Simple Inductive circuit

An ideal inductor is a simple coil of wire without a resistance. In DC circuits, practical inductor acts just like resistors. In AC circuits, the current flow in the inductor is limited by self-inductance in which the application of AC current across the inductor generates a back EMF that tends to oppose further increase in current.

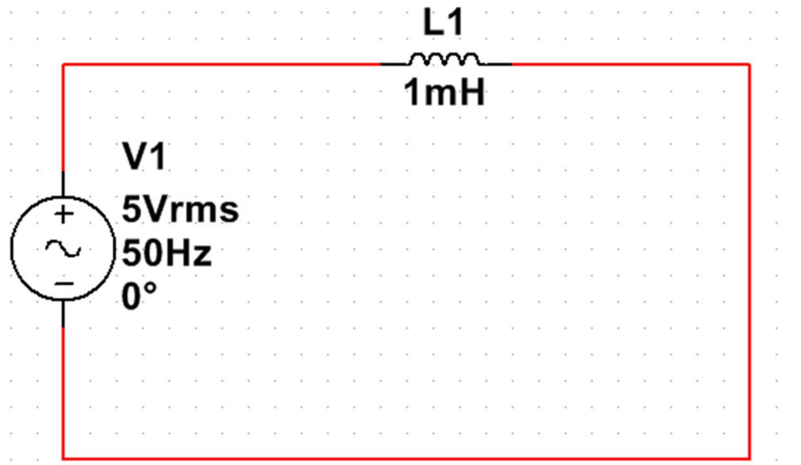

Fig 2.3: A Simple inductive circuit

The EMF induced in an inductor connected across a source $V = V_{peak}\cos(\omega t)$ is given by;

$V - \frac{L\partial I}{\partial t} = 0$; $V = \frac{L\partial I}{\partial t}$; $\partial I/\partial t = V/L$

Where L is the inductance of the inductor.

$\partial I/\partial t = V_{peak}\cos(\omega t)/L$

This can be written as (integrating)

$I = V_{peak}\sin(\omega t)/\omega L$

From the above (graphs of the sine and cosine functions of the resultant current and voltage respectively), it can be seen that the current and voltage in an inductive circuit are out of phase by 90^{o} and the voltage leads the current (ELI).

The inductor has a reactance X_L. Assuming the voltage and the current are in phase i.e. $V = V_{peak}\sin(\omega t)$, then,

$X_L = V/I = V_{peak}\sin(\omega t) / (V_{peak}\sin(\omega t)/\omega L) = \omega L$

X_L is called the inductive reactance of the inductor. Its unit is in Ohms

The instantaneous power delivered to the inductor is given by $P = IV = V_{peak}{}^2\sin(\omega t)\cos(\omega t) / \omega L$

The average power dissipated by the inductor (ideal) is zero.

RLC CIRCUITS

Capacitors and Inductors can sometimes be connected with resistors in a circuit. The simplest representation involves a single resistor, an inductor and a resistor connected in series with an AC source as shown in figure 2.4.

The total opposition to the flow of current is called the impedance (Z) of the circuit and it is made up in part by the resistance, the capacitive reactance and the inductive reactance (not the sum).

The potential difference across each circuit element can be represented by a phasor diagram as shown in figure 2.5.

Preview from Notesale.co.uk
Page 6 of 11