Ref. No.: Ex/EE/PC/B/T/212/2024

B. E. ELECTRICAL ENGINEERING 2ND YEAR 1ST SEMESTER EXAMINATION, 2024

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

Part I (50 marks)

Use Separate Answer-script for Each Part

Answer ***Any Three*** questions (3×16)

(***Two*** marks are reserved for well organized answers)

Question No.			Marks
Q1	(a)	Find out the currents i_1 and i_2 in the circuit shown in Figure Q1(a), where R=4k.	8

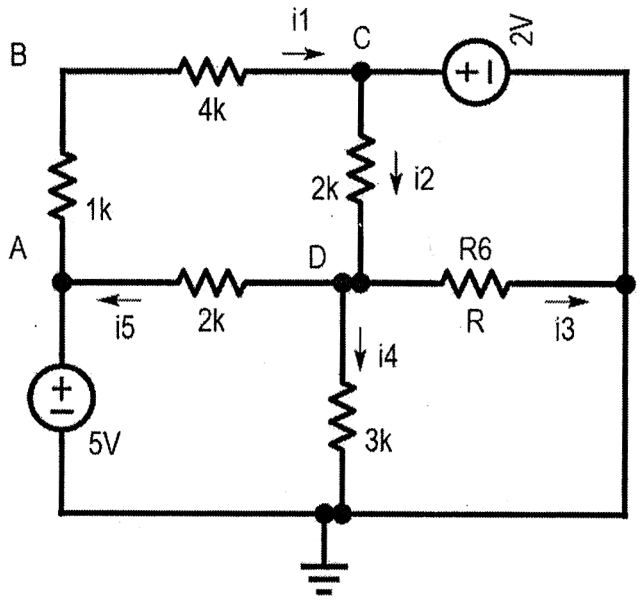

Figure Q1(a)

(b) Obtain the Thevenin equivalent of the circuit shown in Figure Q1(b). 8

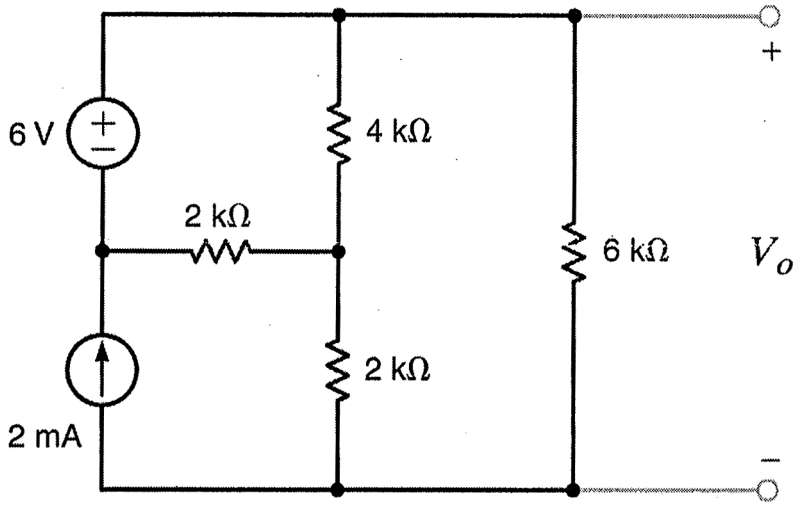

Figure Q1(b)

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Q2 (a) State and prove Millman's Theorem for n number of voltage sources (with open circuit voltages E_i and their respective internal impedances Z_i) connected in parallel. 4

(b) Consider the circuit shown in Figure Q2(b). 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. 4

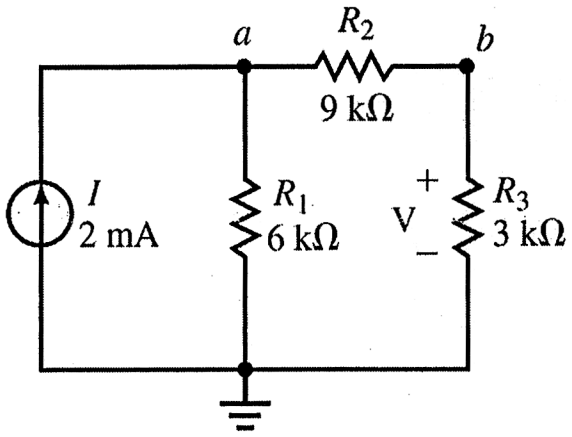

Figure Q2(b)

(c) Find V_x in the circuit, given in Figure Q2(c), by using source transformation. 8

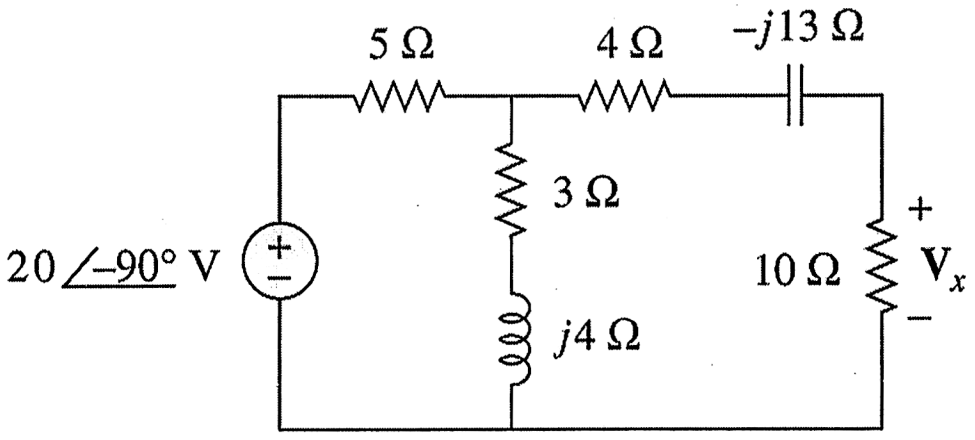

Figure Q2(c)

Q3 (a) Write down the mesh equations for the circuit shown in the Figure Q3(a). 8

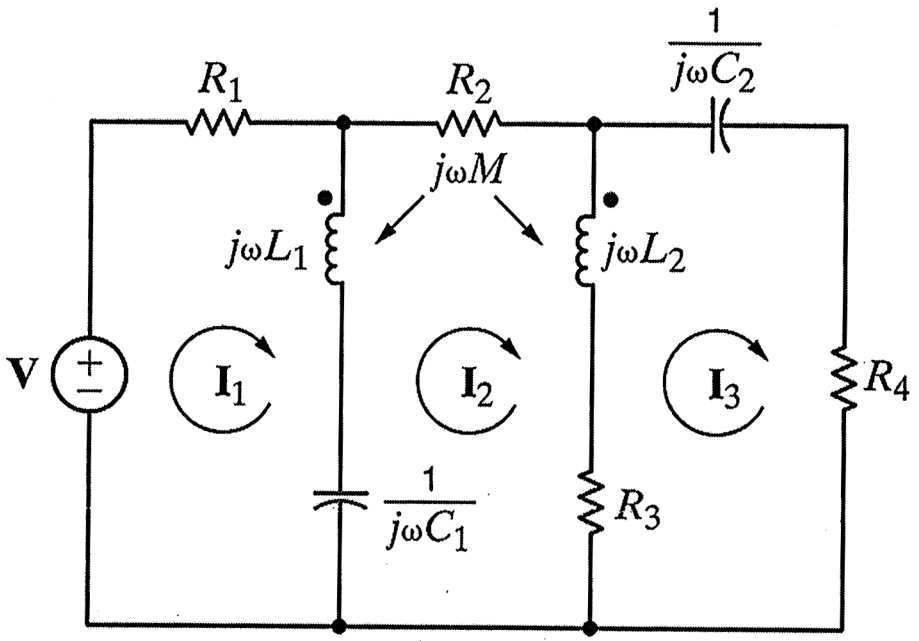

Figure Q3(a)

(b) Determine the value of the current I_0 for the circuit shown in Figure Q3(b). 8

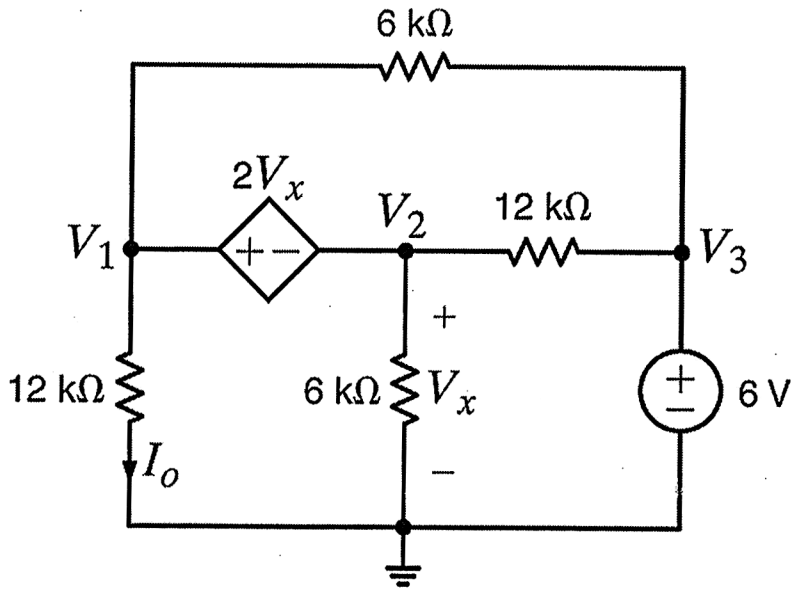

Figure Q3(b)

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Q4 (a) Consider the magnetically coupled circuit as shown in Figure Q4(a).
The reference directions of the current and mutually induced voltages for both the coils are as indicated.
For all the possible combinations of the coil orientations 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. 4

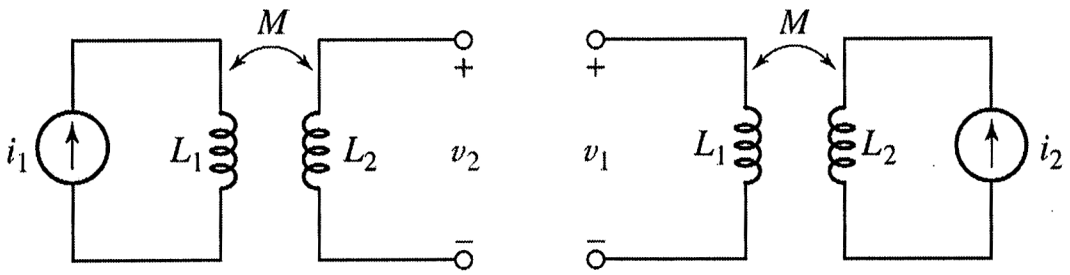

Figure Q4(a)

(b) With the help of an example define the following for a graph of a network 4
(i) Tree, (ii) Co-Tree, (iii) Twigs, (iv) Chords.

(c) For the network shown in the Figure Q4(c), draw the oriented graph.
Obtain the Tie-Set Matrix to derive the loop equations. 8

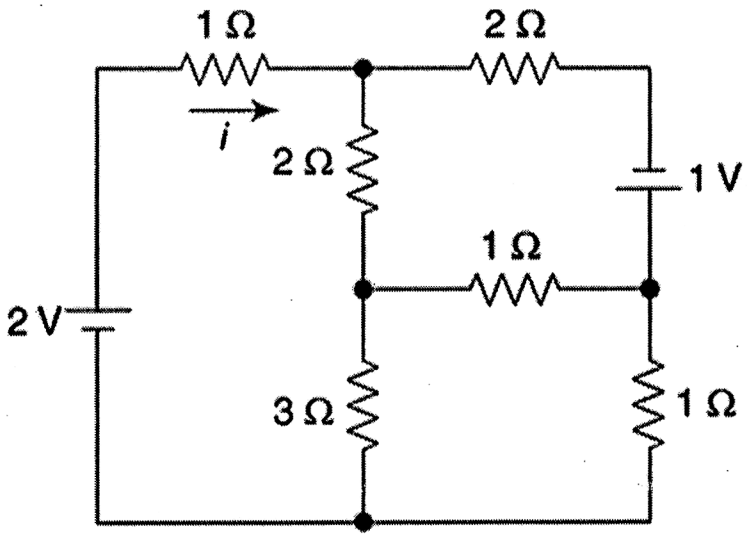

Figure Q4(c)

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Q5 (a) For the network shown in the Figure Q5(a), prepare a Cut-Set schedule and obtain the network equilibrium equations. 8

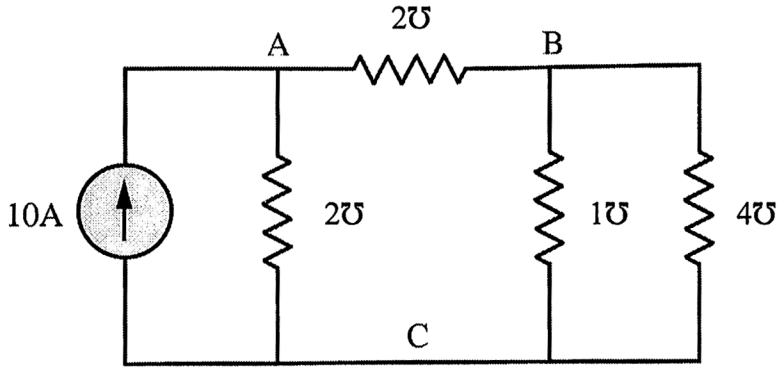

Figure Q5(a)

(b) For the circuit shown in Figure Q5(b), the Switch S_1 has been closed for a long time and S_2 is kept open. At $t = 0$, S_2 is closed and, simultaneously, S_1 is opened. Find the expressions for i, v_L and v_R for $t > 0$. 8

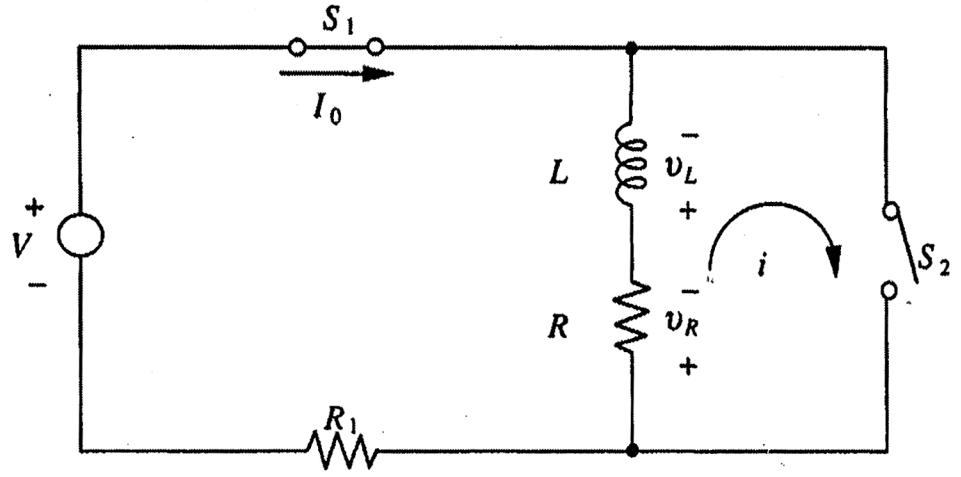

Figure Q5(b)

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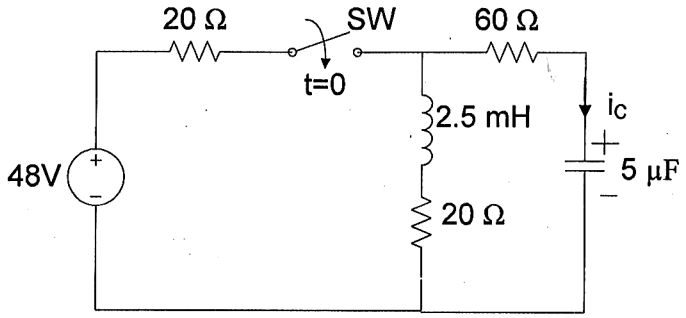
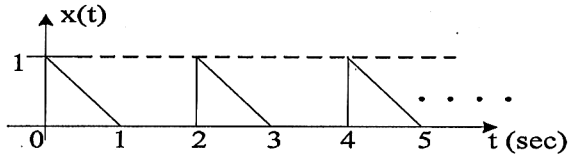
B.E. ELECTRICAL ENGINEERING SECOND YEAR FIRST SEMESTER EXAM 2024
SUBJECT: - CIRCUIT THEORY

Time: Three hours

Full Marks: 100
(**50** marks for this part)

Use a separate Answer-Script for each part

No. of Question		PART -II Answer any Three (Two marks reserved for well organized answers)	Marks
1)	a)	Consider the circuit shown in Fig. 1(a) where the initial energy stored in the capacitor is zero. Find the capacitor current in time domain after closing the switch "SW" at t=0.  Fig. P -1(a)	(8)
	b)	Find the Laplace transform of waveform given in Fig P-1(b). Derive the formula you used.  Fig. P -1(b)	(8)
2)	a)	Find the current *i(t)* if the staircase waveform shown in Fig. P-2 (a) is applied to an RL series circuit with R= 1Ω and L = 1 H. Assume all initial conditions to be zero.	(10)
	b)	A circuit has the following transfer function: $$\frac{C(s)}{R(s)} = \frac{s^2+3s+4}{s^2+4s+4}$$ Find *C(t)* when *r(t)* is a unit step. Also state if the circuit is undamped, underdamped, critically damped or overdamped.	(6)

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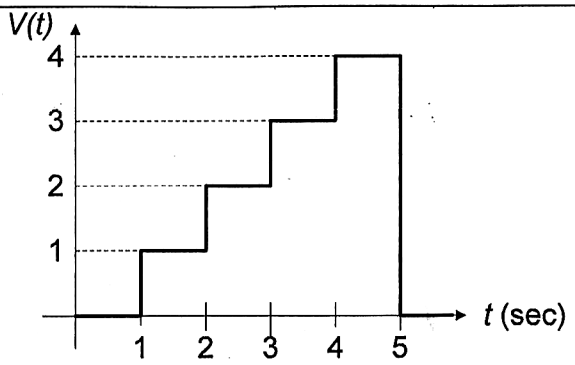

Fig. P -2(a)

3)	a)	Write a short note on significance of performing the analysis of the electric circuits in complex frequency domain.	(8)
	b)	A series combination of resistance R and inductance L, initially relaxed, and was excited with a dc voltage source at t = 0. Derive expression for the current in the circuit. Also show that the current through the circuit rises to 63•21% of the steady state value at the end of an interval of one time constant.	(8)
4)	a)	Draw a two port network whose y parameters are $y_{11} = -y_{12} = -y_{21} = y_{22} = 1.5s$. If two such networks are cascaded, determine the y parameter of the overall network.	(10)
	b)	Derive the condition for reciprocity and symmetry of a two port network when specified by its ABCD parameters.	(6)
5)	a)	Determine the z and h-parameters of the network as shown in Fig. P-5(a).	(8)
	b)	Obtain the short circuit admittance parameters in terms of hybrid parameters and inverse hybrid parameters.	(8)

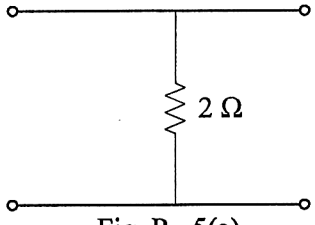

Fig. P - 5(a)