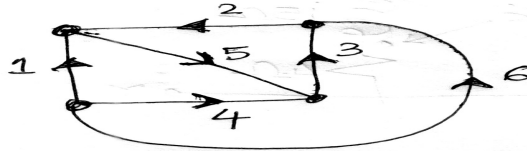


INSTRUCTIONS:

1. The question paper contains 5 questions, each of 5 marks, for a total of 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper, etc., if applicable, will be supplied to the candidates

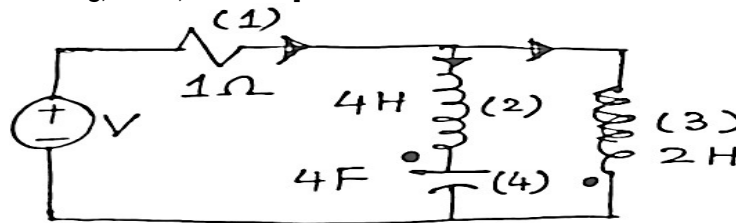
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| Q.1(a) Derive the relationship among the submatrices, the Fundamental tie-set matrix [B], and the cut-set matrix [Q]. | [2] | 1 2 |
| Q.1(b) For the given graph shown in Fig. 1, write down the basic tie-set matrix and take the Tree branches 2, 4, 5. Write down the KVL equations from the matrix. | [3] | 1 2 |



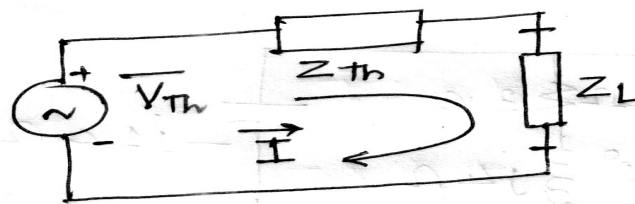
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| Q.2(a) Illustrate the properties of a tree in a graph. A reduced incidence matrix of a graph is given below. Obtain the number of possible trees. | [2] | 1 2 |
|---|-----|-----|

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

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|---|-----|-----|
| Q.2(b) Draw the network graph shown in Fig. 2. Formulate the Fundamental Cut-set matrix. Write the equilibrium equation in matrix form on a node basis. [Note: (2) & (4) acting as a twig, $M=1H$, $V=1$ volt] | [3] | 1 2 |
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| Q.3(a) The graph associated with an electrical network has 7 branches and 5 nodes. Evaluate: Number of independent KVL equations, Number of independent KCL equations, the minimum number of equations required for the solution of the network, the order of the Tie-set matrix, and the Order of the Cut-set matrix, respectively. | [2] | 2 3 |
| Q.3(b) For the circuit shown below in Fig. 3, determine the maximum power transfer across the load. Given: $Z_{TH} = R_{TH} + X_{TH}$, $Z_L = R_L + X_L$ (Where R_L is variable and X_L is a fixed quantity.) | [3] | 2 3 |

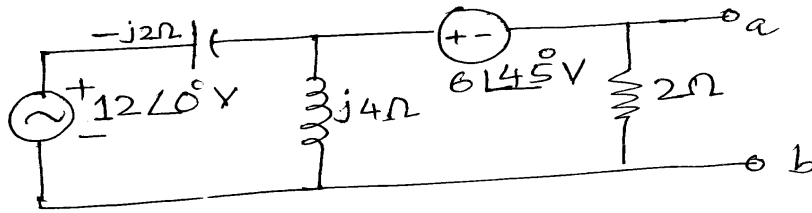


Q.4(a) State and explain the Substitution Network Theorem.

[2] 2 3

Q.4(b) Obtain the Thevenin equivalent circuit as seen from the terminals a-b in Fig. 4.

[3] 2 3



Q.5(a) Represent the relationship between (i) the branch voltage matrix and the tree branch twig voltage matrix, (ii) Twig current and link current, and (iii) branch currents and link currents.

[2] 2 3

Q.5(b) In the network shown below in Fig. 5, R₁ is changed from 20Ω to 18Ω. Evaluate the change in current I, using the Compensation Theorem.

[3] 2 3

