

7. (a) Write the properties of a loop.
 (b) Consider the following incidence matrix and draw the corresponding graph.

$$A = \begin{bmatrix} 1 & 1 & 0 & -1 & 0 & 0 & 0 \\ 0 & -1 & 1 & 0 & 0 & -1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

- (c) Prove that KVL for graph theory is $BV_b = 0$ (B = tie-set matrix, V_b = branch voltage matrix)
 (d) Explain how many branches are present in a co-tree.

$3 + 3 + 4 + 2 = 12$

Group - E

8. (a) Derive the following interrelationships
 (i) Z parameters in terms of ABCD parameters.
 (ii) Y parameters in terms of Z parameters.
 (b) Find Z-parameters for the network shown in the Fig. 8.

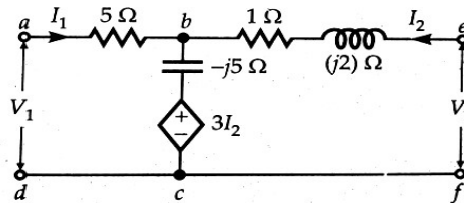


Fig: 8

$(3 + 3) + 6 = 12$

9. (a) Derive the condition of reciprocity of transmission parameters.
 (b) Find Y-parameters for the network shown in the Fig. 9

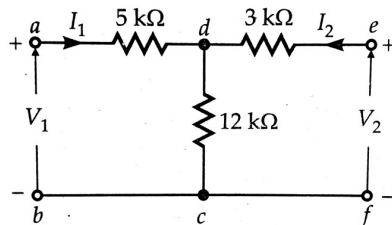


Fig: 9

Show whether the network is reciprocal or not, and whether symmetrical or not.

$4 + (6 + 2) = 12$

**CIRCUIT THEORY ANALYSIS
 (ELEC 4182)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group - A
 (Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) If an electrical network consists of no source of excitation, the network is known as
 (a) unilateral network (b) bilateral network
 (c) active network (d) passive network.
- (ii) Laplace Transform analysis gives
 (a) time domain response only (b) frequency domain response only
 (c) both (a) and (b) (d) neither (a) nor (b).
- (iii) How many fundamental tie-sets will be generated for a graph with 'n' number of nodes and 'b' number of branches?
 (a) n+1 (b) n-1
 (c) b-n+1 (d) b+n-1.
- (iv) What is the initial value of the transfer function $\frac{1}{s(s+2)}$?
 (a) 0 (b) 2 (c) infinite (d) 1.
- (v) The condition of symmetry in Z parameter is
 (a) $Z_{11} = Z_{22}$ (b) $Z_{12} = Z_{21}$ (c) $Z_{11} = Z_{12}$ (d) $Z_{21} = Z_{22}$.
- (vi) Superposition theorem is not applicable for
 (a) current calculation (b) voltage calculation
 (c) power calculation (d) none of the above.
- (vii) Application of Norton's theorem to a circuit yields
 (a) equivalent current source and impedance in series
 (b) equivalent current source and impedance in parallel
 (c) equivalent voltage source and impedance in series
 (d) equivalent voltage source and impedance in parallel.
- (viii) A two port network is symmetrical if
 (a) $A = D$ (b) $A = C$ (c) $B = D$ (d) $B = C$.

- (ix) Number of fundamental cut-sets of any graph will be
 - (a) same as the number of twigs
 - (b) same as the number of links
 - (c) same as the number of nodes
 - (d) same as the total number of branches in the graph.

- (x) Inverse Laplace transform of $\frac{1}{s+2}$ is
 - (a) e^{-st}
 - (b) e^{st}
 - (c) e^{2t}
 - (d) e^{-2t} .

Group - B

- 2. (a) Find the current through 5Ω resistor using mesh analysis for the given network shown in Fig. 1.

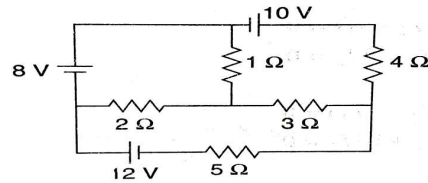


Fig. 1

- (b) Find the node voltages V_x and V_y using nodal analysis for the given network shown in Fig. 2.

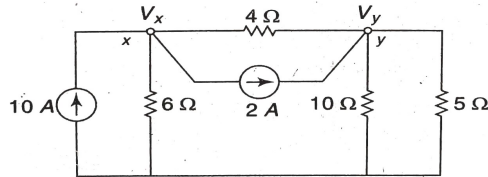


Fig. 2

6 + 6 = 12

- 3. (a) Find the current in the circuit shown in Fig. 3 through the 6Ω resistor using Superposition theorem.

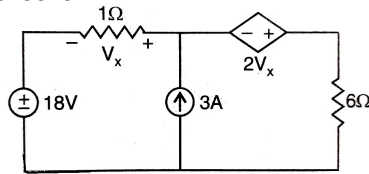


Fig. 3

- (b) Find the current in the circuit shown in Fig. 4 through the 5Ω resistor using Norton's theorem.

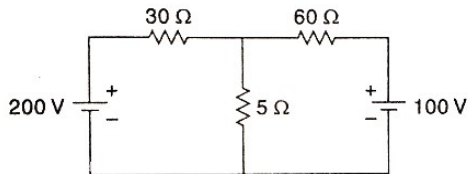


Fig. 4

6 + 6 = 12

Group - C

- 4. (a) What is the advantage of using Laplace Transformation in electrical circuit analysis? Define step function, delayed step function and find Laplace transform of these functions.

- (b) For the current $i(t) = 5u(t) - 3e^{-2t}$, find $I(s)$ and also determine the values of $i(0^+)$ and $i(\infty)$.

(2 + 2 + 2) + 6 = 12

- 5. (a) If a series R-L circuit with $R=4\Omega$ and $L=1\text{ H}$ is excited by a 48 V d.c. source find the current $I(s)$ using Laplace Transformation. Assume the initial current through the inductor is 3 A.

- (b) Determine the Laplace Transform of the following waveform shown in Fig. 5.

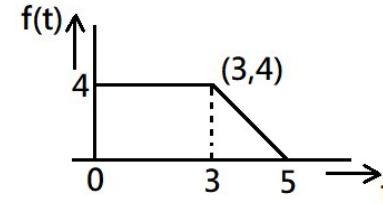


Fig. 5

6 + 6 = 12

Group - D

- 6. (a) Compute complete incidence matrix from the directed graph given in the Fig. 6.

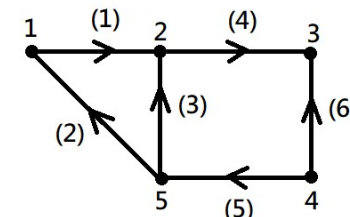


Fig. 6

- (b) From the above graph, consider a tree given in the Fig. 7 and compute tie-set matrix and fundamental cut-set matrix.

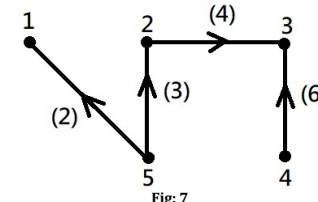


Fig. 7

4 + (4 + 4) = 12