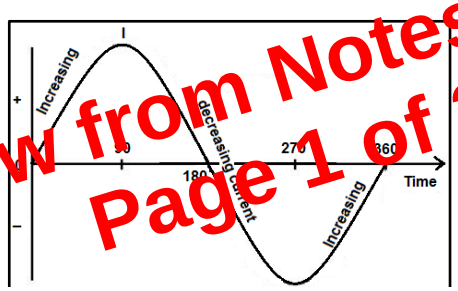
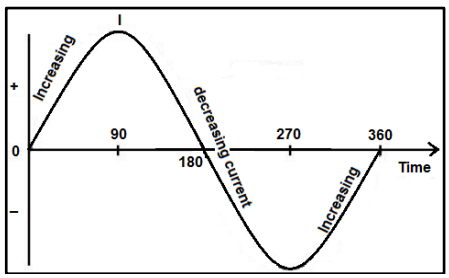
UNIT - II
PAPER B
Chapter # 7
AC FUNDAMENTALS

7.1 ALTERNATINGCURRENT & VOLTAGE:

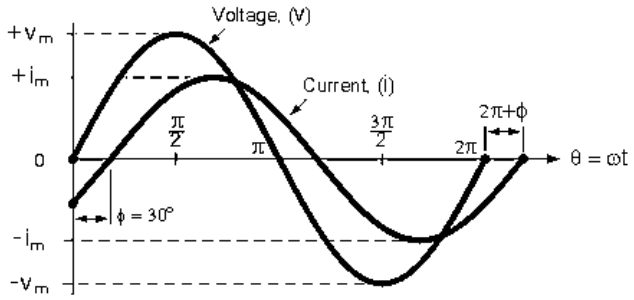
Alternating current abbreviation is AC, it is the flow of electric charge that periodically reverses. It starts, say, from zero, grows to a maximum value, decreases to zero, reverses in direction, reaches a maximum in the opposite direction, returns again to the original value zero, and repeats this cycle indefinitely. The AC current is denoted with "I" and measured in Amperes denoted with "A".



AC current flows with AC voltage source. AC Voltage is the pressure provided from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop, enabling them to do work such as illuminating a light. AC voltage periodically reverses. It starts, say, from zero, grows to a maximum value, decreases to zero, reverses in direction, reaches a maximum in the opposite direction, returns again to the original value zero, and repeats this cycle indefinitely. In brief, voltage = pressure, and it is denoted with "V" and measured in volts which is also denoted with "V".



waveforms then we will need to take into account this phase difference, Φ of the waveform. Consider the diagram below.



The generalized mathematical expression to define these two sinusoidal quantities will be written as:

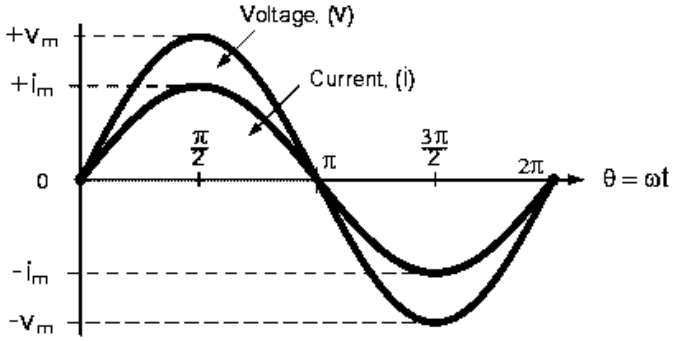
$$v_{(t)} = V_m \sin(\omega t)$$

$$i_{(t)} = I_m \sin(\omega t - \phi)$$

The current i, is lagging the voltage v, by angle Φ and in our example above this is 30°. So the difference between the two Phasor representing the two sinusoidal quantities is angle Φ and the resulting Phasor diagram will be.

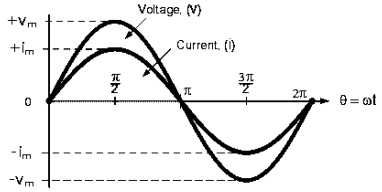
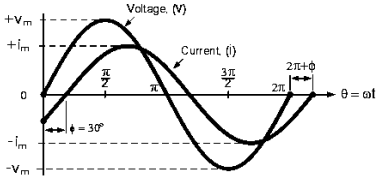
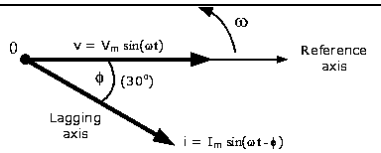
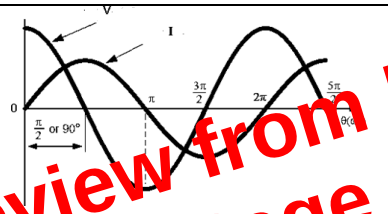
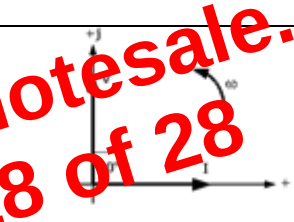
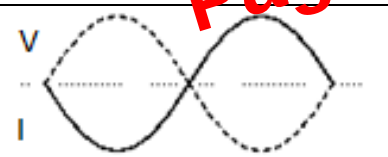
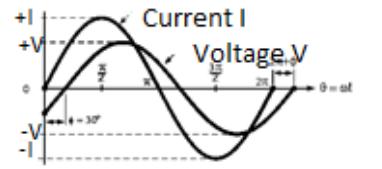
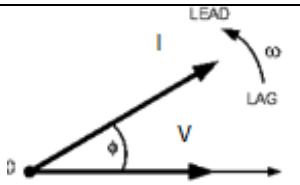
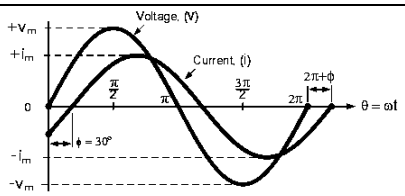
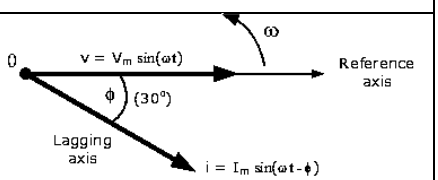
IN PHASE:

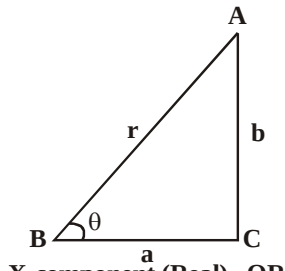
The phase involves the relationship between the position of the amplitude crests and troughs of two waveforms. Phase can be measured in distance, time, or degrees. If the peaks of two signals with the same frequency are in exact alignment at the same time, they are said to be in phase. In figure voltage and current are shown in phase.



OUT OF PHASE:

The phase involves the relationship between the position of the amplitude crests and troughs of two waveforms. Phase can be measured in

Position of Quantities	Wave Form	Phasor Diagram
Voltage and Current are in phase		
Voltage and Current are out of phase		
Voltage and Current are in phase quadrature		
Voltage and Current are in anti-phase		
Current is Leading Voltage		
Current is Lagging Voltage		



Y-component (Imaginary) OR Quadrature (Reative)

X-component (Real) OR In-phase (Active)

To convert from rectangular to polar, find the polar magnitude through the use of the Pythagorean Theorem (the polar magnitude is the hypotenuse of a right triangle, and the real and imaginary components are the adjacent and opposite sides, respectively), and the angle by taking the arctangent of the imaginary component divided by the real component:

EXAMPLE 1:

Convert 5 ∠36.87º into rectangular form?

SOLUTION:

5 ∠ 36.87º (Polar form)
(5) (cos 36.87º) = 4 (real component)
(5) (sin 36.87º) = 3 (imaginary component)
4 + j3 (rectangular form)

EXAMPLE 2:

Convert -5∠30º into rectangular form?

SOLUTION:

-5 Cos 30º = -4.33 Real component
-5 Sin 30º = -2.5 Imaginary component
-4.33-j2.5 (Rectangular form)

EXAMPLE 3:

Convert 15 ∠ -60º into rectangular form?

SOLUTION:

15 Cos (-60º) = 7.5 Real component
15 Sin (-60º) = -13 Imaginary component
7.5-j13 (Rectangular form)

EXAMPLE 4:

Convert 4+j3 into polar form?

SOLUTION:

Z = 4 + j3 ---------- Rectangular form
r = $\sqrt{a^2 + b^2}$ = $\sqrt{4^2 + 3^2}$ = 5
tan θ = b / a