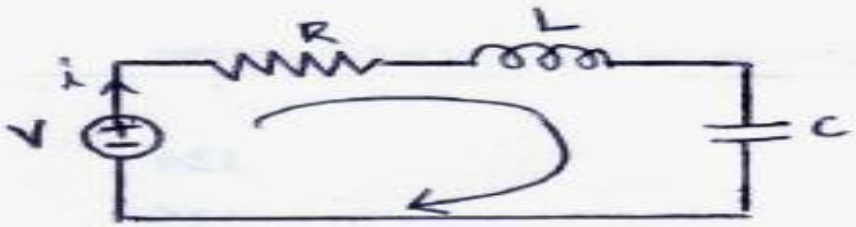
UNIT 1

Graph Theory

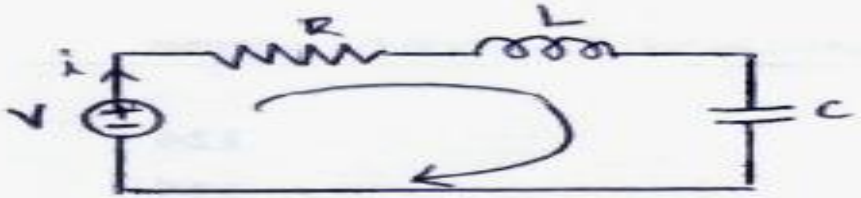
Contents

1. Graph of a Network definitions
2. Tree and co tree
3. Link, basic loop
4. Basic cut set
5. Incidence matrix
6. Cut set matrix
7. Tie set matrix
8. Duality
9. Loop and Nodal methods of analysis.

Example: 1) Draw the dual of a network for given network shown in figure.



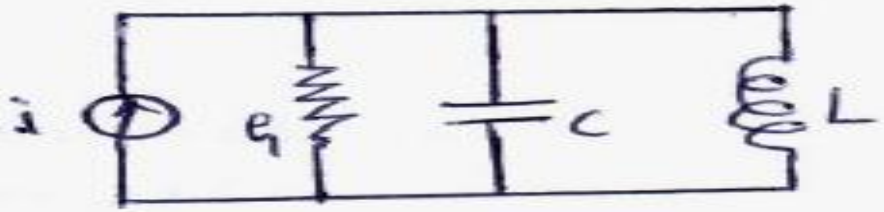
Solution:



The integro- differential equations for the circuit is

$$R\,i + L\,(di/dt) + (1/C)\int i\,dt = v \qquad (1)$$

Dual Network

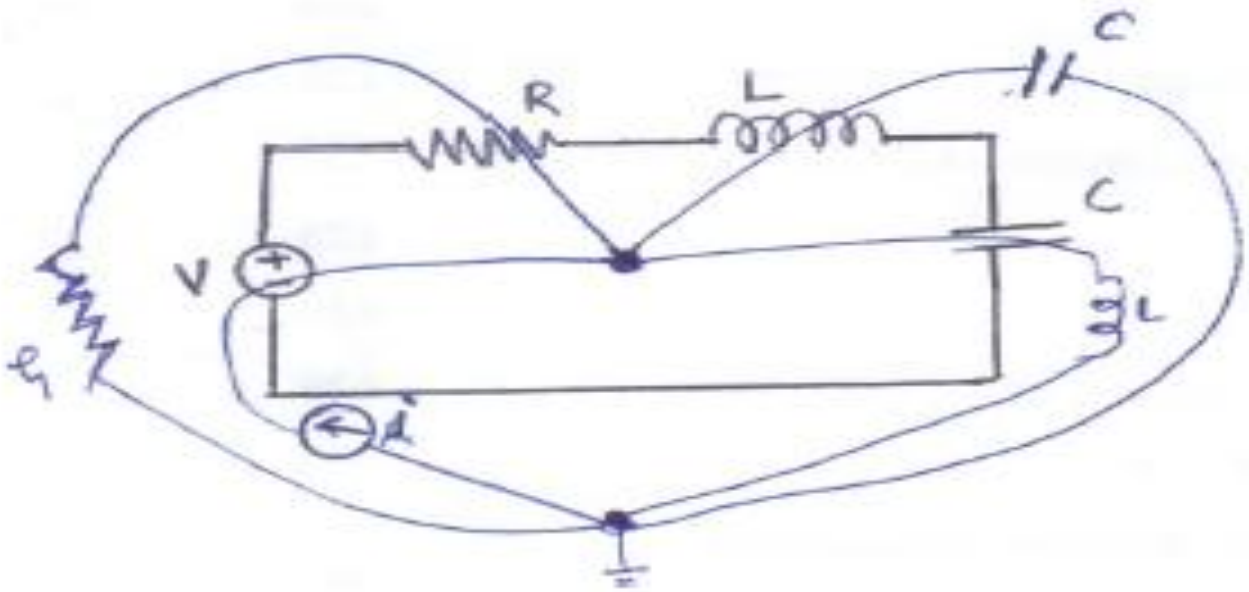


The integro- differential equations for the circuit is

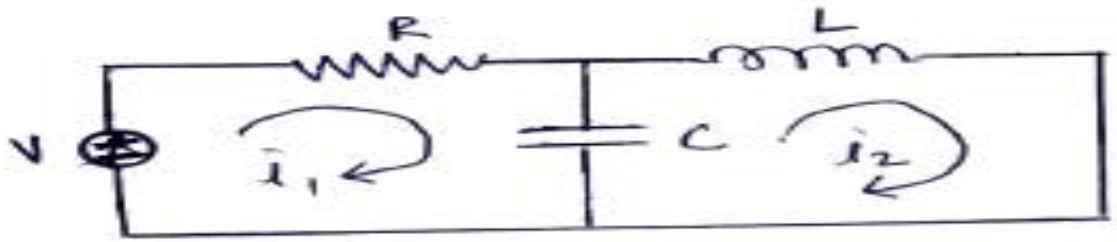
$$(1/R)\, v + C\,(dv/dt) + (1/L) \int v\, dt = i \qquad (2)$$

OR

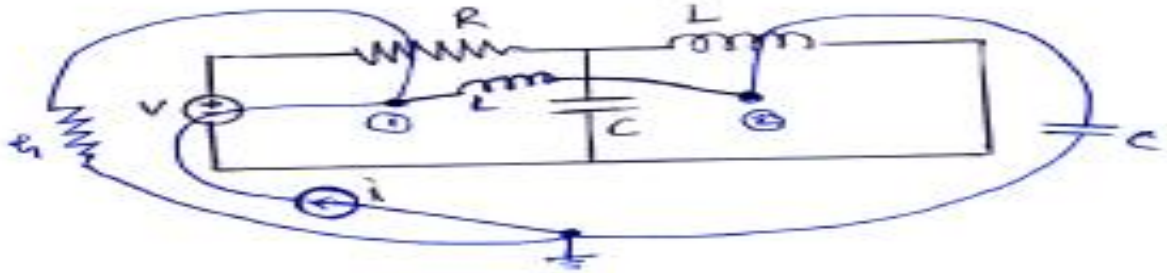
$$G\, v + C\,(dv/dt) + (1/L) \int v\, dt = i$$



Example: 2) Draw the dual of the network shown in figure.



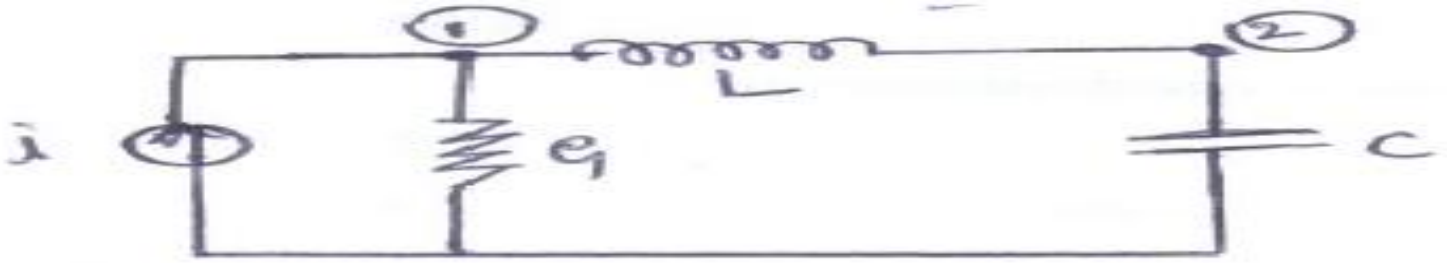
Solution:



The integro- differential equations for the network is

$$R\, i_1 + (1/C) \int (i_1 - i_2)\, dt = v(t) \quad (1)$$

$$L\, (di_2/dt) + (1/C) \int (i_2 - i_1)\, dt = 0 \quad (2)$$

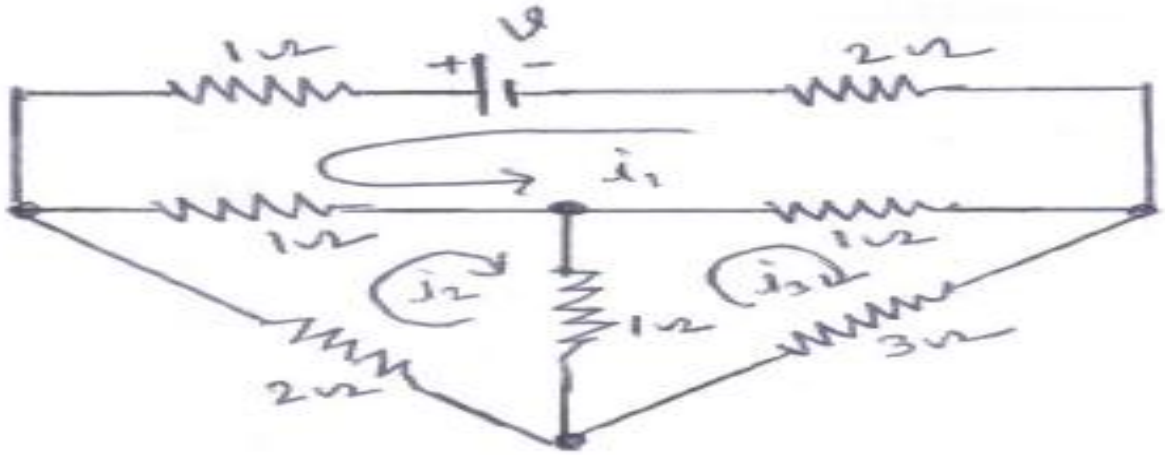


The integro- differential equations for the network is

$$G\,v_1 + (1/L)\int (v_1 - v_2)\,dt = i \qquad (1)$$

$$C\,(dv_2/dt) + (1/L)\int (v_2 - v_1)\,dt = 0 \qquad (2)$$

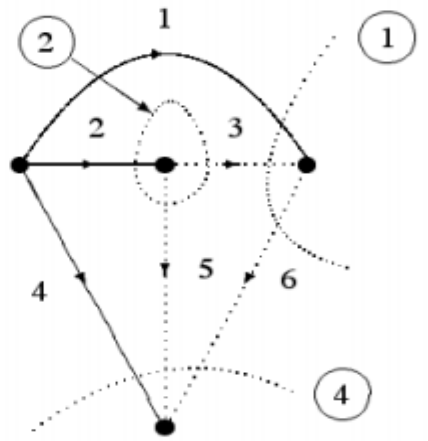
Example: 3) Draw the dual of the network shown in figure.



Basic loop matrix (B-matrix)

The B-matrix describes the way the basic loop is chosen.
Each column corresponds to a branch (*b* columns).
Each row corresponds to a basic loop (*b*–*t* rows).

Construction
For each row:
Put a "+1" in the entry corresponding to the loop co-tree branch.
Put a "0" in the entry corresponding to other co-tree branches.
Put a "+1" or "–1" in the entry corresponding to each loop tree branch; "+" if it is consistent with the co-tree branch direction and "–" otherwise.



$$B = \begin{array}{c} \\ 3 \\ 5 \\ 6 \end{array} \left[\begin{array}{ccc|ccc} 1 & 2 & 4 & 3 & 5 & 6 \\ \hline -1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & -1 & 0 & 1 & 0 \\ 1 & 0 & -1 & 0 & 0 & 1 \end{array}\right]$$

$$B = [\, B_1 \mid \mathbf{1} \,]$$

Applications

The basic cutset and loop matrices will be used to formulate independent Kirchhoff's law equations. This will give much more efficient solution to circuit analysis problems.

Mesh —enhanced— General loop analysis

Nodal —enhanced— General cutset analysis

References

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.

2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.

3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.

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5. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.Syllabus

6. K.M. Soni, “ Network Theory”, S.K. Kataria Publication