POSTAL Study Package 2019

Electrical Engineering

Conventional Practice Sets

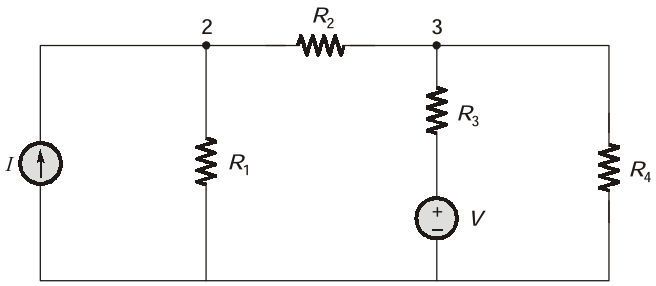
Electric Circuits

Contents

MADE EASY Publications

3 CHAPTER
Network Graph and Resonance Circuit

Q.1 What do you mean by a 'TREE' in graph theory of network? List out the properties of a TREE. For the network shown below, find the total number of possible trees and also draw all the trees.



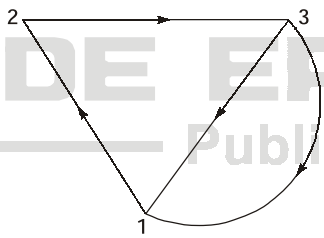
Solution:

A **'TREE'** is a connected subgraph of a connected graph containing all the nodes of the graph but does not have any loops. A tree has $(n-1)$ number of branches where 'n' is the number of nodes or vertices of the graph. The branch of a tree are called **twigs**; those branches that are on a tree are called links or chords. All the links of a tree together constitute the complement of the corresponding tree and is called the co-tree.

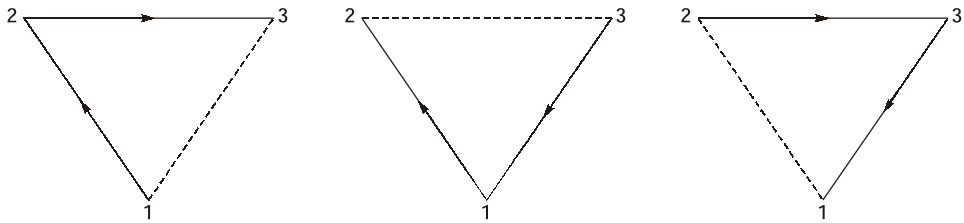
Properties of a TREE:

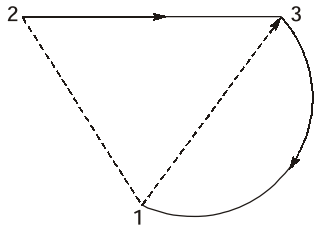
- In a tree, there exists one and only one path between any pair of nodes.
- Every connected graph has atleast one tree.
- The number of terminal nodes or end vertices of every tree are two.
- A connected subgraph of a connected graph is a tree if there exists all the nodes of the graph.
- Each tree has $(n-1)$ branches, where 'n' is the number of nodes of the tree.
- The rank of tree is $(n-1)$. This is also the rank of the graph to which the tree belongs.

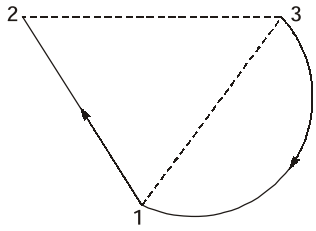
For the given network, the directed graph will be shown as,



Possible trees are:

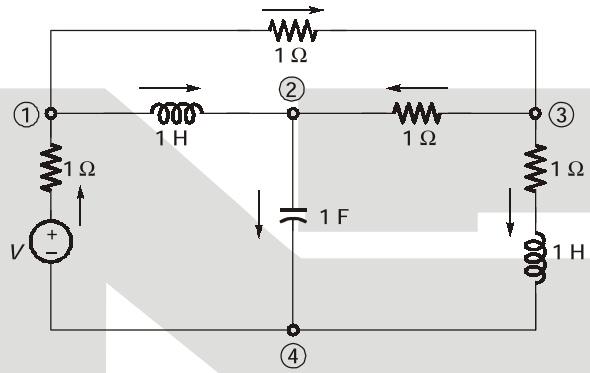






Hence, total number of possible trees = 5.

Q.2 Consider a network having circuit elements *R*, *L* and *C* indicating its direction of current as in figure below:

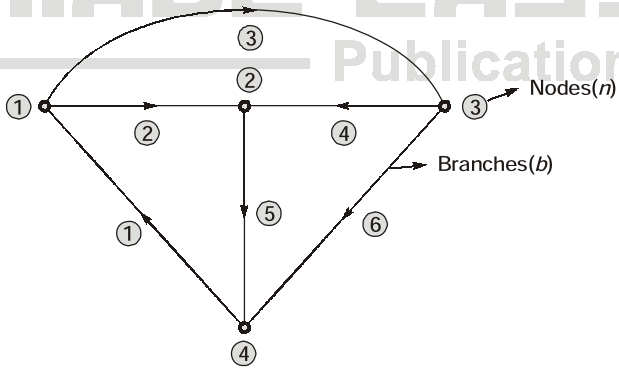


(a) Draw its directed graph and hence calculated total number of trees, total number of links and rank of the graph?

(b) What do you mean by *f*-circuit matrix or Tie-set matrix? For this above directed graph. Determine the Tie-set matrix '*B*'.

Solution:

(a) For this given network, the directed graph will be as below,



here, $b = 6$ and $n = 4$

$\therefore$ Total number of possible trees $= (n-1) = 3$

Total number of links $= L = b-(n-1)$

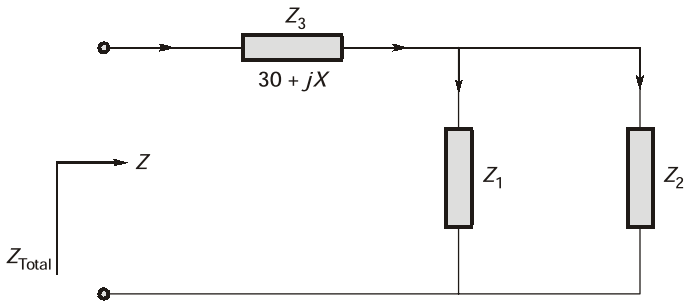
$= 6 - 3 = 3$

and the rank of the graph $= R = (n-1) = 3$

Q.7 Two impedances $Z_1 = 20 + j10$ and $Z_2 = 10 - j30$ are connected in parallel and this connection is in series with $Z_3 = 30 + jX$. Find the value of X which will produce resonant in the circuit?

Solution:

According to the given question, the circuit may be drawn as,



$\therefore$ Total impedance of this circuit = Z

$$= Z_3 + (Z_1 \,||\, Z_2)$$

$$= (30 + jX) + \left[\frac{(20 + j10)(10 - j30)}{20 + j10 + 10 - j30}\right]$$

$$= (30 + jX) + \frac{200 - j600 + j100 + 300}{30 - j20}$$

$$= (30 + jX) + \left(\frac{500 - j500}{30 - j20}\right)$$

$$= 30 + jX + \left[\frac{500(1 - j)(30 + j20)}{(30)^2 + (20)^2}\right]$$

$$= 30 + jX + \frac{5}{13}(50 - j10)$$

$$= \left(30 + \frac{5}{13} \times 50\right) + j\left(X - \frac{5}{13} \times 10\right)$$

At the resonant condition, the imaginary part of the total impedance expression is zero, so,

$$X - \frac{5}{13} \times 10 = 0$$

or, $$X = \frac{50}{13} = 3.85\ \Omega$$

Q.8 A voltage $V(t) = 10 \sin \omega t$ is applied to a series RLC circuit. At the resonant frequency of the circuit, the maximum voltage across the capacitor is found to be 500 volt. Moreover, the B.W is known to be 400 rad/sec and the impedance at resonance is 100 Ω. Calculate:

(a) the resonant frequency in Hz.

(b) the values of L and C.