COMMUNITY COLLEGE OF CITY UNIVERSITY

Course code & title	:	AST10401 Introduction to Electrical Engineering
Session	:	Semester B 2013/14
Time allowed	:	Two hours

This paper has EIGHT 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 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. By mesh current analysis, determine the power delivered to the 15Ω resistor in the circuit in Figure 1. 7 marks

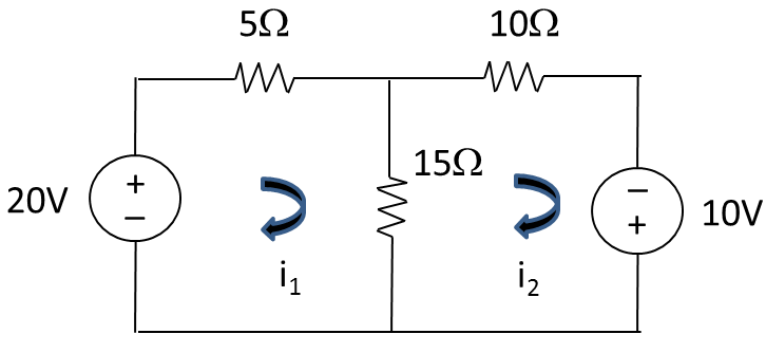

Figure 1

2. Consider the circuit shown in Figure 2, use nodal voltage analysis to determine the voltages at node X and Y and the power of the 6Ω resistor. 7 marks

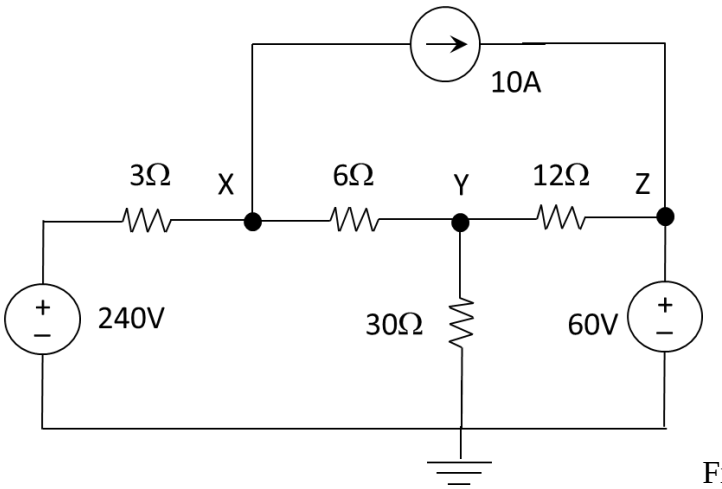

Figure 2

3. Use superposition to find the voltage at node A and the power of the current source in the circuit in Figure 3. 8 marks

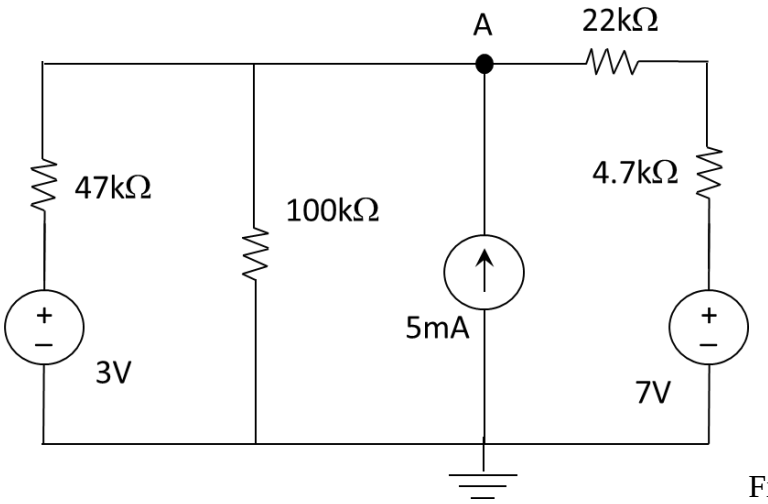

Figure 3

4. Design and draw a first order circuit with an 2H inductor, resistor(s), switch(es) and voltage source(s) such that the current $i(t)$ passing through the 2H inductor for $t \geq 0$ is govern by $i(t) = 2 + 3e^{-10t}$. 8 marks

5. Given a balanced three-phase system with three AC voltage sources shown in Figure 5

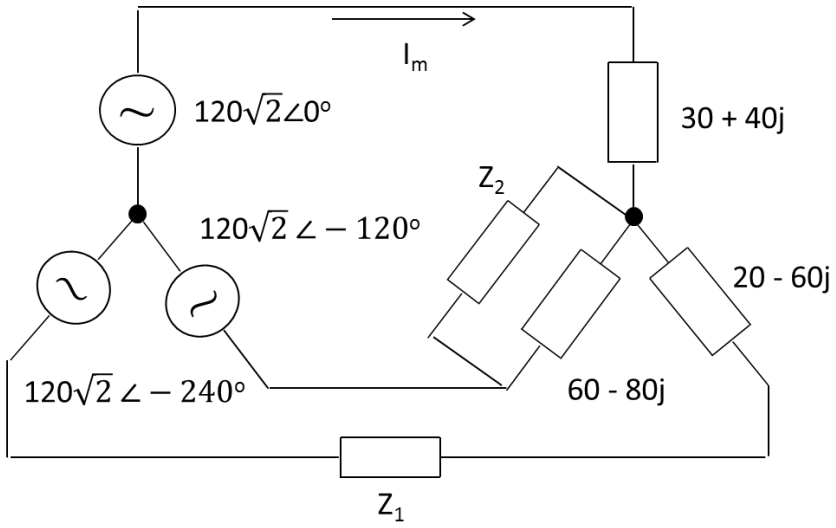

Figure 5

(a) Determine the current phasor I_m and the required impedance Z_1. 3 marks

(b) Determine the instantaneous power of the three-phase source. 2 marks

(c) Determine the required impedance Z_2. 5 marks

Section B (60%)

Attempt ANY THREE questions from this section.

6. Consider the circuit in Figure 6.

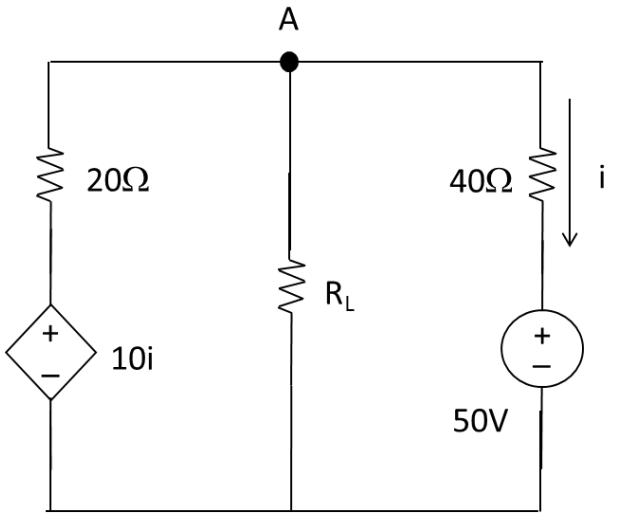

Figure 6

(a) State the Thevenin theorem in electrical engineering. 3 marks

(b) Determine the value of R_L such that the resistance would receive a maximum power transfer. 5 marks

(c) For the result in (b), calculate the maximum power transfer to R_L. 6 marks

(d) Suppose a 30V voltage source is added between node A and 40Ω resistor so that node A is connected to the positive terminal of the source. With your answers to (b) and (c), determine the value of R_L such that the resistance would receive a maximum power transfer and also determine the maximum power transfer to that R_L. Note that no mark will be given if you fail to use your answers to (b) and (c). 6 marks

7. There are two switches S1 and S2 in Figure 7. S1 has been opened and S2 has been closed for a long time. At $t = 0$, S1 is closed while S2 is opened.

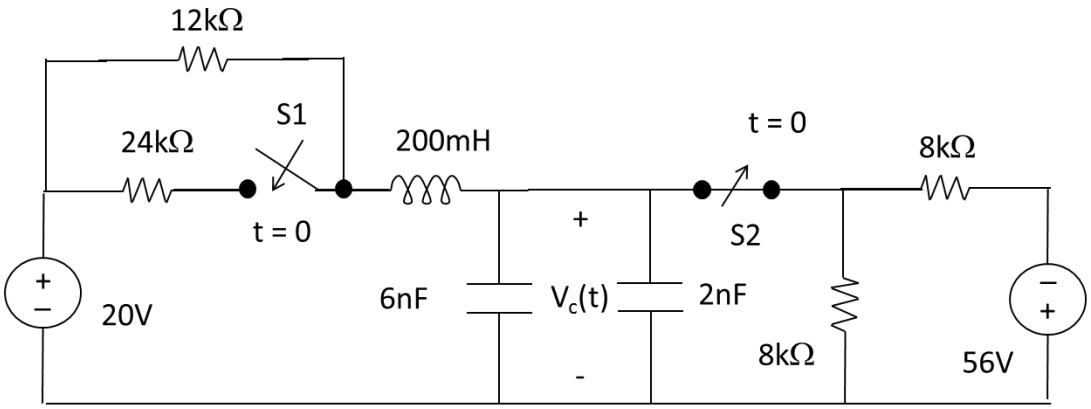

Figure 7

(a) Draw the steady state equivalent circuit before $t = 0$. 2 marks

(b) Determine $V_c(t)$ and the inductor current at $t = 0$. 2 marks

(c) Draw the steady state equivalent circuit after $t = 0$. 2 marks

(d) Determine the expression of $V_c(t)$ for $t \geq 0$. 9 marks

(e) Determine the expression of inductor voltage for $t \geq 0$. 5 marks

8. The switch in Figure 8 has been in position A for a long time. It moves to position B at $t = 0$.

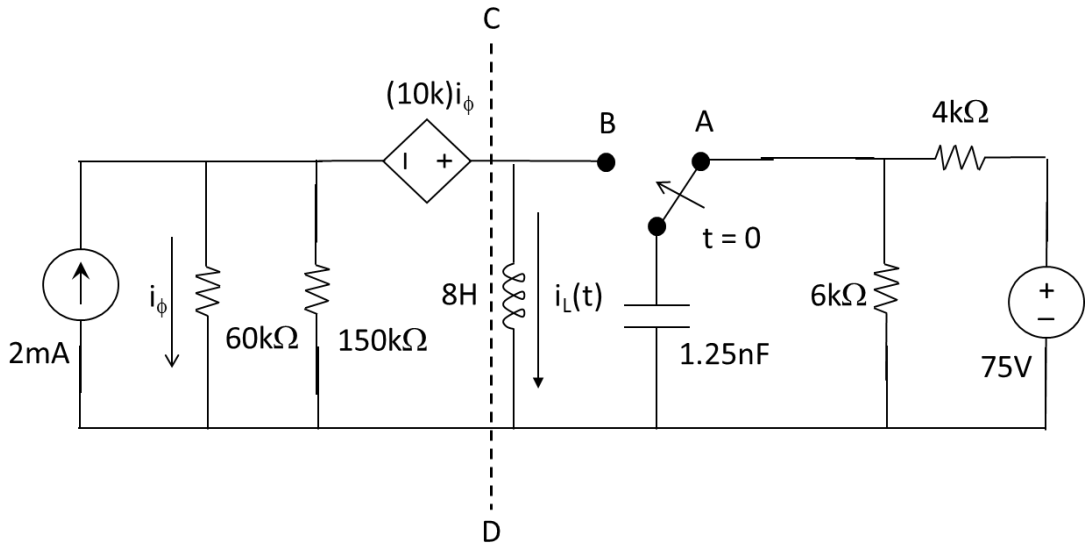

Figure 8

(a) Find the Norton equivalent to the left hand side of C-D. 8 marks

(b) Determine the capacitor voltage and the inductor current at $t = 0$. 3 marks

(c) Determine the expression of $i_L(t)$ for $t \geq 0$. 9 marks

9. Consider the circuit shown in Figure 9 with an AC voltage source $v_s(t) = 100\cos(60t)$.

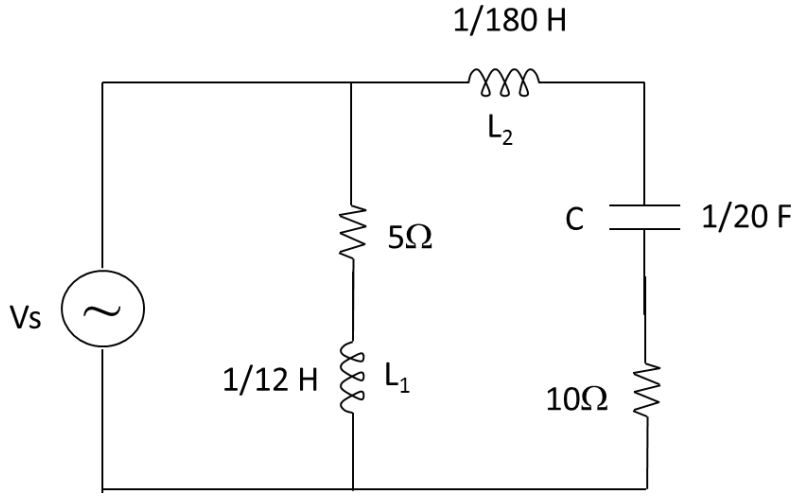

Figure 9

(a) Find the impedances of the capacitor and inductors. 3 marks

(b) Determine the AC current in time domain generated from the AC voltage source $v_s(t)$. 6 marks

(c) Calculate the average power generated by the AC voltage source $v_s(t)$. 3 marks

(d) Perform power factor correction in such a way that the magnitude of source current is minimized. 5 marks

(e) If the angular frequency of the AC voltage source tends to infinity, what is the current generated by the AC source? 3 marks