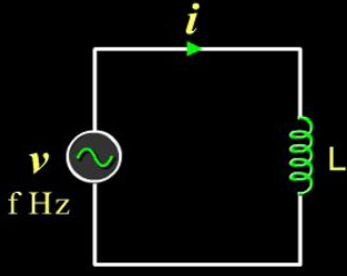


Topics Covered in SKU- Network Analysis:

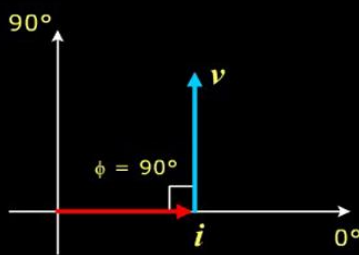
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Voltage and Current Phasors

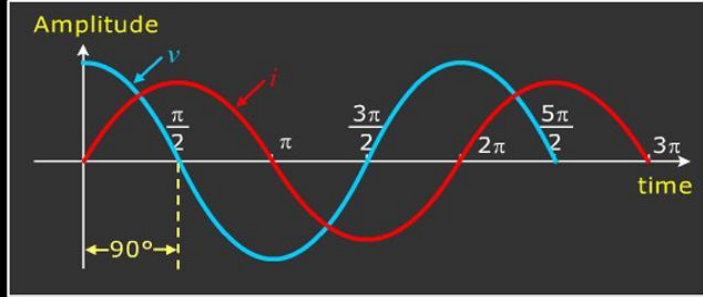


$V = V_m \sin \omega t$

$I = I_m \cos \omega t$



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:

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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.
 $-1I_a - 2(I_a - I_b) + 5V = 0$

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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**

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

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

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

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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

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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