4

Graph Theory
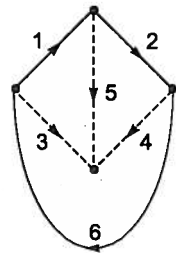
Q.1 Consider the graph and tree (dotted) of the given figure
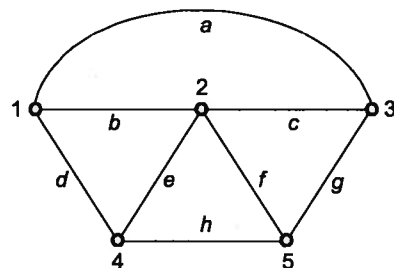

The fundamental loops include the set of lines
(a) (1, 5, 3), (5, 4, 2) and (3, 4, 6)
(b) (1, 2, 4, 3), (1, 2, 6), (3, 4, 6) and (1, 5, 4, 6)
(c) (1, 5, 3), (5, 4, 2), (3, 4, 6) and (2, 4, 3, 1)
(d) (1, 2, 4, 3) and (3, 4, 6)

[ESE-1999]

Q.2 Identify which of the following is NOT a tree of the graph shown in the figure

(a) begh   (c) defg
(c) adhg   (d) aegh
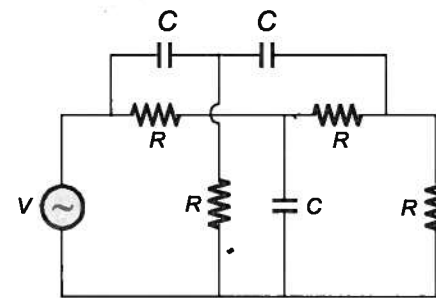
[GATE-1999]

Q.3 A network has 10 nodes and 17 branches. The number of different node pair voltages would be
(a) 7   (b) 9
(c) 10   (d) 45   [ESE-2000]

Q.4 The number of edges in a complete graph of n vertices is
(a) $n(n-1)$ (b) $\dfrac{n(n-1)}{2}$
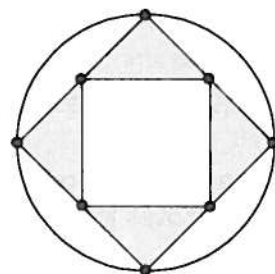(c) n (d) $n-1$ [ESE-2003]

Q.5 The minimum number of equations required to analyze the circuit shown in the figure is

(a) 3   (b) 4
(c) 6   (d) 7

[ESE-2003]
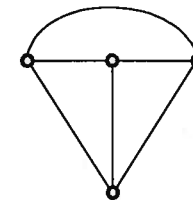
Q.6 Consider a spanning tree of the connected graph:

What is the number of fundamental cut-sets?
(a) 15   (b) 16
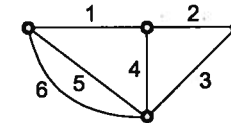(c) 8   (d) 7

[ESE-2004]

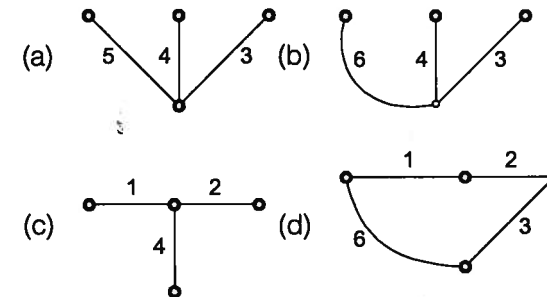**Q.7** What is the total number of trees for the graph shown below?

(a) 4   (b) 8
(c) 12   (d) 16

[ESE-2006]

Q.8 The graph of a network is shown in figure below.

Which one of the figures shown below is not a tree of the graph?

[ESE-2007]

Q.9 For a given connected network and for a fixed tree, the fundamental loop matrix is given by

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

The fundamental cut-set matrix Q corresponding to the same tree is given by

(a) $Q = \begin{bmatrix} -1 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$

(b) $Q = \begin{bmatrix} -1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$

(c) $Q = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$

(d) $Q = \begin{bmatrix} 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & -1 \\ 1 & 0 & 1 & 1 & -1 & -1 \end{bmatrix}$

[ESE-2012]

Q.10 A graph in which at least one path (disregarding orientation) exists between any two nodes of the graph is a
(a) connected graph
(b) directed graph
(c) sub-graph
(d) fundamental graph   [ESE-2014]

Q.11 If Q_t and Q_l be the sub-matrices of Q_f (fundamental cut-set matrix) corresponding to twigs and links of a connected graph respectively, then
1. Q_t is an identity matrix
2. Q_l is a rectangular matrix
3. Q_f is of rank $(n-1)$
Which of the above are correct?
(a) 1 and 2 only   (b) 1 and 3 only
(c) 2 and 3 only   (d) 1, 2 and 3
[ESE-2014]

Q.12 A reduced incidence matrix of a graph is given by

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

The number of possible trees is
(a) 8   (b) 7
(c) 9   (d) 6

[ESE-2015]

Q.13 Draw an oriented graph whose node-to-branch incidence matrix A_a is given by
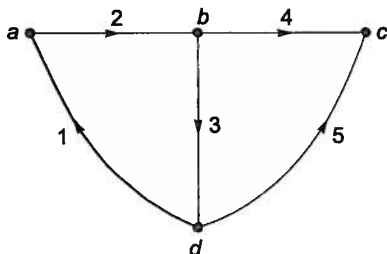
$$A_a = \begin{bmatrix} 1 & 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 1 & 0 & 0 & 0 & 1 \\ 0 & -1 & 0 & -1 & 0 & 1 & 0 & -1 & 1 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 1 & -1 \end{bmatrix}$$

and obtain fundamental circuit (tie-set) matrix for this graph.

[ESE-2006]

Q.14 Consider the given graph of a network and findout:
(i) Incidence matrix
(ii) Reduced incidence matrix $[A]$

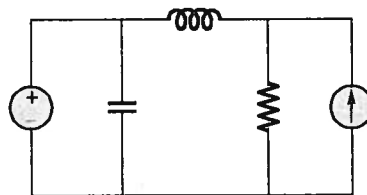**T1.** Which of the following is not true about a fully connected graph with 'n' nodes
(a) Maximum number of possible trees $= n^{(n-2)}$
(b) Number of links = Number of fundamental tie set
(c) The degree of each node $= n$
(d) Number of tree branches = Rank of graph

T2. Consider the network shown below

The dual of the network is

(a)

(b)

(c)

(d)