COMMUNITY COLLEGE OF CITY UNIVERSITY

Course code & title	:	AST10401 Introduction to Electrical Engineering
Session	:	Semester A 2016/17
Time allowed	:	Two hours

This paper has SEVEN pages (including this cover page).

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1. This paper consists of 9 questions in 2 sections.
2. Answer ALL questions in Section A and ANY THREE questions in Section B.
3. Use the supplied answer book to answer all the questions.
4. Write the question numbers that you attempted on the front cover of your answer book and at the top right-hand corner of each page that you have written answers on.
5. Start a new page for each question. If additional sheet is used, insert appropriately to the corresponding question.

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*This is a **closed-book** examination.*

Candidates are allowed to use the following materials/aids:

Approved Calculators

Materials/aids other than those stated above are not permitted. Candidates will be subject to disciplinary action if any unauthorized materials or aids are found on them.

NOT TO BE TAKEN AWAY

Section A (40%)

Attempt ALL questions from this section

1. Use nodal analysis to find V_o and the power of the 40V voltage source in Figure Q1. 8 marks

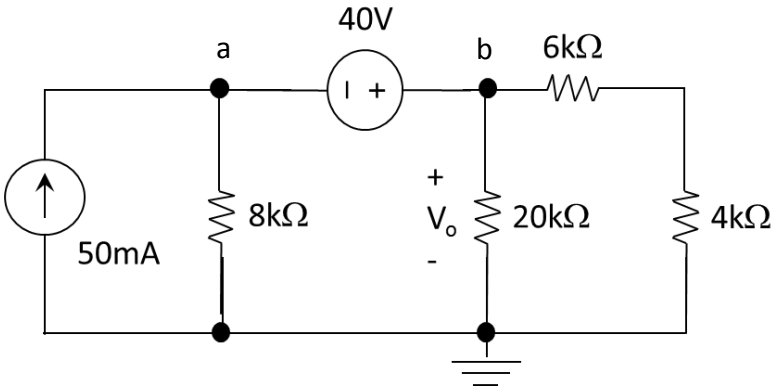

Figure Q1

2. The switch in the circuit shown in Figure Q2 has been at position **a** for a long time. At t = 0s, the switch is moved to position **b**. Find the expression of the capacitor voltage $V_c(t)$ for $t \geq 0$s. 8 marks

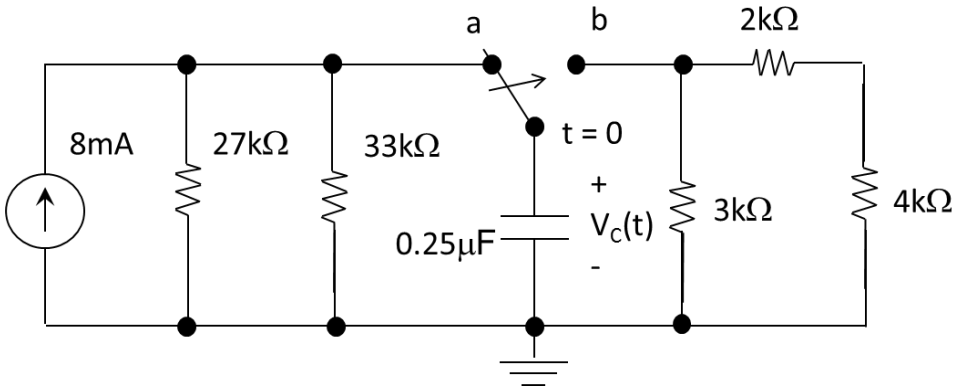

Figure Q2

3. Consider the balanced three phase circuit with angular frequency ω = 5000 rad/s shown in Figure Q3.

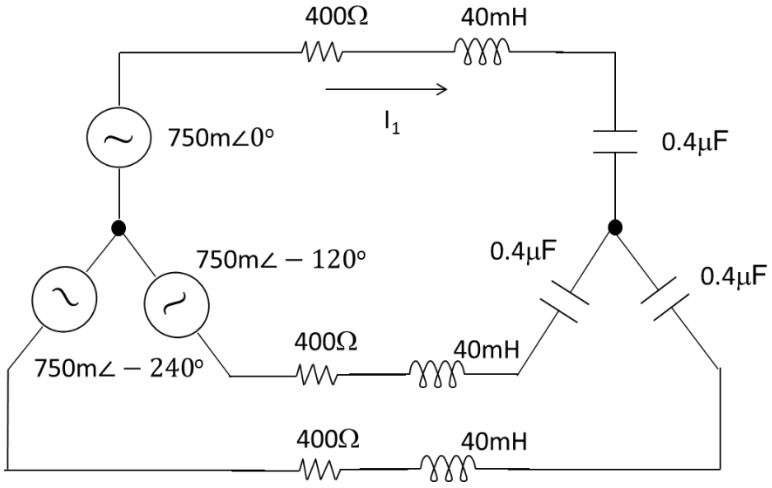

Figure Q3

(a) Find I_1 in time domain representation. 6 marks

(b) Determine the instantaneous power of the source part of the three phrase circuit. 2 marks

4. Use superposition to find i_x shown in Figure Q4. 8 marks

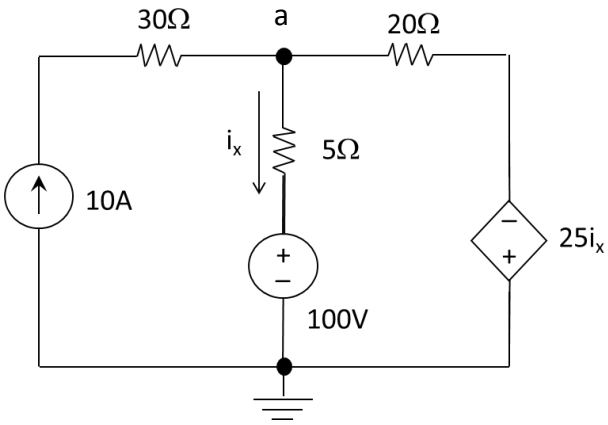

Figure Q4

5. Design a first order circuit using one voltage source, one two-terminal switch (a kind of switch shown in Figures Q8 or Q9), one 1H inductor and resistors to product the inductor current response 8 marks

$i_L(t) = 4 - 3e^{-50t} \quad for \quad t \geq 0s.$

Also draw a circuit diagram for your design.

Section B (60%)

Attempt ANY THREE questions from this section

6. Consider the circuit shown in Figure Q6.

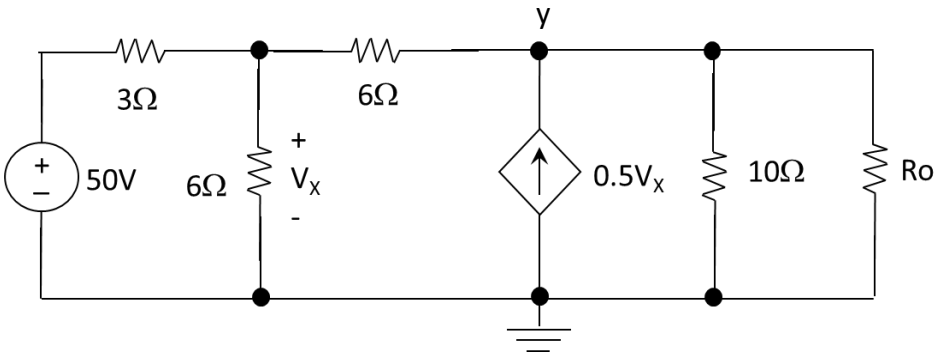

Figure Q6

(a) State the Thevenin theorem in electrical engineering. 2 marks

(b) Find the resistance of the resistor Ro such that the resistor Ro receives the maximum power transfer in the circuit. Also determine the maximum power transfer to the resistor Ro. 12 marks

(c) If we replace the resistor Ro by another resistor R_1 so that the receive power of R_1 is 200W, find the resistance of R_1. 4 marks

(d) If we replace the resistor Ro by a short wire, determine the current in the short wire. 2 marks

7. Given the balanced three-phase circuit shown in Figure Q7 with angular frequency $\omega = 10000$ rad/s, $R = 1.6\text{k}\Omega$ and $C = 62.5\text{nF}$ ($n = 1\times10^{-9}$).

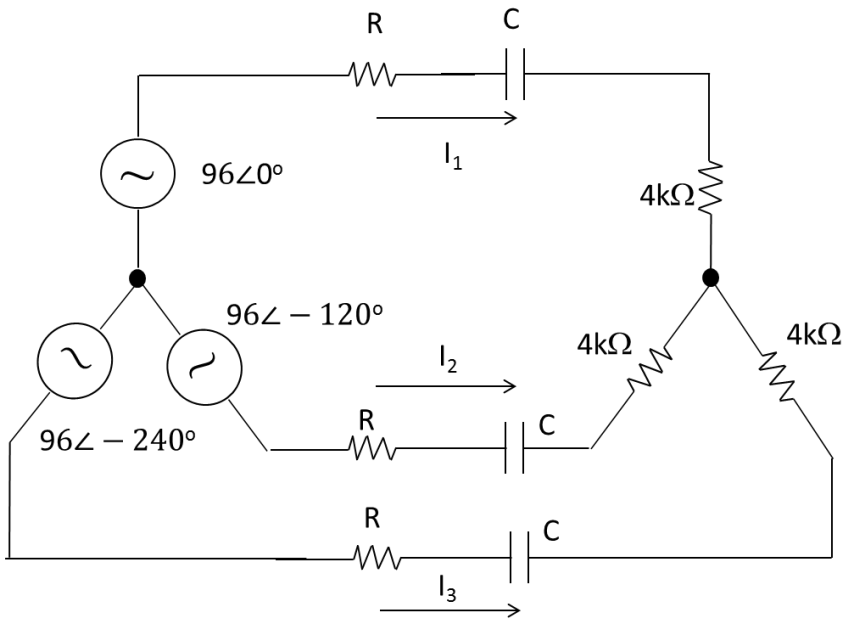

Figure Q7

(a) Find the AC currents I_1, I_2 and I_3 in time domain form. 6 marks

(b) Now we add an inductor with inductance L parallel to the 4kΩ resistor in each phase. Determine the inductance L so that the power factor of the effective load experienced by the AC voltage source in each phase is 1. 9 marks

(c) Determine the AC current I_1 in time domain form based on the result in (b). 5 marks

8. The switch in the circuit shown in Figure Q8 has been opened for a long time and the switch is then closed at t = 0s.

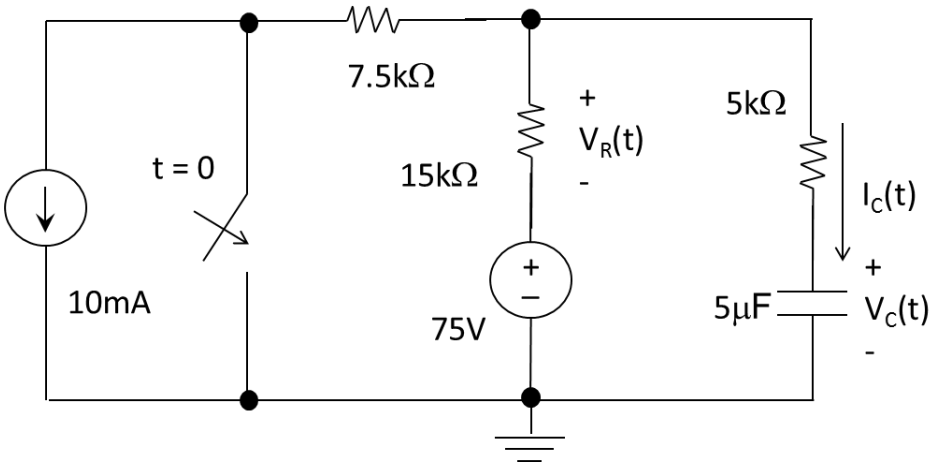

Figure Q8

(a) Draw the steady state equivalent circuit just before t = 0s. 3 marks

(b) Determine the expression of the capacitor voltage $v_c(t)$ for $t \geq 0$s. 9 marks

(c) Determine the expression of the voltage of 15kΩ, $v_R(t)$ for $t \geq 0$s. (Note that you are not allowed to use calculus in this question.) 4 marks

(d) If the switch is opened again at t = 1/20s, find the current of the capacitor $i_C(t)$ at t = 1/20s. (Note that you are not allowed to use calculus in this question.) 4 marks

9. Consider the circuit shown in Figure Q9. The switch in the circuit has been opened for a long time and the switch is then closed at t = 0s.

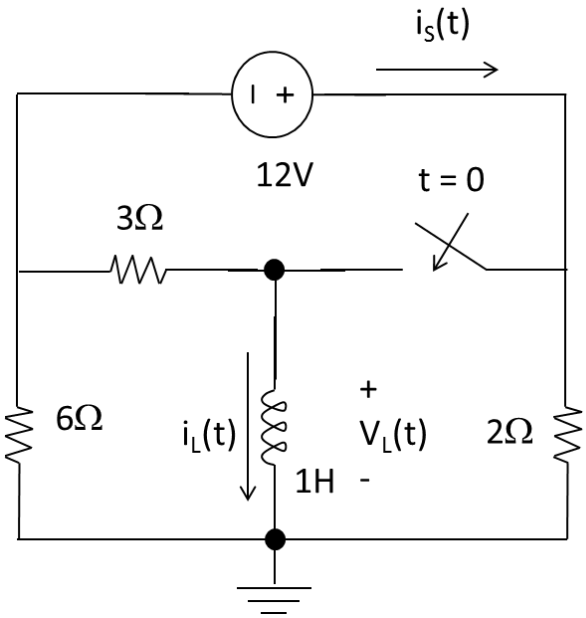

Figure Q9

(a) Draw the steady state equivalent circuit just before t = 0s. 3 marks

(b) Determine the expression of the inductor current $i_L(t)$ for $t \geq 0$s. 9 marks

(c) Determine the expression of the current of 12V voltage source $i_S(t)$ for $t \geq 0$s. (Note that you are not allowed to use calculus in this question.) 4 marks

(d) If the switch is opened again at t = 1/20s, find the voltage of the inductor $V_L(t)$ at t = 1/20s. (Note that you are not allowed to use calculus in this question.) 4 marks

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