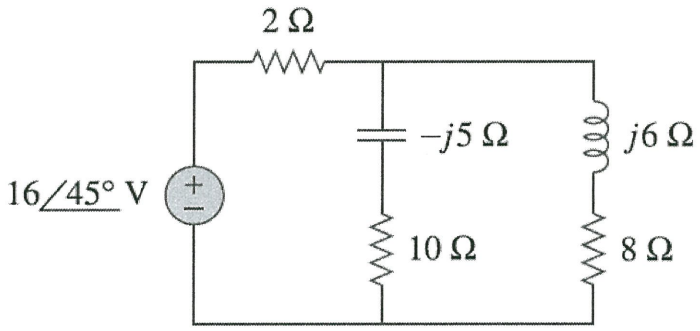


**FIGURE Q7(a)**