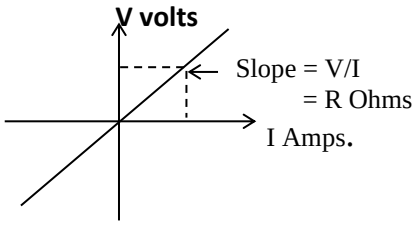
Short Answer Type

1.State Ohms law?

Ans: **Ohm's Law**:
Ohm's law states that, temperature remaining constant the voltage across many types of conducting materials is directly proportional to the current flowing through the material. In equation form,

$v = Ri.$



2.write the voltage and current relationship in Resistor, Inductor and Capacitor.

Ans: In Resistor, $V = RI$

In Inductor,

$$V = L\frac{dI}{dt}$$

In Capacitor,

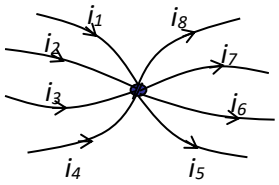
$$V = \frac{1}{C}\int Idt$$

3.State Kirchhoff's Laws?

Kirchhoff's Current Law: It states that the algebraic sum of the currents entering or leaving any junction is zero.

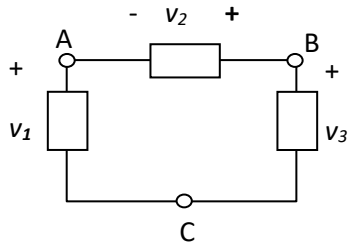
i.e., $i_1 + i_2 + i_3 + i_4 - i_5 - i_6 - i_7 - i_8 = 0$

(or) $-i_1 - i_2 - i_3 - i_4 + i_5 + i_6 + i_7 + i_8 = 0.$



Kirchhoff's Voltage Law: It states that the algebraic sum of the voltages around any closed path in a circuit is zero.

i.e., $v_1 + v_2 - v_3 = 0.$



4.Write the Fundamental Definition of Alternating Current?

Ans: Consider the sinusoidal voltage $v(t) = V_m \sin \omega t$

Instantaneous value: It is defined as the value of an alternating quantity at a particular instant of given time. Generally denoted by small letters.

e.g. I = Instantaneous value of current v = Instantaneous value of voltage

Amplitude/ Peak value/ Crest value/ Maximum value: It is defined as the maximum value (either positive or negative) attained by an alternating quantity in one cycle. Generally denoted by capital letters.

e.g. I_m= Maximum Value of current

V_m= Maximum value of voltage

Frequency: It is defined as number of cycles completed by an alternating quantity per second. Symbol is f. Unit is Hertz (Hz).

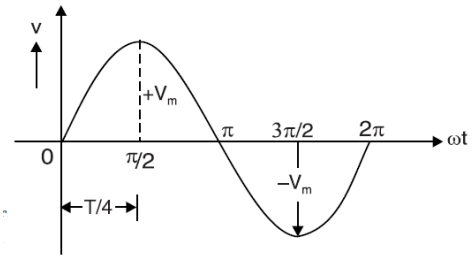
$$f = \frac{1}{T}$$

Time period: It is defined as time taken to complete one cycle. Symbol is T. Unit is seconds.

$$T = \frac{2\Pi}{\omega}$$

Phase: Phase is defined as the fractional part of time period or cycle through which The quantity has advanced from selected zero position of reference

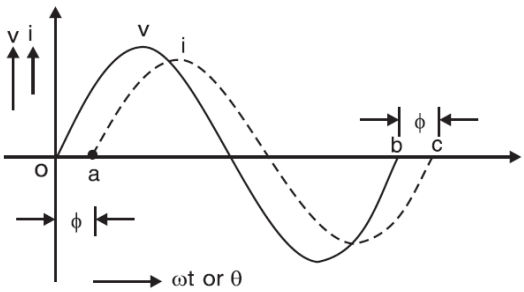
Phase of $+V_m$ is $\pi/2$ rad or T/4 sec
Phase of $-V_m$ is $3\pi/2$ rad or 3T/4 sec



Phase Difference:
When two alternating quantities of the same frequency have the different zero points they are said to have a phase difference. angle between the two zero points is the angle of phase difference.

The generalized mathematical expression to define these two sinusoidal quantities will be written as: $V = V_m \sin \omega t$

$$i = I_m \sin(\omega t - \Phi)$$



5. An alternating current i is given by; i = 141·4 sin 314 t Find (i) the maximum value (ii) frequency (iii) time period and (iv) the instantaneous value when t is 3 ms.

Solution. Comparing the given equation of alternating current with the standard form $i = I_m \sin\omega t$,
(i) Maximum value, I_m = **141·4 A**
(ii) Frequency, $f = \omega/2\pi = 314/2\pi$ = **50 Hz**
(iii) Time period, $T = 1/f = 1/50$ = **0·02 s**

(iv) i = 141·4 sin 314 t
When t = 3 m sec = 3×10^{-3} sec,
i = 141·4 sin $314 \times 3 \times 10^{-3}$ = **114· 35 A**

6. Define Average and RMS values.

Ans: Average Value: The arithmetic average of all the values of an alternating quantity over one cycle is called its average value.

$$\text{Average value} = \frac{\text{Area under the curve}}{\text{Base length}}$$

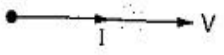
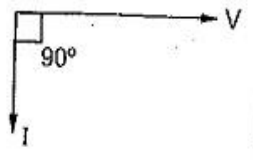
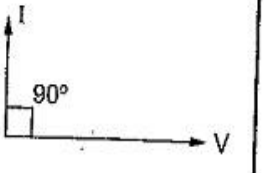
$$V_{avg} = \frac{1}{2\pi}\int_0^{2\pi} v \, . \, d(\omega t)$$

RMS (Root Mean Square) or Effective value:
The effective or RMS value of an alternating quantity is that steady current (dc) which when flowing through a given resistance for a given time produces the same amount of heat produced by the alternating current flowing through the same resistance for the same time.

The r.m.s. value of symmetrical wave can also be expressed as = $\sqrt{\frac{\text{area of half-cycle of squared wave}}{\text{Half cycle base}}}$

$$V_{rms} = \sqrt{\frac{1}{\pi}\int_0^{\pi} v^2 \, . \, d\theta}$$

7. List out the Phase relation between voltage and current in Pure resistive, inductive and capacitive circuits.
Ans: summarization the behaviour of pure R, L and C in the tabular form.

Parameter	Characterisitics	Impedance in rectangular form	Impedance in polar form	Phasor diagram
Pure resistance R	V and I are in phase	Z = R + j0	$Z = R \angle 0°$	
Pure inductance L	I lags V by 90°	$Z = 0 + j X_L$	$Z = X_L \angle +90°$	
Pure capacitance C	I leads V by 90°	$Z = 0 - j X_C$	$Z = X_C \angle -90°$	

8. Define Impedance

Ans: The total opposition offered to the flow of alternating current by a circuit is called **impedance** Z of the circuit.
In R-L series circuit,
Impedance, $Z = \sqrt{R^2 + X_L{}^2}$ where $X_L = 2\pi fL$
The magnitude of impedance in R-L series circuit depends upon the values of R, L and the supply frequency f.

9. What is power factor.

The numerical value of cosine of the phase angle between the applied voltage and the current drawn from the supply voltage gives the power factor. It is also defined as the ratio of resistance to the impedance. It is denoted as cos φ.

$$\cos\phi = \text{p.f.} = \frac{R}{Z}$$

For pure L and C, $\phi = 90°$ hence the p.f. is zero.

10.What is Apparent, True and Reactive Powers?
Ans:

i) Apparent power. The total power that appears to be transferred between the source and load is called **apparent power.** It is equal to the product of applied voltage (V) and circuit current (I).

Apparent power, $S = V \times I = VI$

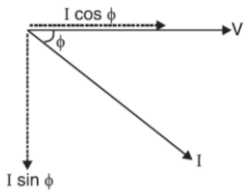
It is measured in volt-ampers (VA).

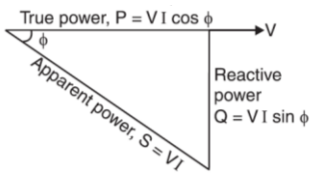
ii) True power: The power which is actually consumed in the circuit is called **true power** or **active power.**
The product of voltage (V) and component of total current in phase with voltage (I cosΦ) is equal to **true power.**

True power, P = Voltage × Component of total current in phase with voltage
$= V \times I \cos \Phi$
$P = VI \cos \Phi$

It is measured in watts (W).

iii) Reactive power:
The component of apparent power which is neither consumed nor does any useful work in the circuit is called **reactive power.**
The product of voltage (V) and component of total current 90° out of phase with voltage (I sinΦ) is equal to **reactive power.**
Reactive power, Q = Voltage × Component of total current 90° out of phase with voltage
$= V \times I \sin \Phi$
$Q = VI \sin \Phi$
It is measured in volt-amperes reactive (VAR).





Subjective Type

1. Draw & Explain the properties of R, L and C elements in an electric circuit with voltage & current relationships.
2. Illustrate ohm's law and its limitations.
3. Illustrate Kirchhoff's current law and Kirchhoff's voltage law with an example.
4. Determine the equivalent resistance for series and parallel connective resistors.
5. Derive Average and RMS value of sinusoidal waveforms.
6. Draw & Explain RL, RC and RLC circuits in terms of its voltage & current relationships, phasor diagram.
7. Derive circuit current, Impedance, Phase angle, Power factor & active power for RL, RC and RLC circuits

Note: Refer numerical problems solved in class & given in assignments, internal examination and also practice unsolved problems in the Textbooks. In addition, follow Model question paper.