Ref No.: Ex/EE/5/T/112/2023

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) FIRST YEAR FIRST SEMESTER - 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. Explain the following: 4×4
   (i) Static and Dynamic Systems.
   (ii) Linear and Non-Linear Systems.
   (iii) Passive and Causal Network.
   (iv) Bilateral and Unilateral Network

2. (a) "The inductor can be represented as an open circuit at t = 0+ & The capacitor can be represented as a short circuit at t = 0+" – Explain. 8

   (b) For the circuit shown in Fig.Q.2(b) steady state is reached with the switch closed. At t= 0, the switch is opened. In this condition find $i_1(0+), i_2(0+), i_1'(0+)$ and $i_2'(0+)$. 8

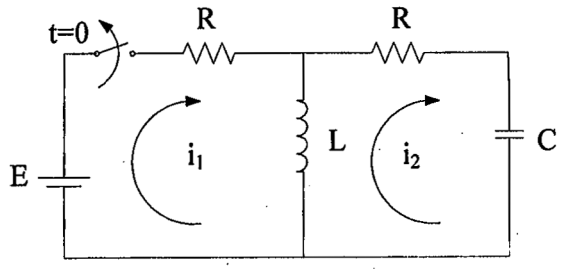

Fig.Q.2(b)

3. (a) State and derive the initial and final value theorem related to Laplace Transform and using them find the initial and final value of the inverse Laplace Transform of the following function 10

$$F(s) = \frac{0.9(s+1)}{2.1s^2 + 5s + 16}$$

[Turn over

(b) For the circuit shown in Fig.Q.3.(b) find $i_L(t)$ 6

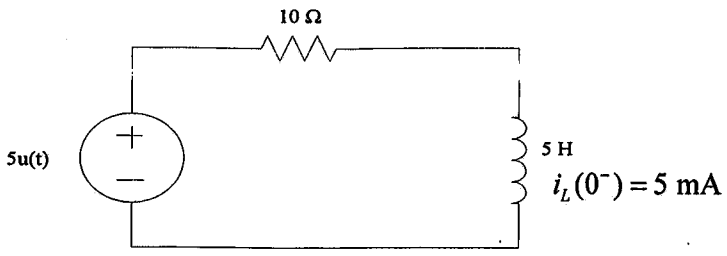

Fig.Q.3.(b)

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

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

5. (a) Find the Laplace transform of the following signal. 8

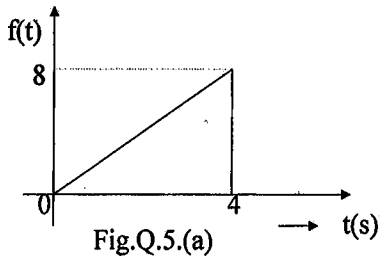

Fig.Q.5.(a)

(b) Find the Laplace transform of the following: 8
(i) $e^{-at}\cos\omega_o t\ u(t)$ (ii) $tu(t)$ (iii) $\sin\omega_o t\ u(t)$ (iv) $t^3e^{-at}u(t)$

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BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING)
1ST YEAR 1ST SEMESTER EXAMINATION, 2023

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

Part II (50 marks)

Question No. | ***Question 1 is compulsory*** | Marks

Answer ***Any Two*** questions from the rest (2×20)

Q1 Answer ***Any One*** : (a) ***or*** (b)

Consider the circuit as shown in Figure Q1.

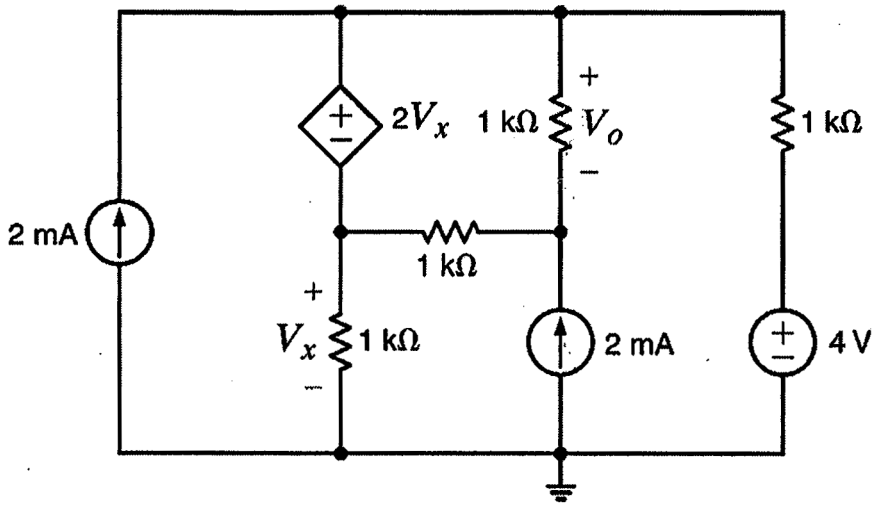


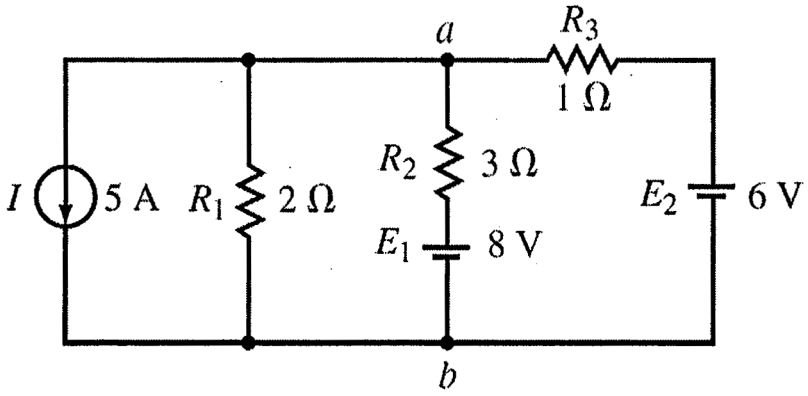
Figure Q1

(a) Determine the value of the voltage V_0 using Loop Analysis technique. 10

OR

(b) Determine the value of the voltage V_0 using Nodal Analysis technique. 10

Q2 (a) Determine the current through the 8-V battery using Mesh analysis for the circuit shown in Figure Q2(a).



8

Figure Q2(a)

Q2 (b) Find the voltage across R_3 in the circuit shown in Figure Q2(b). 8

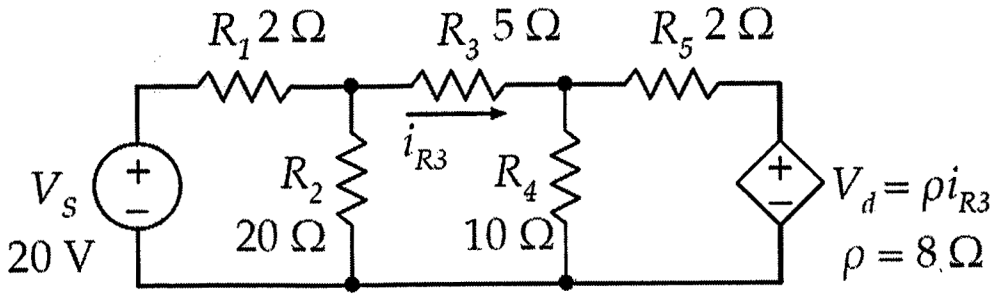


Figure Q2(b)

(c) 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

Q3 (a) Solve for the currents through R_2 and R_3 in the circuit of Figure Q3(a). 12

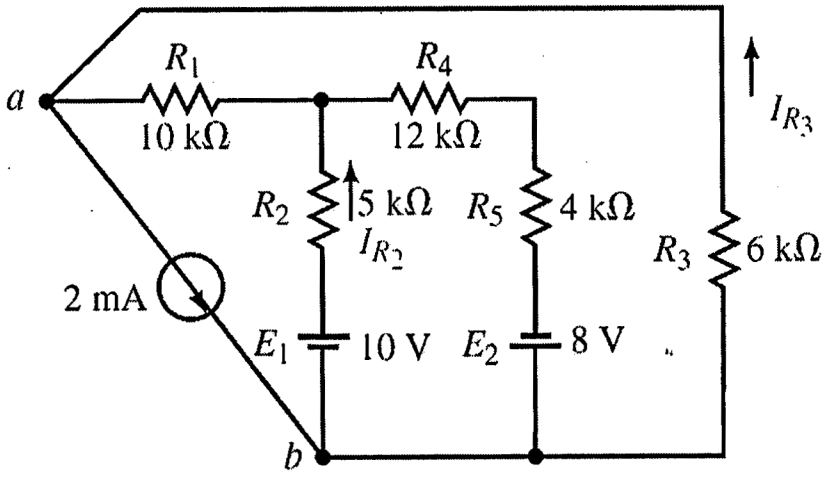


Figure Q3(a)

(b) For the circuit shown in Figure Q3(b) determine the currents I_1 and I_2. 8

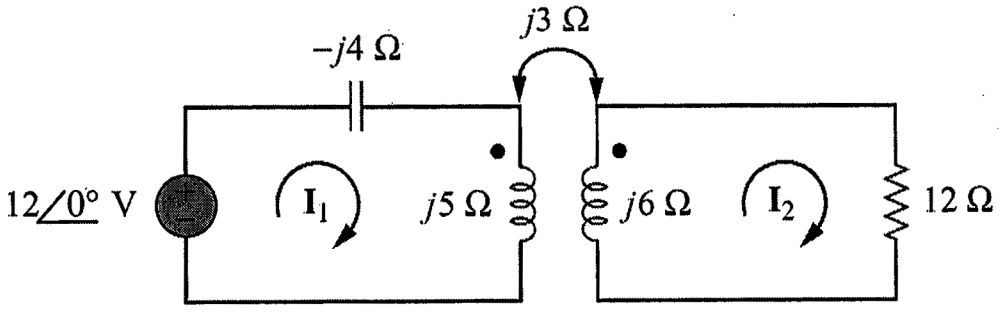


Figure Q3(b)

Q4 (a) For the circuit shown in Figure Q4(a) obtain the Thevenin equivalent circuit across the terminal A-B. 8

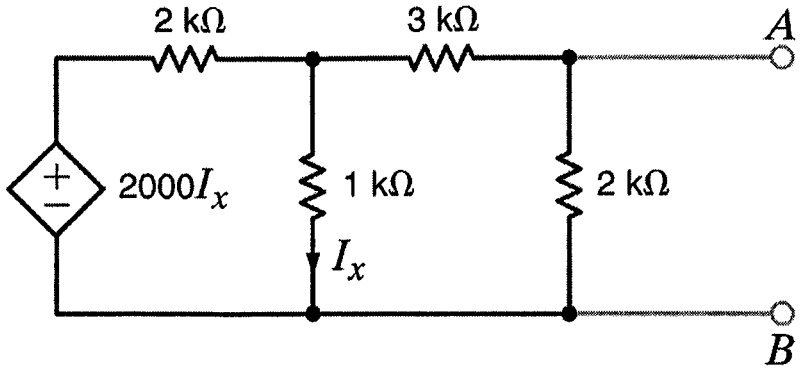


Figure Q4(a)

(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 incidence matrix given next, draw the corresponding graph of the network 8

$$\begin{array}{c} \\ a \\ b \\ c \\ d \end{array} \begin{array}{c} \begin{array}{cccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1 & 1 & -1 \\ 0 & 0 & 0 & 1 & 0 & 0 & -1 & 0 \end{bmatrix} \end{array}$$

Q5 (a) For the oriented graph shown in Figure Q5(a), express loop currents in terms of branch currents for a tree composed of branches 5, 6, 7, 8. 8

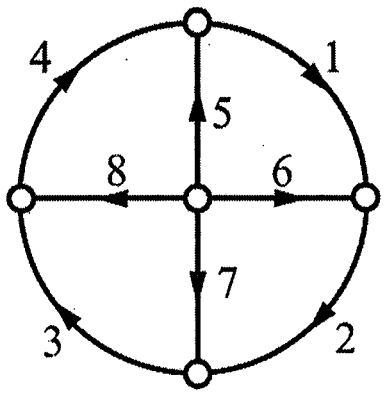


Figure Q5(a)

Q5 (b) Assume that a steady state has been reached before the switches are operated at $t = 0$, as shown in the circuit in Figure Q5(b). Using Laplace Transform technique obtain the expression for $V_0(s)$. 8

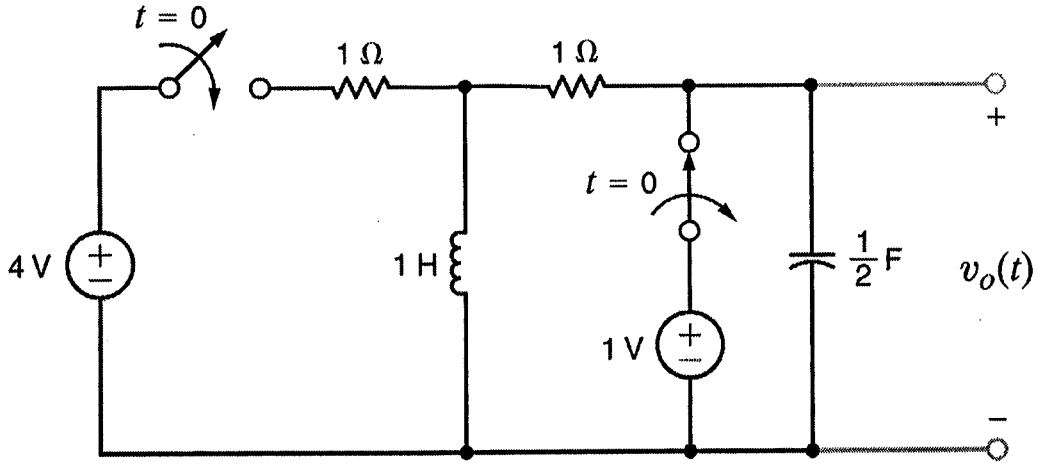
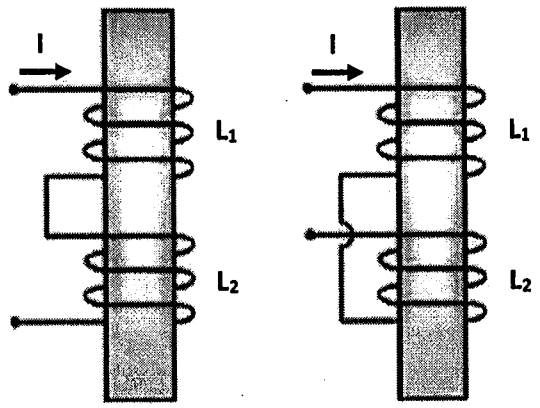


Figure Q5(b)

(c) Put dots to indicate polarities of the mutually coupled coils, L_1 and L_2, connected in series, in two different configurations, as shown in Figure Q5(c)(i) and Q5(c)(ii). 2+2



(i) (ii)

Figure Q5(c)