Ref. No.: Ex/EE/PC/B/T/212/2023

B. ELECTRICAL ENGINEERING 2ND YEAR 1ST SEMESTER EXAMINATION, 2023

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

Part I (50 marks)

Use Separate Answer-script for Each Part

Question No. | Answer *Any Three* questions (3×16) (*Two* marks are reserved for well organized answers) | Marks

Q1 (a) Given the circuit of Figure Q1(a), use nodal analysis to solve for the voltage V_{ab}. 10

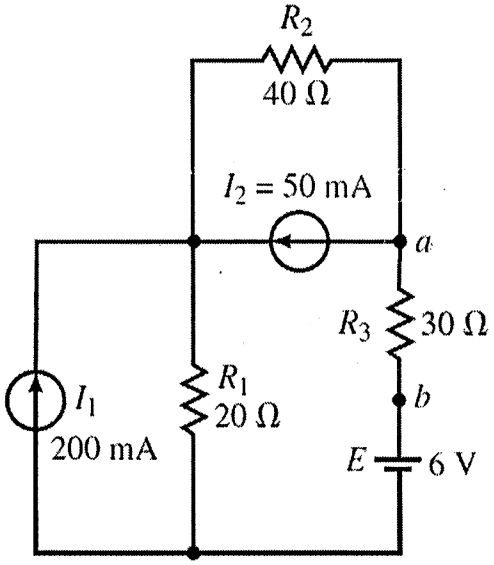

Figure Q1(a)

Q1 (b) Find the Norton equivalent for the circuit shown in Figure Q1(b) with respect to the terminals a and b. Determine the current through R_L. 6

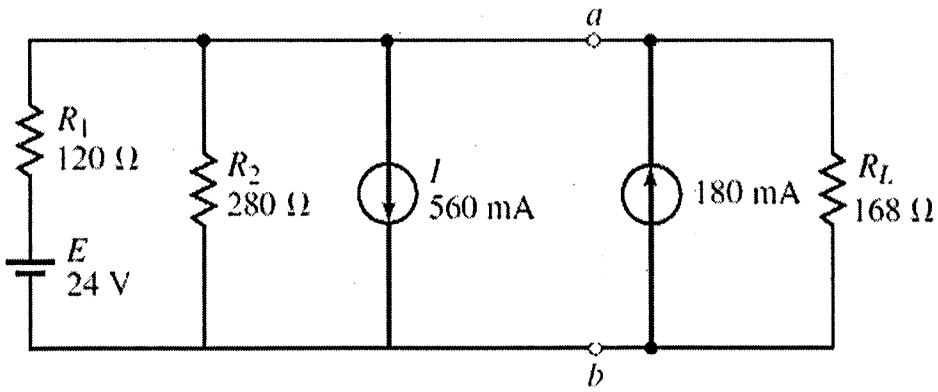

Figure Q1(b)

Q2 (a) With the help of an example, briefly explain the Compensation Theorem. 4

(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

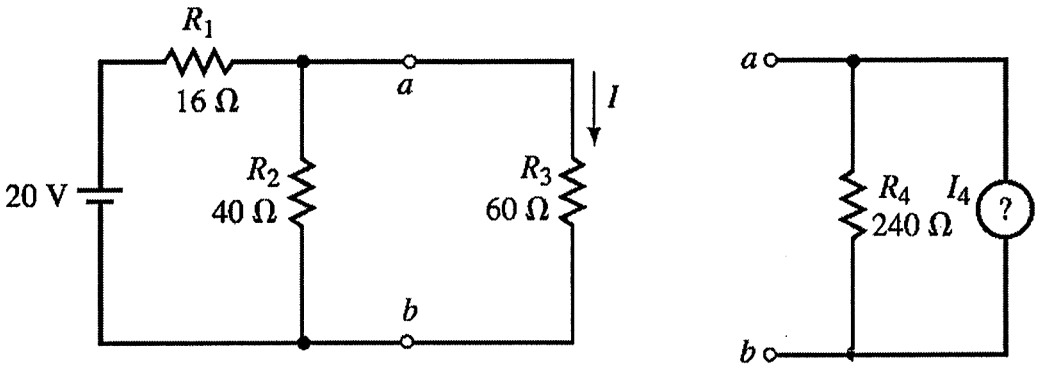

Figure Q2(b)

(c) Find I_o in the circuit, as given in Figure Q2(c), by using the concept of source transformation. (There is no mutual coupling between the inductors.) 6

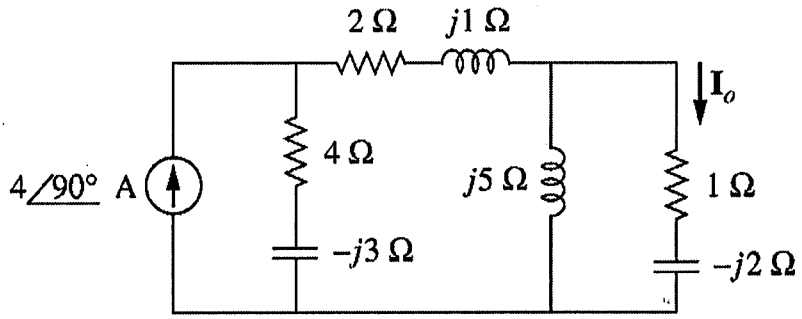

Figure Q2(c)

Q3 (a) For the circuit shown in Figure Q3(a) determine the currents I_1 and I_2. 10

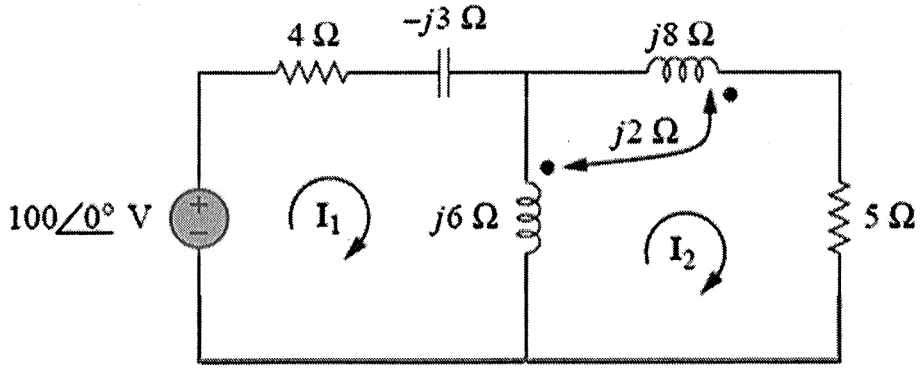

Figure Q3(a)

Q3 (b) For the circuit, as shown in Figure Q3(b), find the value of R that results in maximum power absorbed by R for $\beta = 0.5$ and $\beta = 1.5$. 6

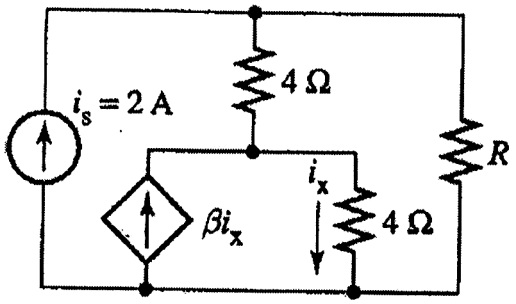

Figure Q3(b)

Q4 (a) With the help of neat diagrams show how the reference polarity of the mutually induced voltage depends on the direction of the inducing current and the dots on the two coupled coils. 4

(b) Two mutually coupled inductors are connected across a voltage source, as shown in Figure Q4(b). Obtain the equivalent inductance of the circuit. 4

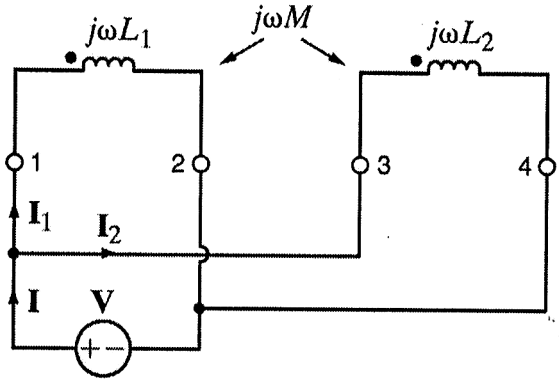

Figure Q4(b)

(c) For the network shown in Figure Q4(c), write a Tie-Set schedule and then obtain the loop equilibrium equations using the Graph Theoretic approach. 8

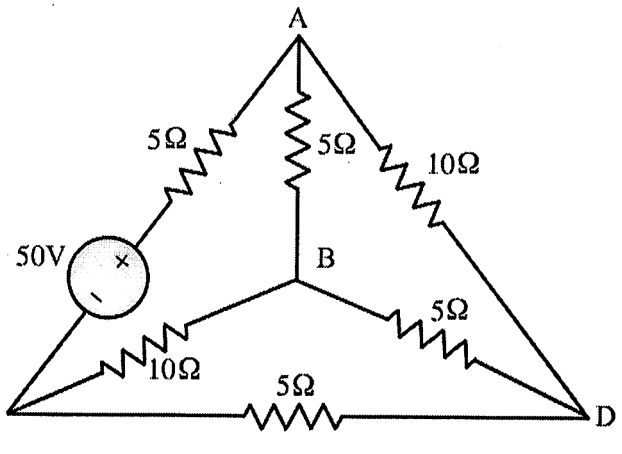

Figure Q4(c)

Q5 (a) Justify the following statement: 4

"All Paths are Subgraph but all Subgraphs are not Path".

Q5 (b) Consider the network shown in Figure Q5(b). For a tree consisting of (1, 2, 3) obtain the Cut-Set matrix. 4

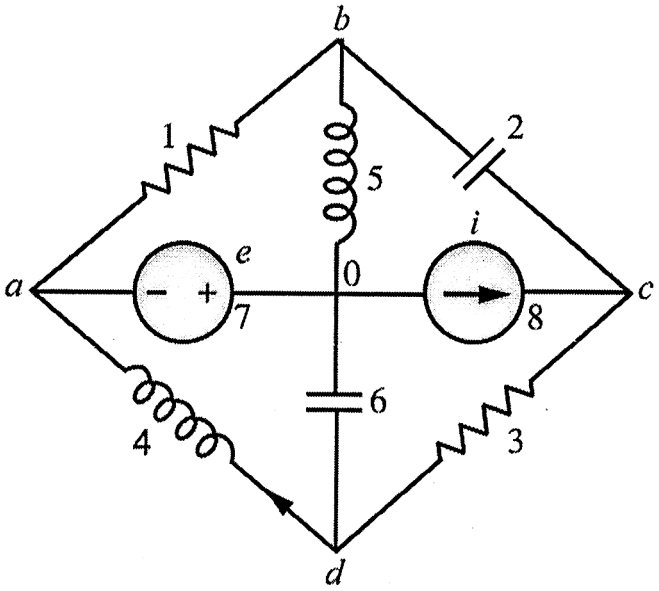

Figure Q5(b)

(c) For the circuit shown in Figure Q5(c) the switch is opened at t=0. Transform the circuit to its s-domain equivalent and obtain the expression for $V_0(s)$. 8

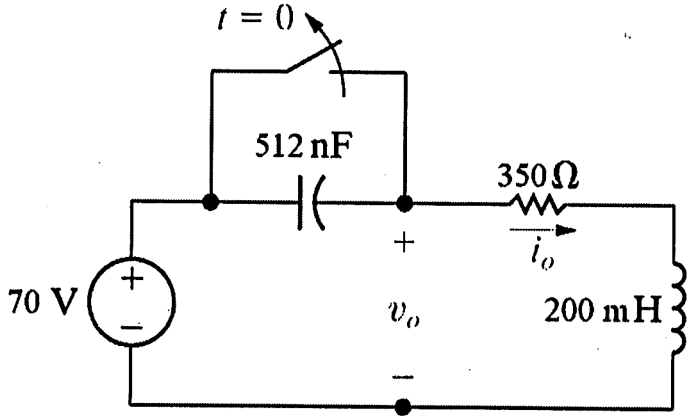

Figure Q5(c)

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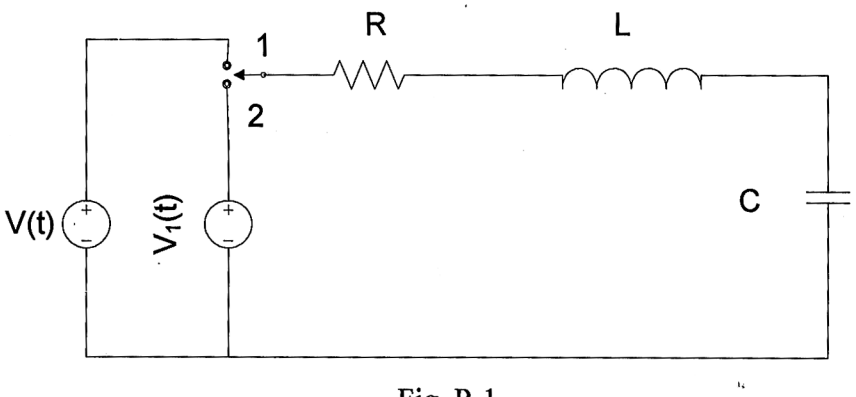
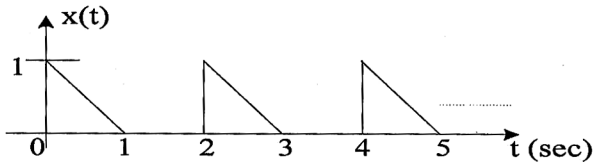
B.E. ELECTRICAL ENGINEERING SECOND YEAR FIRST SEMESTER EXAM 2023

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)	Consider the circuit shown in Fig.P-1. The switch is thrown from position 1 to position 2 at time $t=0$. Just before the switch is thrown, the initial conditions are $i_L(0^+)=2A, v_C(0^+)=2V$. Find the current $i(t)$ after the switch thrown at position 2. Assume $L=1H, R=3\Omega, C=0.5F, V_1=5V$. Sketch the waveform of $i(t)$.  Fig. P-1.	(12+4 =16)
2)	Find the Laplace transform of the periodic signal $x(t)$ as shown in Fig. P-2. Derive the formula that you have used.  Fig. P-2.	(8+8 =16)
3) (a)	The port 1 of the two port network shown in Fig. P-3 (a) is connected to a 200 mV DC source in series with a 1000 Ω resistance. The port-2 of the network is loaded with a resistance of 2.5kΩ. Determine the Z-parameter of the network and the power fed to the load.	(12)

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SUBJECT: - CIRCUIT THEORY

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	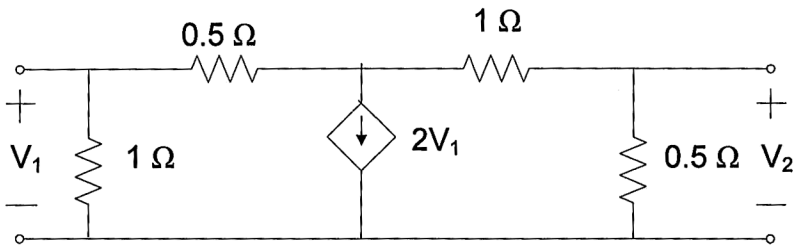 Fig. P-3(a)	
(b)	Obtain the ABCD parameters of a transmission line having a series impedance of (2+j10) Ω and negligible shunt admittance.	(4)
4)	A voltage source of $e = 20\sin(45t + \frac{\pi}{4})$ is suddenly applied to a series combination of R= 45 Ω and L =1 H. (i) Derive the expression of the current through R and L after application of the voltage. (ii) Sketch the waveform of the current. (iii) Explain your observation about the current waveform.	(16)
5)	The Z-parameter of a two port network (N_1) are: $Z_{11} = 10\Omega, Z_{12} = Z_{21} = 6\Omega, Z_{22} = 12\Omega.$ The Y-parameter of another two port network (N_2) are : $Y_{11} = 10mho, Y_{12} = Y_{21} = -6mho, Y_{22} = 12mho.$ The networks N_1 and N_2 are connected in series-parallel fashion. Now a voltage source of 10 V is connected at the input port and a load of 10 Ω is connected at the output port of the series parallel combination of N_1& N_2. Determine the (i) most suitable two-port network parameters of the series-parallel combination of N_1 & N_2, (ii) Power delivered by the source.	(16)