Ref No.: Ex/EE/5/T/112/2023(S)

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) FIRST YEAR FIRST SEMESTER SUPPLEMENTARY EXAM - 2023

SUBJECT: CIRCUIT THEORY

Time: Three Hours | Full Marks: 100 (50 Marks for each part)

Use a separate Answer-Script for each part

Two marks for neat and well-organized answers

Question No.	Part-I	Marks

Answer any three questions

1. (a) Explain the following: — 3×3
   (i) Bilateral Network.
   (ii) Passive network.
   (iii) Time invariant Network.

   (b) Define a unit step function and unit ramp function. What is the relationship between these two singularity functions? — 7

2. (a) The voltage across the capacitor in the Fig.1 is given as follows: $v_c(t) = 2r(t) - 2r(t-1) - 2u(t-1)$. Find the value of the voltage source Vs in terms of singularity functions and sketch it. — 8

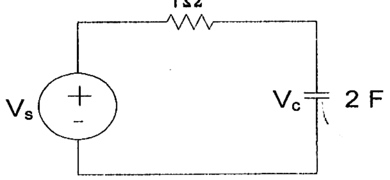

Fig. 1

   (b) For the circuit shown in Fig.2, if the switch is closed at t= 0, find the values of $i(0^+), \frac{di}{dt}(0^+)$ and $\frac{d^2i}{dt^2}(0^+)$ — 8

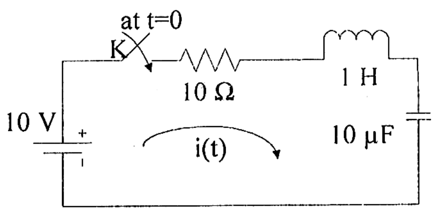

Fig.2

[Turn over

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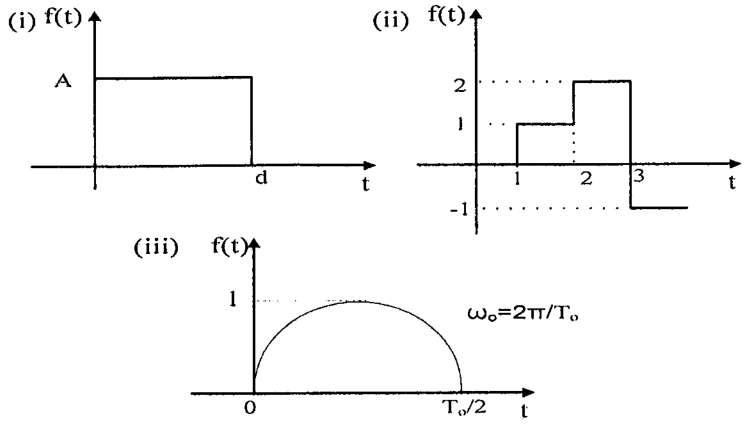
3. (a) Derive and sketch the transformed equivalent of inductance with initial conditions. 4

(b) Find the Laplace transform of the following three signals: 3×4



4. (a) State and derive the initial value theorem. Find the initial and final values of the following function using initial and final value theorem, respectively. 12

$$G(s) = \frac{10(s-1)}{(s+1)(s+2)}.$$

(b) "The capacitor can be represented as a short circuit at t = 0+" – Explain. 4

5. (a) Draw a two port network whose y parameters are $y11 = -y12 = -y21 = y22 = 1$ mho. If two such networks are cascaded determine the y parameter of the overall network. 8

(b) Obtain the ABCD parameters in terms of Z parameters of a two-port network. 8

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1ST YEAR 1ST SEMESTER SUPPLEMENTARY EXAMINATION, 2023

Subject: CIRCUIT THEORY **Time: Three Hours** **Full Marks: 100**

Part II (50 marks)

Question No.	***Question 1 is compulsory*** Answer ***Any Two*** questions from the rest (2×20)	Marks
Q1	Answer ***Any One***: ***Either*** (a) ***or*** (b)	
(a)	Given the circuit of Figure Q1(a), use nodal analysis to solve for the voltage V_{ab}.	10

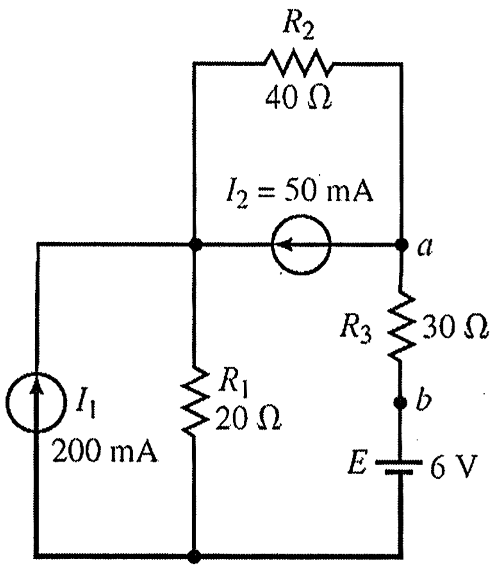

Figure Q1(a)

(b) Use source superposition to obtain V_o. — 10

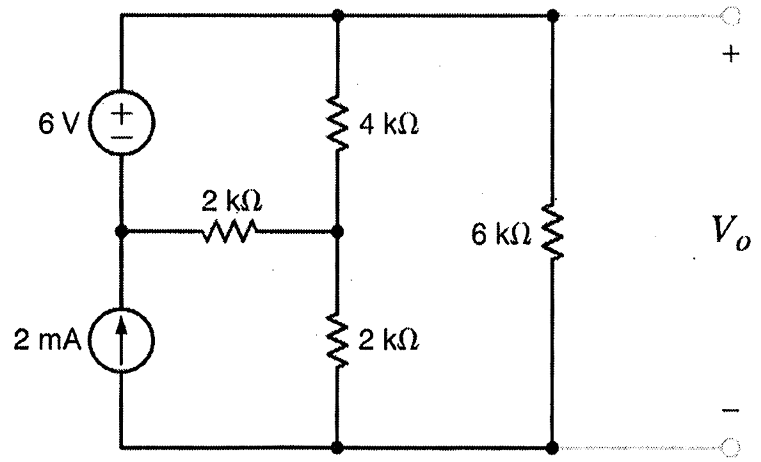

Figure Q1(b)

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Q2 (a) For the circuit shown in Figure Q2(a), find the voltage Vx using nodal analysis. 6

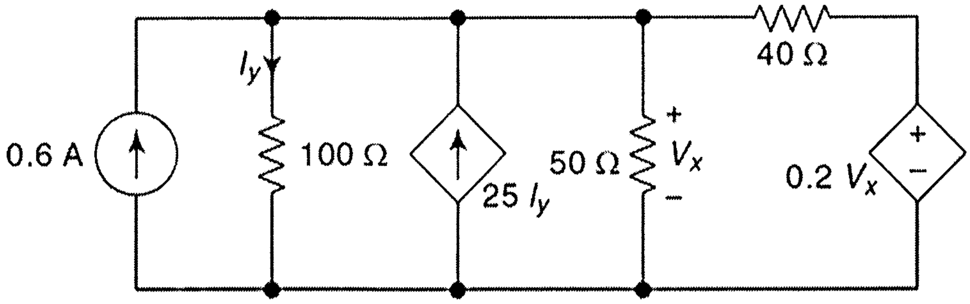

Figure Q2(a)

(b) If the indicated portion in the circuit of Figure Q2(b) is to be replaced with a current source and a 240-ohm shunt resistor, determine the magnitude and direction of the required current source. 6

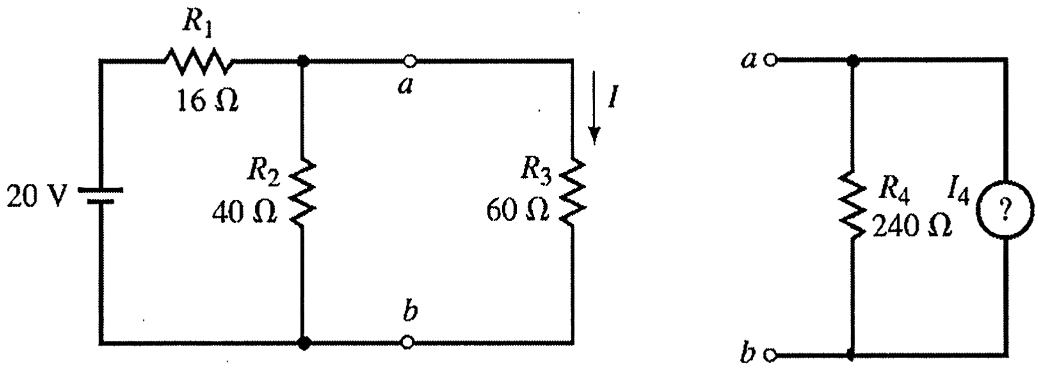

Figure Q2(b)

(c) Find the Norton equivalent for the circuit shown in Figure Q2(c) with respect to the terminals *a* and *b*. Determine the current through R_L. 6+:

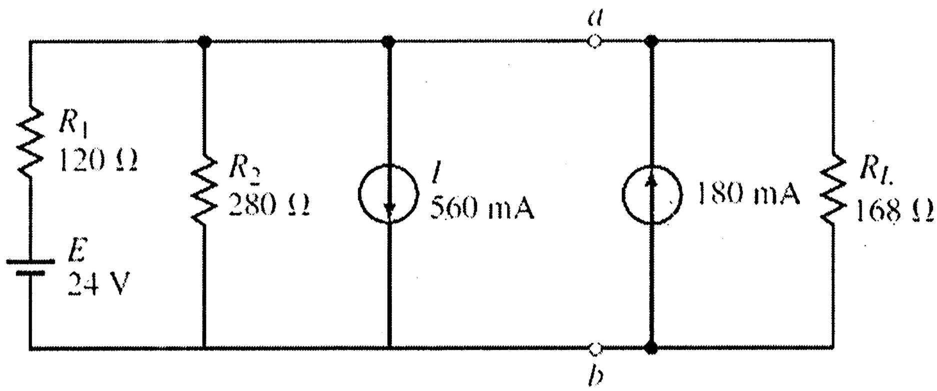

Figure Q2(c)

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Q3 (a) For the circuit shown in Figure Q3(a) the switch is opened at $t = 0$. Transform the circuit to its s-domain equivalent and obtain the expression for $V_0(s)$. 8

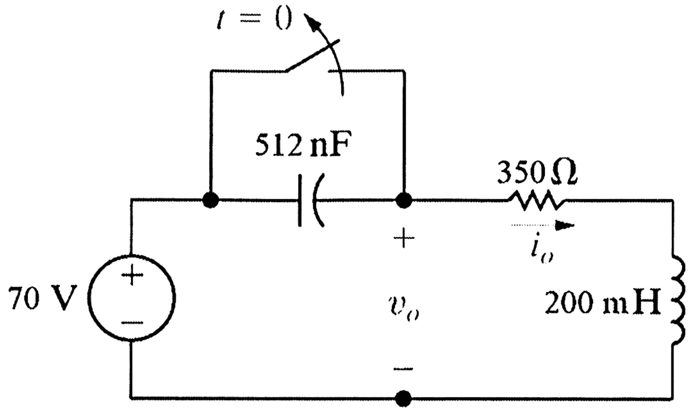

Figure Q3(a)

(b) For the circuit, as shown in Figure Q3(b), find the value of R that results in maximum power absorbed by R for β = 0.5. 6

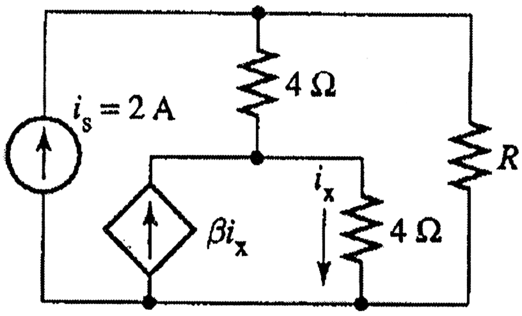

Figure Q3(b)

(c) Consider the circuit shown in Figure Q3(c). Determine the voltage V across resistor R_3. Now, remove the current source I and place it between node b and the reference node. Show that the voltage across the former location of the current source (node a) is now the same as the voltage V. 6

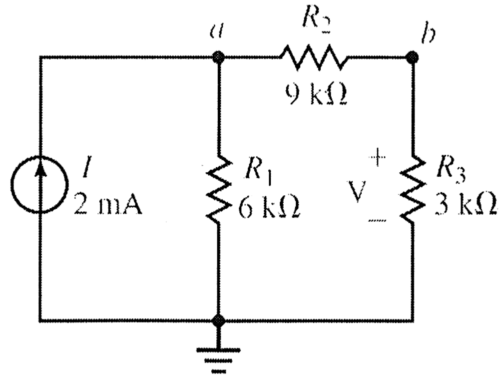

Figure Q3(c)

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Q4 (a) Discuss the dot convention in connection with the coupled magnetic circuits.

Consider the mutually coupled circuit as shown in Figure Q4(a) with the reference directions of the current and mutually induced voltages for both the coils as indicated. For all the four possible combinations of the coil connections show how the polarity of the mutually induced voltage depends on the direction of the inducing current and the dots on the two coupled coils. 2+6

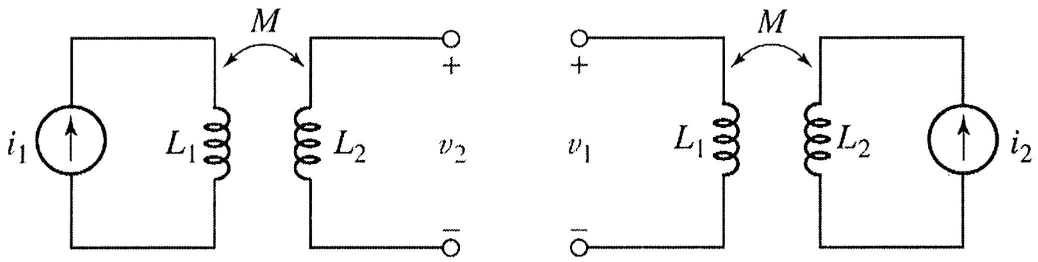

Figure Q4(a)

(b) Find the total inductance of the series coils shown in Figure Q4(b). 6

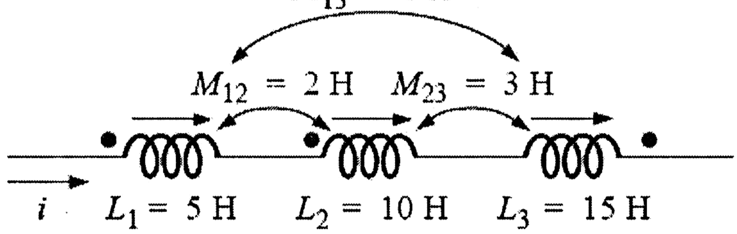

Figure Q4(b)

(c) For the network shown in the Figure Q4(c), draw the oriented graph and obtain the Tie-Set Matrix. 6

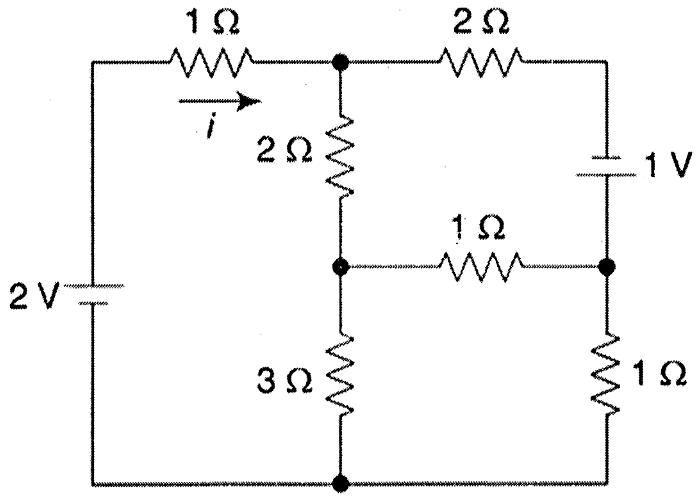

Figure Q4(c)

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Q5 (a) With the help of an example, briefly explain the Compensation Theorem. 4

(b) For the network shown in the Figure Q5(b), obtain fundamental Cut-Set Matrix and then derive the node equations. 8

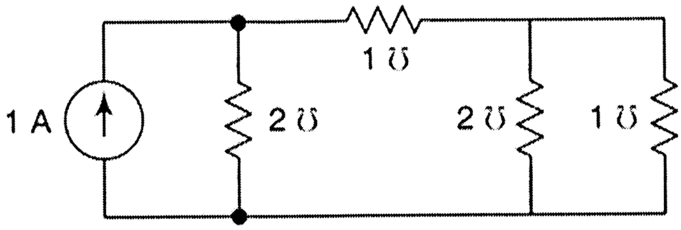

Figure Q5(b)

(c) Derive the loop equations for the loops with currents I_1 and I_2 in the circuit shown in Figure Q5(c). 8

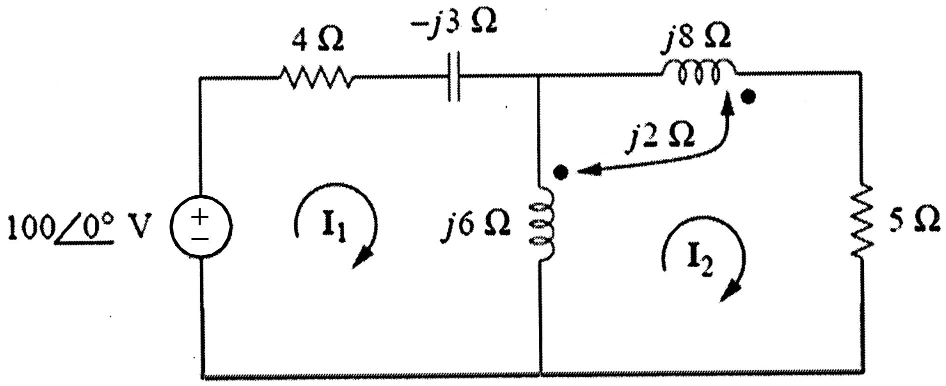

Figure Q5(c)