

**Topics Covered in SKU- Network Analysis:**

Scientech Knowledge Universe www.sku.bz

### Voltage and Current Phasors

$$V = V_m \sin \omega t$$

$$I = I_m \cos \omega t$$

Voltage leads the current by 90°

**Unit I:**

Introduction to LLBP circuit elements R,L,C and their characteristics in terms of Linearity & time dependant nature, KCL and KVL analysis dual networks analysis of magnetically coupled circuits, Dot convention, coupling co-efficient, Tuned circuits. Series & parallel resonance voltage & current sources, controlled sources.

**Unit II:**

Network topology, concept of Network graph, Tree, Tree branch & link, Incidence matrix, cut set and tie set matrices. Network Theorems – Thevenins & Norton’s theorem, superposition, reciprocity, compensation, maximum power transfer and Millman’s theorem, problems with controlled sources.

**Unit III:**

Transient analysis Transients in RL, RC & RLC Circuits initial conditions, time constants. Network driven by constant driving sources & their solutions. Steady state analysis - Concept of phasor & vector, impedance & admittance. Node & mesh analysis of RL, RC and RLC networks with sinusoidal and other driving sources.

**Unit IV:**

Frequency domain analysis – Laplace transform solution of intergo-differential equations. Transform of Waveform – synthesized with step, ramp, Gate and sinusoidal functions. Initial & final value theorem. Network Theorems in transform domain.

**Unit V:**

Concept of signal spectra, Fourier series co-efficient of a periodic waveform. Waveform symmetries. Trigonometric and Exponential form of Fourier series, steady state response to periodic signals.

**Unit VI:**

Network function & Two port networks – concept of complex frequency, port. Network functions of one port & two ports, poles and Zeros network of different kinds. Two port parameters – Z,Y, chain parameters relationship between parameters. Interconnection of two ports. Terminated two port networks.

**Print Shots of SKU- Network Analysis:**

Scientech Knowledge Universe www.sku.bz

**Example : 1**

**Question :** Find currents and voltages in all branches by mesh analysis.

**Solution :**  
 Step 1 : Identify the loops and show the loop currents.  
 Step 2 : Consider loop 'a' and apply KVL in it.  
 $-1I_a - 2(I_a - I_b) + 5V = 0$

Scientech Knowledge Universe www.sku.bz

**Voltage to Current Source Transformation**

Any voltage source in series with a resistance can be modeled as a current source in parallel with the same resistance.

**Voltage Source**  $\rightarrow$  **Current Source**

$$I = \frac{V}{R}$$

$$I = \frac{10}{2}$$

$$I = 5 \text{ Ampere}$$

Scientech Knowledge Universe www.sku.bz

**Superposition Theorem**

**Question :** Find current through 3Ω resistor by superposition theorem.

**Solution :**  
 Step 1 : First consider 5V source and replace 10V source by short circuit.  
 Step 2 : Now we have to find the current through 3Ω, we can apply KVL or KCL for that, Let us try with KCL

Scientech Knowledge Universe www.sku.bz

**Example :**

**Question :** A series RL circuit with  $R = 30 \Omega$  and  $L = 15 \text{ H}$  has a constant voltage  $V = 60 \text{ V}$  applied at  $t = 0$  as shown in figure. Determine the current  $i$ ,  $V_R$  and  $V_L$ .

**Solution :**  
 By applying Kirchhoff's voltage law, we get  
 $30i + 15 \frac{di}{dt} = 60$

### Definitions associated with a graph

**Circuit** Degree of node b = 3 **Graph**

**Degree of Node** : Number of branches incident to a node (away or towards the node) is called the degree of node.  
Degree of nodes : a(4,1) | b(1,5,2)

Branch Node Degree of Node Loop Subgraph

### Incidence Matrix (A)

**Steps to obtain [A]**  
If the  $j^{th}$  branch is incident to  $i^{th}$  node and oriented away from it,  $a_{ij} = 1$  and if it is oriented towards it,  $a_{ij} = -1$ .

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ a & a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ b & a_{21} & a_{22} & a_{23} & a_{24} & a_{25} \\ c & a_{31} & a_{32} & a_{33} & a_{34} & a_{35} \\ d & a_{41} & a_{42} & a_{43} & a_{44} & a_{45} \end{bmatrix}$$

### Star to Delta transformation

**Star** **Delta**

$$R_{AB} = R_{AN} + R_{BN} + \frac{R_{AN} \cdot R_{BN}}{R_{CN}}$$

$$R_{BC} = R_{BN} + R_{CN} + \frac{R_{BN} \cdot R_{CN}}{R_{AN}}$$

$$R_{CA} = R_{AN} + R_{CN} + \frac{R_{AN} \cdot R_{CN}}{R_{BN}}$$

### To determine number of trees of given graph

**Steps**  
Number of trees of any graph is given by:  
 $T = \det [A_i] [A_i^t]$   
Now find value of its determinant.

$$\det [A_i] [A_i^t] = \begin{vmatrix} 2 & -1 & 0 \\ -1 & 3 & -1 \\ 0 & -1 & 2 \end{vmatrix} = 8$$

Number of trees (T) = 8

Trees