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(1) Explain effect of temp. on resistance of
1) Pure metals
2) Alloys
(iii) insulators & Semiconductors
Explain temp. co-efficient of material.

- With Increase in temp. kinetic energy of free electron in the conductor get increased.
- Change in Resistance of a conductor depends on two factors.

i) Initial Resistance (R_0)
ii) Rise in temp. (Δt)

$\therefore \Delta R \propto R_0$

$\therefore \Delta R \propto \Delta t$

$\therefore \Delta R \propto R_0 \Delta t$

$\therefore \Delta R = \alpha R_0 \Delta t$

Where α = temp co-efficient

$\therefore \dfrac{\Delta R}{R_0 \Delta t} = \alpha$

$$\therefore \boxed{\alpha = \dfrac{\Delta R}{R_0 \Delta t}}$$

(i.) Pure metals:

- In pure metals the resistance of the substance increases with the increase in its temp. The increases is large and fairly regular for normal ranges of temp.

(ii.) Alloys:

- The resistance of an alloy remain nearly unaffected by the change in temp.

(iii) Insulator & semiconductor :-

→ For semiconductor & Insulator the value of α is nagative therefor its resistance decrease with increase in temp.

(2) Prove $R_2 = R_1[1+\alpha(t_2-t_1)]$, Where notations have usual meanings.

→ Here change in resistance of a conductor depends on two factors.

(i) Initial Resistance (R_0)

(ii) Rise in temp. (Δt)

$\therefore \Delta R \propto R_0$

$\therefore \Delta R \propto \Delta t$

$\therefore \Delta R \propto R_0 \Delta t$

$\therefore \Delta R = \alpha R_0 \Delta t$

where α = temp. cofficient

$$\therefore \boxed{\alpha = \frac{\Delta R}{R_0 \Delta t}}$$

where, $\Delta R = R - R_0$

$\Delta t = t - t_0$

R_0, t_0 = initial

R, t = final

$$\alpha = \frac{R - R_0}{R_0(t - t_0)}$$

$\therefore \alpha R_0(t - t_0) = R - R_0$

$\therefore R_0 + \alpha R_0(t - t_0) = R$

$R = R_0 + \alpha R_0(1 + t_0)$

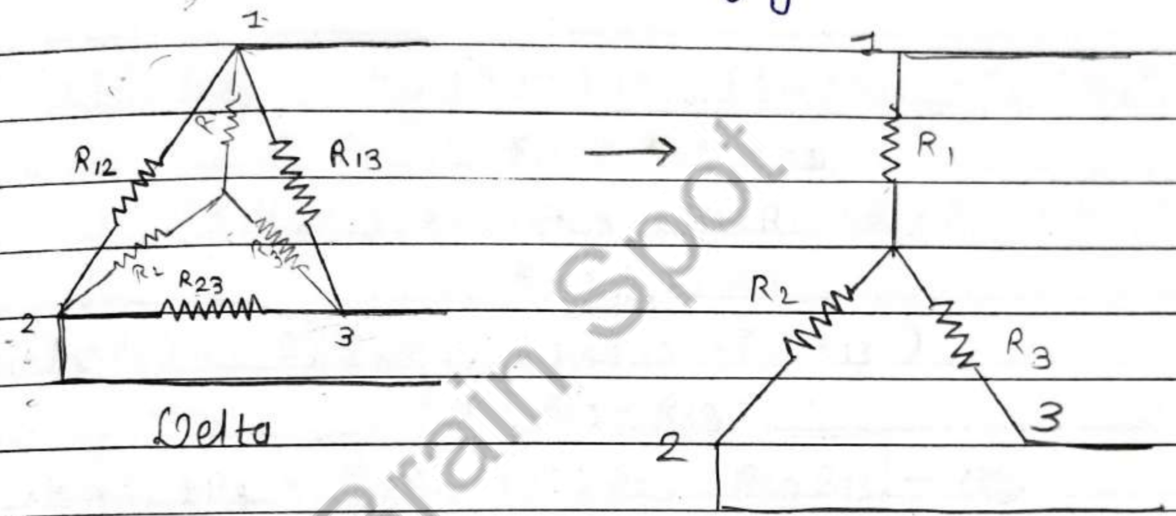
$$\therefore \boxed{R = R_0[1 + \alpha(t - t_0)]}$$

(4) With necessary diagram derive the formula for star to delta and delta to star transformation

- when there are more no. of loops in a network the network can be simplified using star-delta or delta-star transformation.

Δ→star

- It is the replacement of delta connected resistances into equivalent star connected system.
- Suppose three resistances R_{12}, R_{23} and R_{31} are connected in delta fashion between the terminals 1, 2 and 3 as shown in fig a.



Delta

Star

- Resistance between (1) & (2) for star

$$\boxed{R_{12} = R_1 + R_2} \quad \text{—(1)}$$

- Resistance between 1 & 2 for delta $= \boxed{\dfrac{R_{12}(R_{13}+R_{23})}{R_{12}+R_{13}+R_{23}}}$ —(2)

- Resistance between 2 & 3 for star $\boxed{R_{23} = R_2 + R_3}$ —(3)

- Resistance between 2 & 3 for delta $= \boxed{\dfrac{R_{23}(R_{13}+R_{12})}{R_{12}+R_{13}+R_{23}}}$ —(4)

- Resistance between 3 & 1 for star $\boxed{R_{31} = R_3 + R_1}$ —(5)

- Resistance between 3 & 1 for delta $= \boxed{\dfrac{R_{31}(R_{12}+R_{23})}{R_{12}+R_{13}+R_{23}}}$ —(6)

Resistance measured between terminal 1 & 2 in both system must be equal. There for equating the eq^n ① & ②, we get

$$R_1 + R_2 = \frac{R_{12}(R_{13}+R_{23})}{R_{23}+R_{12}+R_{13}} \quad —— ①$$

&

$$R_3 + R_1 = \frac{R_{31}(R_{23}+R_{12})}{R_{13}+R_{23}+R_{12}} \quad —— ②$$

$$R_2 + R_3 = \frac{R_{23}(R_{13}+R_{12})}{R_{12}+R_{23}+R_{31}} \quad —— ③$$

Now adding ①, ② & ③

$$2(R_1+R_2+R_3) = \frac{R_{12}(R_{13}+R_{23}) + R_{23}(R_{12}+R_{13}) + R_{31}(R_{23}+R_{12})}{R_{12}+R_{23}+R_{31}}$$

$$= \frac{R_{12}R_{13} + R_{12}R_{23} + R_{23}R_{12} + R_{23}R_{13} + R_{31}R_{12} + R_{31}R_{23}}{R_{12}+R_{23}+R_{31}}$$

$$\cancel{2}(R_1+R_2+R_3) = \frac{\cancel{2}(R_{12}R_{13} + R_{12}R_{23} + R_{23}R_{13})}{R_{12}+R_{23}+R_{13}}$$

$$\therefore \boxed{R_1+R_2+R_3 = \frac{R_{12}R_{13} + R_{12}R_{23} + R_{23}R_{13}}{R_{12}+R_{23}+R_{13}}} \quad —— ④$$

by substituting ④ by ③

$$R_1 = \frac{R_{12}R_{13} + \cancel{R_{12}R_{23}} + \cancel{R_{23}R_{13}} - \cancel{R_{23}R_{13}} - \cancel{R_{23}R_{12}}}{R_{12}+R_{23}+R_{13}}$$

$$\therefore \boxed{R_1 = \frac{R_{31}R_{12}}{R_{12}+R_{23}+R_{13}}}$$

$$\boxed{R_2 = \frac{R_{12}R_{23}}{R_{12}+R_{23}+R_{13}}}$$

$$\boxed{R_3 = \frac{R_{23}R_{13}}{R_{12}+R_{23}+R_{13}}}$$

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$$R_1R_2 = \frac{R_{12}R_{13}R_{12}R_{23}}{(R_{12}+R_{23}+R_{13})^2} \; ; \quad R_2R_3 = \frac{R_{12}R_{23}^2R_{13}}{(R_{12}+R_{23}+R_{13})^2}$$

$$R_3R_1 = \frac{R_{23}R_{13}^2R_{12}}{(R_{12}+R_{23}+R_{13})^2}$$

$$R_1R_2 + R_2R_3 + R_3R_1 = \frac{R_{12}R_{13}R_{12}R_{23} + R_{12}R_{23}^2R_{13} + R_{23}R_{13}^2R_{12}}{(R_{12}+R_{23}+R_{13})^2}$$

$$= \frac{R_{12}R_{13}R_{23}\,\cancel{(R_{12}+R_{23}+R_{13})}}{(R_{12}+R_{23}+R_{13})^{\cancel{2}}}$$

$$R_1R_2 + R_2R_3 + R_3R_1 = \frac{R_{12}R_{13}R_{23}}{(R_{12}+R_{23}+R_{13})}$$

$$= \frac{R_{31}R_{12}}{(R_{12}+R_{23}+R_{13})^2} \times R_{23}$$

$$R_1R_2 + R_2R_3 + R_3R_1 = R_1 \times R_{23}$$

$$R_{23} = \frac{R_1R_2 + R_2R_3 + R_3R_1}{R_1}$$

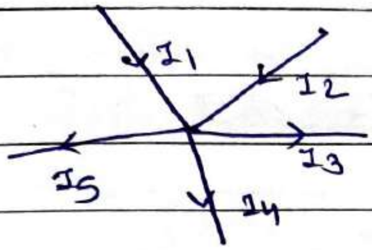
$$\boxed{R_{23} = R_2 + R_3 + \frac{R_2R_3}{R_1}}$$

(5) State and explain Kirchoff's voltage and current laws.

→ Kirchoff's current law:

→ It states that algebric sum of all the current entering or leaving a Junction is equal to zero

→ $\therefore \Sigma I = 0$



$$+I_1 + I_2 - I_3 - I_4 - I_5 = 0$$
$$I_1 + I_2 = I_3 + I_4 + I_5$$

→ It is defined as current entering the junction is equal to current leaving the junction.

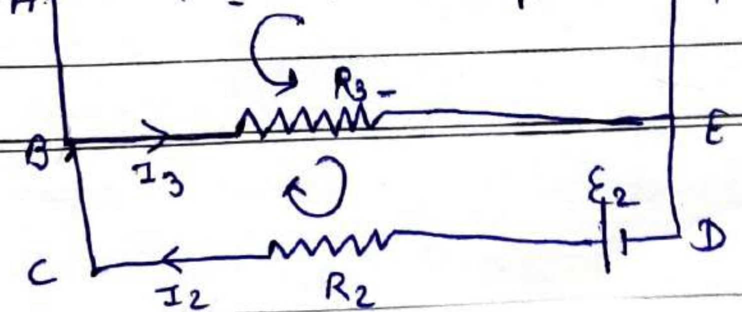
→ Kirchoff's voltage law:

→ It states that the algebric Sum of all the voltage ~~it states~~ and emf in a closed loop is equal to zero.

$$\Sigma E = \Sigma IR$$

$$\Sigma E + \Sigma V = 0$$
$$\Sigma E + \Sigma IR = 0$$

→ Proof's



→ Apply KVL, in ~~mesh~~ loop ABEFA

$$I_1R_1 + I_3R_3 - E_1 = 0$$

$$\therefore \; I_1R_1 + (I_1+I_2)R_3 - E_1 = 0 \quad \text{—— (1)}$$

→ Apply KVL, in ~~mesh~~ loop CBEDC

$$I_2R_2 + I_3R_3 - E_2 = 0$$

$$I_2R_2 + (I_1+I_2)R_3 - E_2 = 0 \quad \text{—— (2)}$$

→ Substracting (1) - (2)

$$I_1R_1 + \cancel{(I_1+I_2)R_3} - E_1 = 0$$

$$\underset{-}{I_2R_2} + \underset{-}{\cancel{(I_1+I_2)R_3}} \underset{+}{-E_2} = 0$$

$$I_1R_1 - I_2R_2 - E_1 + E_2 = 0$$

$$\therefore \; (I_1R_1 - I_2R_2) - (E_2 - E_1)$$

$$\Sigma IR + \Sigma E = 0$$

$$\Sigma V + \Sigma E = 0$$

$$(I_1R_1 - I_2R_2) - E_1 + E_2 = 0$$

$$(I_1R_1 - I_2R_2) - (E_1 - E_2) = 0$$

$$\Sigma IR - \Sigma E = 0$$

$$\therefore \boxed{\Sigma IR = \Sigma E}$$

This law signify conservation of energy.

Electromagnetics

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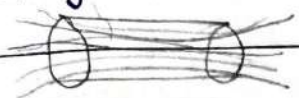
① Explain the given terms :

a) Magnetic Flux :-

The total no. of magnetic lines of force in a magnetic field ~~in a mag~~ is called the magnetic flux.



It is denoted by a symbol ϕ

The unit of magnetic flux is Weber (Wb.)

b) Magnetic flux density :

It is defined as the flux per unit area at right angle to the flux.

It is denoted by B.

Its unit is Wb/m^2 (or Tesla)

Mathematically, $\boxed{B = \frac{\phi}{A}}$

c) Magnetomotive force (MMF) :-

It is defined as the force that tends to establish the flux through a magnetic circuit.

It is equal to the product of the current (I) flowing through the coil and the no. of turns (N) of the coil. Thus,

$$\boxed{m.m.f = NI}$$

Its unit is ampere-turns (or AT)

Magnetic field intensity :- (H)

Magnetic field intensity is

defined as the magnetomotive force per unit length of the magnetic flux path.

- It is denoted by **H.**
- Its unit is ampere turns/meter (AT/m.)

$$\therefore H = \frac{m.m.f.}{l} = \frac{NI}{l} \text{ AT/m}$$

[illegible] magnetic Material [illegible] magnetic flux [illegible]

- **e) Permiability :**

  - It is ability of a magnetic material to create the magnetic flux through it.
- It is denoted by symbol μ.
- It is given by the product of permeability of a vacumm and relative permeability of a magnetic material.

Ex $\mu = \mu_0 \mu_r$

where μ_0 = permeability of a vacuum

μ_r = relative permeability of a material

- Unit: henry/meter (H/m)

- **Reluctance :**

  - It is directly proportional to the length of the magnetic circuit and inversely proportional to the area of cross-section of the magnetic path.
  - It is denoted by symbol S.
  - Mathematically, $S = \frac{l}{\mu_0 \mu_r A} = \boxed{\frac{mmf}{\phi}}$
- Its Unit is AT/wb

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g) Permeance :-

It is define as the resiprocal of the reluctance.

unit:· Weber / ampere turns (Wb/AT) or Henry (H)

Mathmatically ;

$$\text{Permeance}(\lambda) = \frac{1}{\text{reluctance}(S)}$$

(2) Compare Electrical circuit and magnetic circuit by their similarites and dissimilarities

Magnetic Circuit	Electric Circuit
The close path for the magnetic flux is called magnetic circuit.	The close path for the electrical current is called electrical circuit
The number of magnetic lines of force decide the magnetic flux	Flow of electron decide the current passing through the conductor.
$\text{Flux}(\phi) = \frac{\text{MMF}}{\text{Reluctance}}$	$\text{Current}(I) = \frac{\text{EMF}}{\text{Resistance}}$
MMF is the driving force in the magnetic circuit. The unit of MMF is ampere - turns (AT)	EMF is the driving force in the electric circuit. The unit of Emf is volts (V).

Reluctance (S) opposed by the magnetic path to the flux. The unit of reluctance is AT/wb.	Resistance (R) oppose the flow of current. The unit of resistance is ohm (Ω).
Flux (ϕ) measured in weber (Wb.)	Current (I) measured in Ampere (A)
MMF measured in Amp Turns (AT).	EMF measured in Volts (V).
Reluctance $S = \frac{l}{\mu_0 \mu_r A}$	$R = \rho \frac{l}{A}$
Permanence $= \frac{1}{\text{Reluctance}} = \frac{1}{S}$	conductance $= \frac{1}{\text{Resistance}} = \frac{1}{R}$
Permeability (μ)	Conductivity (σ)
Reluctivity	Resistivity
Flux density (B) $= \phi/A \left(\frac{Wb}{m^2}\right)$	Current Density (J) $= I/A$
Magnetic Intensity (H) $= \frac{NI}{L} \left(\frac{AT}{m}\right)$	Electrical Intensity (E) $= \frac{V}{d} \left(\frac{V}{m}\right)$
Kirchoff MMF law and flux law is applicable to the Magnetic Flux	Kirchoff current law and kirchhoff voltage law is applicable to the electric circuit.

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③ Distinguish statically induced and dynamically induced EMF. Derive expression for dynamically induced EMF.

~ Statically induced emf:

~ The voltage induced in the conductor due to change in the magnetic field.

~ Conductor is stationary.

~ Magnetic field is changing in a stationary Magnetic System.

~ Ex: Transformer

~ Dynamically induced emf:

~ The voltage in the conductor due to relative motion of conductor and magnetic field.

~ Conductor is moving / stationary

~ Magnetic field is stationary / moving.

~ Derivation:

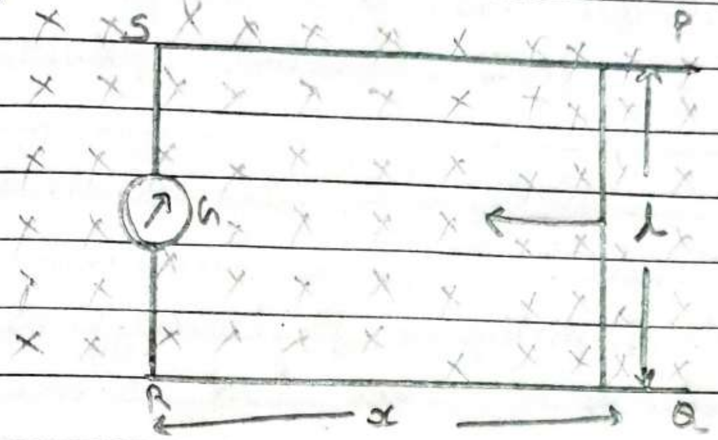
~ If the length $RQ = x$ & $PQ = RS = l$, the magnetic flux linked with ~~time~~ the loop PQRS $\boxed{\phi = Blx}$ $\left\{ \because B = \frac{\phi}{A} \right\}$

~ As x is changing with time, the amount of magnetic flux linked with the loop changes. Therefore, an e.m.f is induced in the loop given by

$$e = -\frac{d\phi}{dt} = \frac{-d}{dt}(Blx) \; ; \; e = Bl\left(-\frac{\partial x}{\partial t}\right)$$

$$\therefore \boxed{e = BlV}$$

$-\frac{dx}{dt} = v$ is the velocity of the conductor PQ towards the left. e is called motional electro-motive force.



(4) Explain self-induced e.m.f and mutually induced e.m.f

→ Self induced emf:-

→ Definition: "The emf induced in the coil due to change its own flux linked with is known as self induced emf"

કોઇલમાં પ્રેરિત emf તેના પોતાના પ્રવાહ સાથે જોડાયેલ ફેરફારને કા. સ્વપ્રેરિત emf તરીકે ઓળખાય છે.

→ Conductor remains stationary and flux linked with it is changed.

કંડક્ટર સ્થિર રહે છે અને તેની સાથે જોડાયેલ પ્રવાહ બદલાઇ જાય છે

→ The induced emf, e, in a coil is proportional to the rate of the change of the magnetic flux passing through it due to its own current.

$$\boxed{e_1 = -L\frac{di}{dt}}$$

→ The negative sign is used to indicate that EMF is opposing the cause producing it.

પ્રેરિત emf, e, તેના પોતાના વર્તમાનને કારણે તેમાંથી પસાર થતા ચુંબકીય પ્રવાહના ફેરફારના દરના પ્રમાણસર છે

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Mutually induced emf:-

Definition :- "The emf induced in a coil due to the change of flux produced by another neighbouring coil linking to it, is called Mutually induced emf"

It derives as $e = M\frac{di}{dt}$

(5) What is co-efficient of coupling? Derive expression for the same bt^n two magnetically coupled coils.

Definition:

"The fraction of magnetic flux produced by the other coil is called the co-efficient of coupling between the two coils It is denoted by (K)"

Two coils are taken coil A and coil B, when current flows through one coil it produces flux the whole flux may not link with the other coil coupled and this is because of leakage flux by a fraction (K).

Derivation:

Consider two magnetic coils A and B
When current I_1 flows through coil A

$$L_1 = \frac{N_1\phi_1}{I_1} \quad \text{and} \quad M_1 = \frac{N_2\phi_2}{I_1} \quad \text{---} (1) \quad \{\because \phi_2 = K\phi_1\}$$

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Considering coil B in which current I_2 flows

$$L_2 = \frac{N_2 \phi_2}{I_2} \quad \text{and} \quad M_2 = \frac{N_1 \phi_1}{I_2} = \frac{N_1 K \phi_2}{I_2} \quad \text{—— (2)}$$

as ($\phi_1 = K\phi_2$)

Multiplying eq^n (1) and (2)

$$M_1 M_2 = \frac{N_2 \phi_1 K}{I_1} \times \frac{N_1 K \phi_2}{I_2}$$

$$M^2 = K^2 \frac{N_1 \phi_1}{I_1} \frac{N_2 \phi_2}{I_2} \quad \{\because M_1 = M_2 = M\}$$

$$M^2 = K^2 L_1 L_2$$

$$\therefore M = K\sqrt{L_1 L_2}$$

$$\therefore \cancel{K = \frac{M}{\sqrt{L_1 L_2}}}$$

The amount of coupling between the inductively coupled coils is expressed in turms of the co-efficien of coupling, which is defined as

$$\boxed{K = \frac{M}{\sqrt{L_1 L_2}}}$$

where,

M = mutual inductance bt^n the coils

L_1 = self " of the first coil, and

L_2 = self inductance of " second " .

6) Derive the expressions of equivalent inductance, when two magnetically coupled coils are connected in series in two different ways.

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AC Fundamentals and Analysis of A.C. Circuit

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(1) Define following terms with respect to a.c. waveform (i) Frequency (ii) Power factor (iii) R.M.S. value (iv) Phase & Phase difference (v) Average value (vi) Form factor (vii) ~~Speed~~ crest Factor (viii) Amplitude

→ (i) Frequency :: દરેક સેકન્ડમાં કેટલા cycle.

→ It is defined as number of cycle completed by an alternating quantity per second.

→ It is denoted by a symbol f.

→ Its unit is Hz

→ (ii) Power fector:

→ It is defined as the cosine of angle between voltage and current.

→ mathmatically,

$$P.f. = \cos\phi$$

where ϕ is the angle btⁿ voltage and current

→ (iii) RMS value:

→ It is the equivalent D.C current which when as flowing through a given circuit for a given time produces same amount of heat as produced by an alternating current when flowing through the same circuit for the same time.

Vrms = Root mean square value of voltage.

Irms = " " " " " current.

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(iv) Phase difference :-

It is defined as angular displacement between two zero value or two maximum values of the two-alternating quantity having same frequancy.

(v) Aaverage value :

It is defined as the average of all instantaneous value of alternating quantities over a half cycle.

Iav Vav

(vi) ~~fram~~ form factor :-

It is defined as the ratio of rms value ~~to~~ and average value of an alternating quantity denoted by K_f.

$K_f = 1.11$ for sine wave

(vii.) Creast factor / Peak factor :-

It is defined as the ratio of peak value to rms value of an alternating quantity

$K_p = 1.41$ for sine wave

(viii) Amplitude :-

It is defined as the maximum value attend by an alternating quantity in one cycle.

It is denoted by capital letters.

I_m = max of current

V_m = " " voltage

P_m = " " Power

(2) Explain the phenomenon of generation of Alternating voltages and currents and derive expression for it with suitable diagrams

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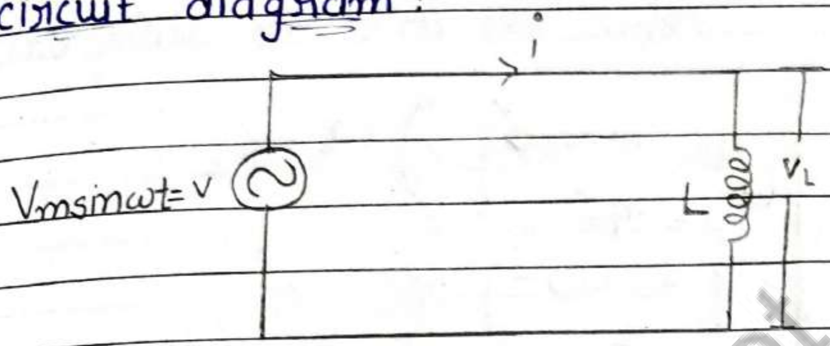
1) Prove that current through pure Inductor is always lagging by 90° to its voltage

→ An AC circuit of a pure Inductor to which an alternating voltage $v = V_m \sin\omega t$ is applied.

→ circuit diagram :



→ Equations for voltage and current :-

→ voltage source $v = V_m \sin\omega t$

→ Due to self-inductance of the coil, there will be emf induced in it. This back emf will appose the instantaneous rise or fall of current through the coil, it is given by.

$$\boxed{e_b = -L\frac{di}{dt}}$$

→ As, circuit does not contain any resistance, there i no ohmic drop and hence applied voltage is equal and opposite to back emf.

$$\therefore V = -e_b$$

$$\therefore v = -\left(-L\frac{di}{dt}\right)$$

$$\therefore v = L\frac{di}{dt}$$

$$\therefore V_m \sin\omega t = L\frac{di}{dt}$$

$$\therefore \boxed{di = \frac{V_m \sin\omega t\, dt}{L}}$$

→ Integrate on both the sides.

$$\therefore \int di = \frac{V_m}{L}\int \sin\omega t\, dt$$

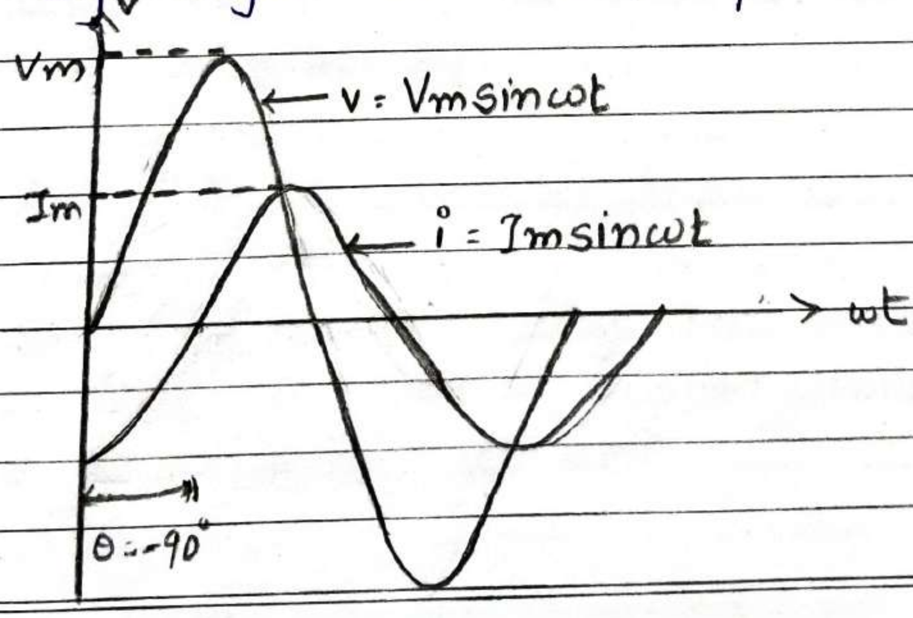
$$i = \frac{V_m}{L}\left(\frac{-\cos\omega t}{\omega}\right)$$

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

$$= -\frac{V_m}{\omega L}\sin(\pi/2 - \omega t)$$

$$\boxed{i = \frac{V_m}{\omega L}\sin(\omega t - \pi/2)} \quad \text{— (1)}$$

→ from eq^n (1) = it is clear that the current lags the voltage by angle $\pi/2$ in a purely inductive circuit.



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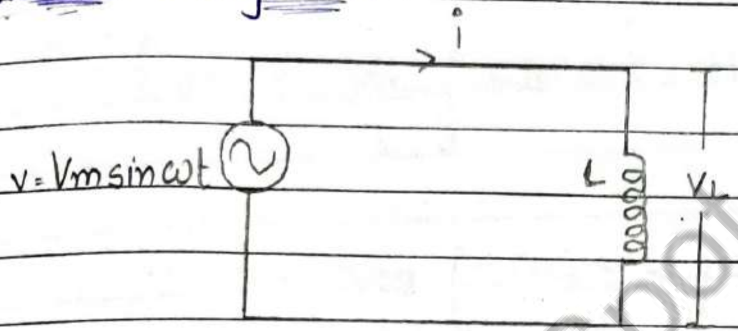
5) Prove that average power consumption in pure inductor is zero.

→ An AC circuit consisting of a pure Inductor to which an alternating voltage $v = V_m \sin\omega t$ is applie

→ Circuit Diagram :



→ Equations for Voltage and Current.

→ As shown in the diagram $\boxed{v = V_m \sin\omega t}$

→ Due to self inductance of the coil, there will be emf induced in it. This emf will oppose the instantaneous rise or fall of current through the coil, it is given by.

$$\boxed{e_b = -L\frac{di}{dt}}$$

→ As, circuit does not contain any resistance, there is no ohmic drop and hence applied voltage is equal and opposite to back emf

$$v = -e_b$$

$$v = -\left(-L\frac{di}{dt}\right)$$

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$\therefore V = L\frac{di}{dt}$

$\therefore V_m \sin\omega t = L\frac{di}{dt}$

$$\therefore \boxed{di = \frac{V_m \sin\omega t \, dt}{L}}$$

vi) Integrate on both the sides,

$$\therefore \int di = \frac{V_m}{L}\int \sin\omega t \, dt$$

$$\therefore i = \frac{V_m}{L}\left(\frac{-\cos\omega t}{\omega}\right)$$

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

$$= -\frac{V_m}{\omega L}\sin(\pi/2 - \omega t)$$

$$\boxed{i = \frac{V_m}{\omega L}\sin(\omega t - \pi/2)}$$

vii) From above eq^n it is clear that the current lags the voltage by 90° in a purely inductive circuit.

viii) Power

→ The instantaneous value of power drawn by this circuit is given by the product of the instantaneous values of voltage and current.

$$p = vi$$

$$= V_m \sin\omega t \times I_m \sin(\omega t - 90^\circ)$$

$$= V_m \sin\omega t \times (-I_m \cos\omega t)$$

$$\therefore p = \frac{-2V_mI_m \sin\omega t \cdot \cos\omega t}{2}$$

$$\boxed{p = -\frac{V_mI_m}{2}\sin(2\omega t)}$$

Average Power :-

$$P_{av} = \frac{\int_0^{2\pi} -\frac{V_mI_m}{2}\sin(2\omega t)\, d(\omega t)}{2\pi}$$

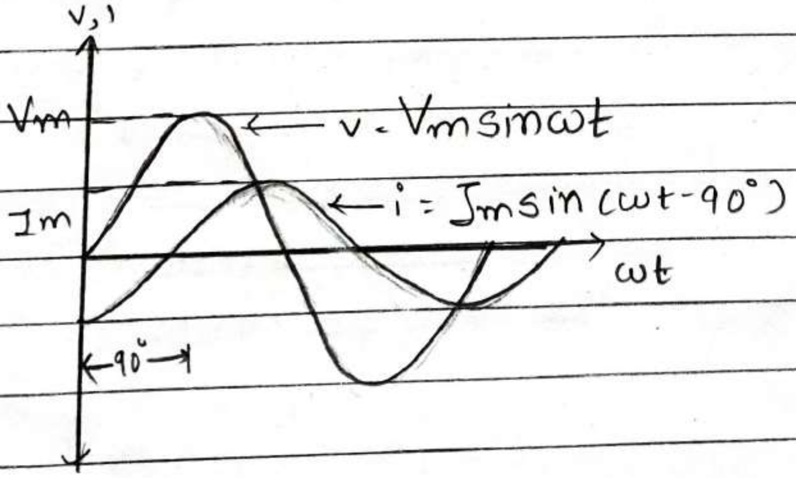
$$= \frac{-V_mI_m}{4\pi}\int_0^{2\pi} \sin(2\omega t)\, d(\omega t)$$

$$= \frac{-V_mI_m}{4\pi}\left[-\frac{\cos 2\omega t}{2}\right]_0^{2\pi}$$

$$= \frac{V_mI_m}{4\pi}\left[\cos 4\pi - \cos 0\right]$$

$$\boxed{P_{av} = 0}$$

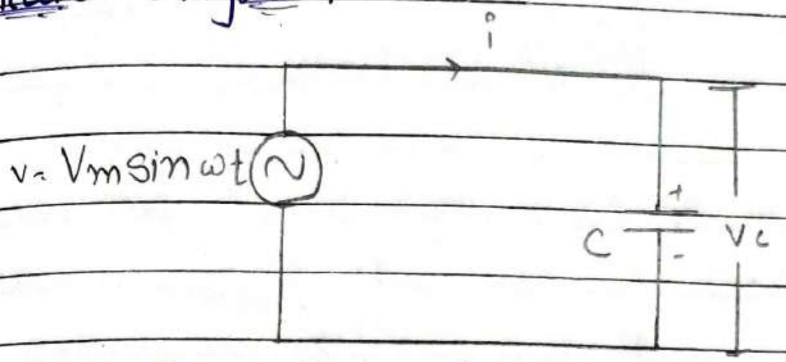
hence, the average power consumed by purely inductive ac circuit is zero.



6) Prove that current through pure capasitive circuit leads its voltage by 90°.

An A.C voltage supply $v = V_m \sin\omega t$.

Circuit diagram



Equation for voltage & current.

→ votage source

$$\boxed{v = V_m \sin\omega t}$$

→ A pure capasitor having zero resistance. Thus, the alternating supply applied to the plates of the capacitor the capacitor is charged.

→ If the charge on the capacitor plates at any instant is 'q' and the potential difference btⁿ the plates at any instant is 'V_t' then we know that,

$$q = Cv$$

$$\therefore \boxed{q = CV_m \sin\omega t}$$

→ The current is given by rate of change of charge

$$i = \frac{dq}{dt}$$

$$\therefore i = \frac{d(CV_m \sin\omega t)}{dt}$$

$X_C = \frac{1}{\omega C}$

$X_L = \omega L$

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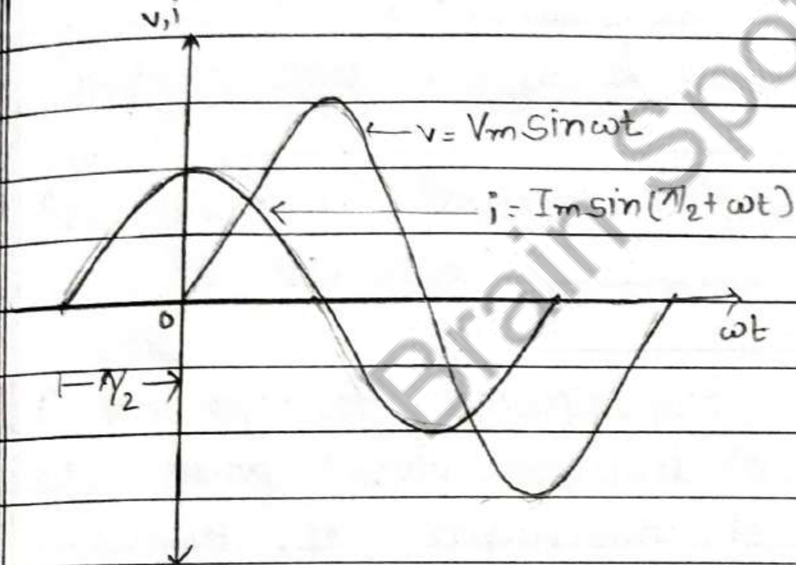
$\therefore i = \omega C V_m \sin\omega t \cos\omega t$

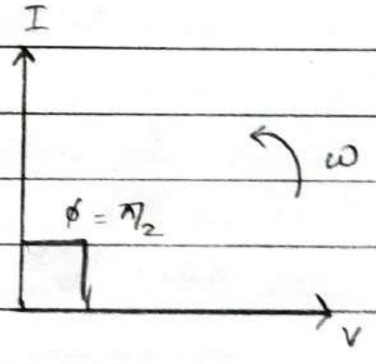
$= \frac{V_m}{1/\omega C} \cos\omega t$

$i = \frac{V_m}{X_C} \cos\omega t$

$\boxed{i = I_m \sin(\omega t + \pi/2)}$

→ From the above equations it is clear that the current leads the voltage drop by angle $\pi/2$ in a purely capacitive circuit.

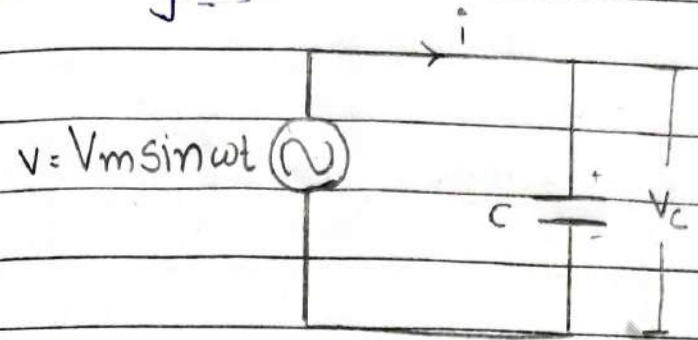




7) Prove that average power consumption in pure capacitor is zero.

An A.C voltage supply $\boxed{v = V_m \sin\omega t}$

circuit diagram :



** Equations for voltage & current

As shown in diagram voltage source
$\boxed{v = V_m \sin\omega t}$

A pure capacitor having zero resistance. Thus, the alternating supply applied to the plates of the capacitor, the capacitor is charged.

If the charge on the capacitor plates at any instant is 'q' and the potential difference $b t^n$ the plates at any instant is 'v' then we know that,

$$q = Cv$$
$$\therefore \boxed{q = CV_m \sin\omega t}$$

The current is given by rate of change of charge.

$$i = \frac{dq}{dt}$$

$$i_1 = \frac{d(CV_m \sin \omega t)}{dt}$$

$$i = \omega C V_m \cos \omega t$$

$$= \frac{V_m}{1/\omega C} \cos \omega t$$

$$= \frac{V_m}{X_C} \cos \omega t$$

$$\boxed{i = I_m \sin(\pi/2 + \omega t)}$$