ELEMENTS OF ELECTRICAL ENGINEERING (UE24EE141B)

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Unit 2 – Lecture 23 - Analysis of Single-Phase AC circuits with R Load and L Load

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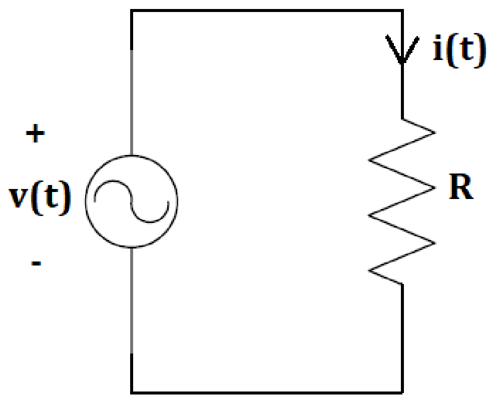
Response of Resistive Load to Sinusoidal Supply



Let the supply voltage be $v(t) = V_m \sin(\omega t)$

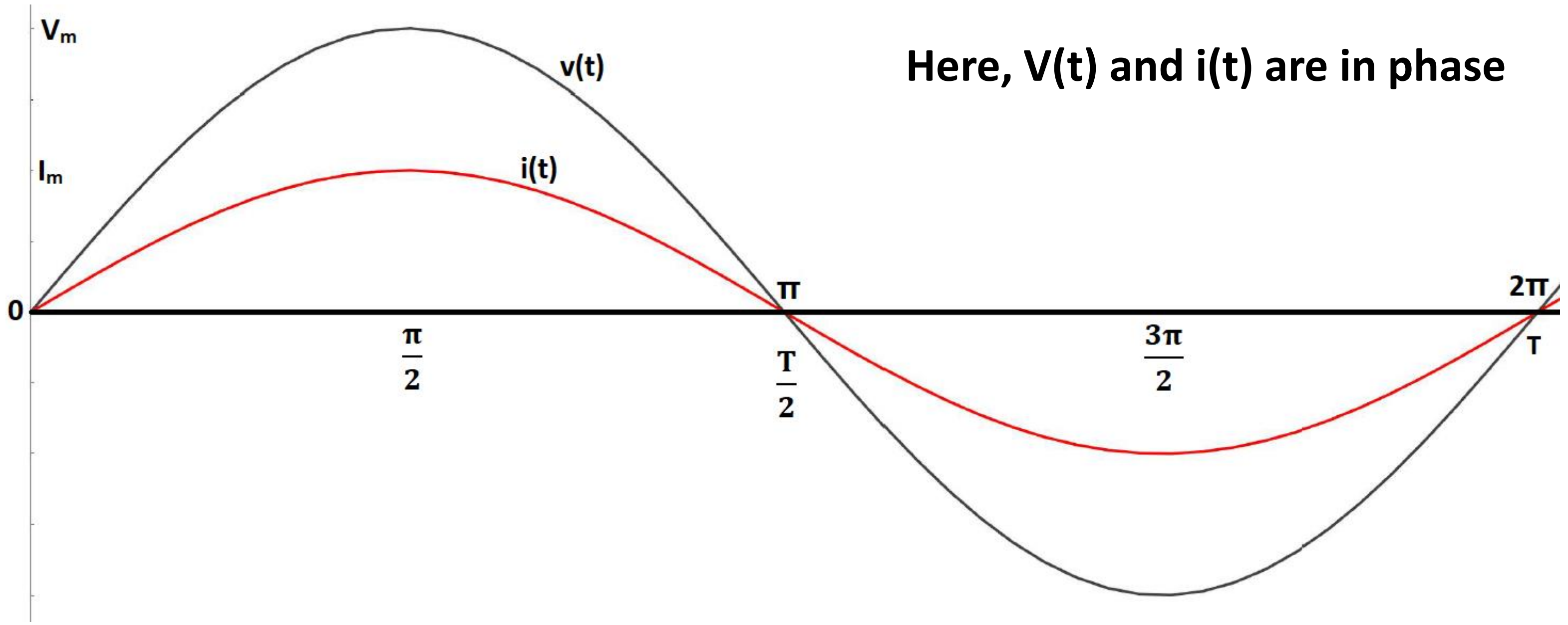
where, V_m is the peak value of voltage

By Ohm's Law, $i(t) = \dfrac{v(t)}{R}$

Hence current will be of the form, $i(t) = I_m \sin(\omega t)$

where, $I_m = \dfrac{V_m}{R}$ is the peak value of current

Response of Resistive Load to Sinusoidal Supply

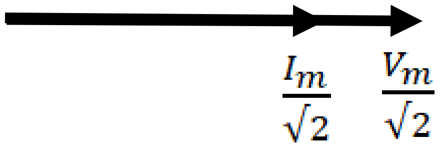


Here, V(t) and i(t) are in phase

$$v(t)=V_m\sin(\omega t) \Rightarrow \bar{V}=\frac{V_m}{\sqrt{2}}\angle 0^\circ$$

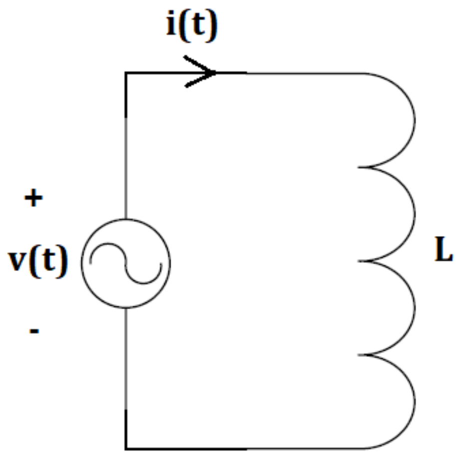
$$i(t)=I_m\sin(\omega t) \Rightarrow \bar{I}=\frac{I_m}{\sqrt{2}}\angle 0^\circ$$

Phasor Diagram:



$$\text{Impedance, } Z=\bar{V}/\bar{I}=R\angle 0^\circ=R\ \Omega$$

Response of Pure Inductive Load to Sinusoidal Supply



Let the supply voltage be $v(t) = V_m \sin(\omega t)$

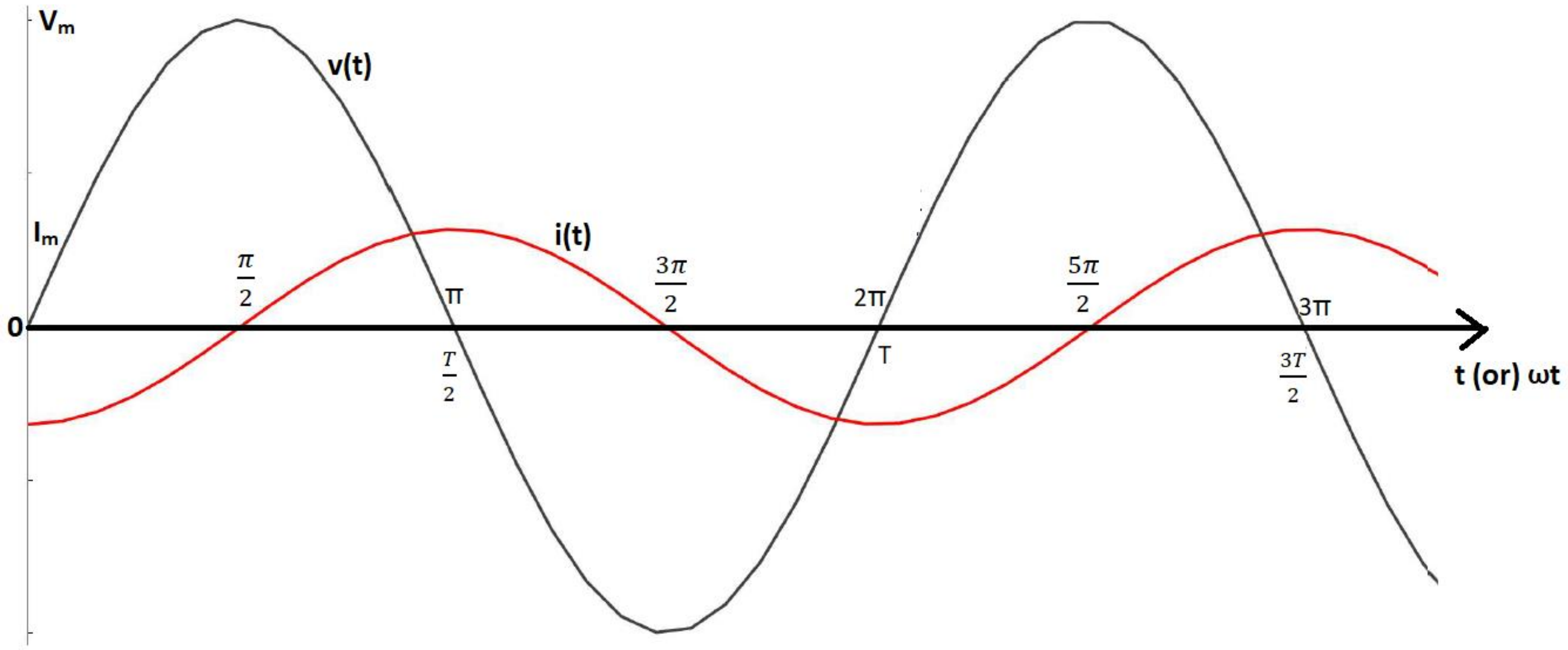
In a pure inductor, $i(t) = \frac{1}{L}\int v(t)dt$

$$= \frac{-V_m}{\omega L}\cos(\omega t)$$

$$= I_m \sin(\omega t - 90°)$$

where, $I_m = \frac{V_m}{\omega L}$ is the peak value of current

Response of Pure Inductive Load to Sinusoidal Supply



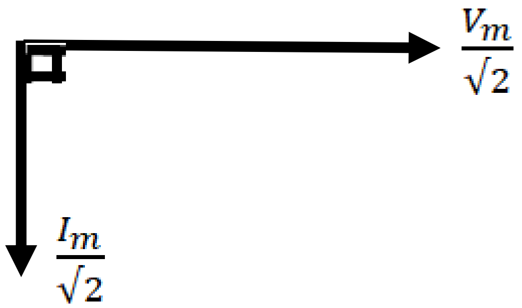
In a pure inductor, current **lags** voltage by 90°

Response of Pure Inductive Load to Sinusoidal Supply

$v(t)=V_m \sin(\omega t) \;\Rightarrow\; \bar{V} = \frac{V_m}{\sqrt{2}} \angle 0^\circ$

$i(t)=I_m \sin(\omega t-90^\circ) \;\Rightarrow\; \bar{I} = \frac{I_m}{\sqrt{2}} \angle -90^\circ$

Phasor Diagram:



$$Z = \frac{\bar{V}}{\bar{I}} = \frac{\frac{V_m}{\sqrt{2}} \angle 0^\circ}{\frac{I_m}{\sqrt{2}} \angle -90^\circ} = \omega L \angle 90^\circ = jX_L \quad \Omega$$

Where, $X_L=\omega L$ is called '**Inductive Reactance**'

Text Book & References

Text Book:

"Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 11th Edition, Pearson Education, 2012.

Reference Books:

1. "Basic Electrical Engineering - Revised Edition", D. C. Kulshreshta, Tata- McGraw-Hill, 2012.
2. "Basic Electrical Engineering", K Uma Rao, Pearson Education, 2011.
3. "Engineering Circuit Analysis", William Hayt Jr., Jack E. Kemmerly & Steven M. Durbin, 8th Edition, McGraw-Hill, 2012.

THANK YOU

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