STUDY MATERIAL

SUBJECT : BASIC ELETRICAL ENGG. (BEE)

(MODULE – I)

Sec-B

SEMESTER : 1ST /2ND

BRANCH : MECH/CE/EE/EEE/CSE/ETC

Sem 2nd

BEE

DEPARTMENT OF ELECTRICAL ENGINEERING

SRINIX COLLEGE OF ENGINEERING, BALASORE

(www.srinix.org)

Electric charge

Atom Consist of electrons, protons & neutrons.

→ Electron has -vely charge (-1.6×10^{-19} C)
→ proton has +vely charge (1.6×10^{-19} C)
→ neutron has no charge.
→ study of charge is called Electricity

Electric current

An Electric current is the movement of electric charge along a definite path.

→ in case of Conductor moving of charges ~~electron~~ are electron.

→ Unit is Ampere.

$$\boxed{I = \frac{Q}{t}} \quad \text{or} \quad \boxed{Q = It}$$

(a) **direct current** (steady current) :- it is a current where magnitude as well as direction remain Constant.

→ Ex - cell, battery, dc Generator.

(b) **Alternating current** :- it is the current whose magnitude & direction changes regular interval of time

(c) **varing current** :- The current where magnitude change but direction unchanges

(c) ~~steady~~ Transient current

It is a current for a very short Interval of time.

Ex :- dc ckt Concept of Capaciter

emf The force which causes the flow of electron is called emf.

→ force is nothing but energy experience on the changes.

$$\boxed{E = \frac{W}{Q}}$$

W → energy experience (Jouls)

Q → change ~~exper~~ transfered in ~~Cato~~ Coulombs.

E → emf of source.

voltage Energy ~~transfered~~ would be required of a change transfered from one point to another ckt.

→ Energy required movement of change from one ckt to ~~ckt~~ another

$$\boxed{V = \frac{W}{Q}}$$

Resistance The properties of material which oppose the flow of current.

→ Unit is (ohm) Ω

Conductance - Reciprocal of Resistance (seimen)

Unit is Seimen

Specific Resistance & Resistivity = (ρ)

~~Conductivity~~ - ~~reciprocal of Resitivity~~

Resistance of the Conductor is directly length of Conductor & Inversely proportional to the ~~Area~~ crossectional area of the Conductor.

i.e $R \propto \frac{l}{A} \Rightarrow R = \frac{\rho l}{A}$

$$\boxed{\rho = \frac{RA}{l}}$$

ρ → specific resistance.

Conductivity :- It is Reciprocal of Resistivity

$$\boxed{\gamma = \frac{1}{\rho}}$$

$\gamma \rightarrow$ conductivity

Unit siemens/meter.

Ohm's law

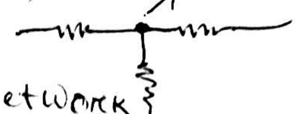
Ohm's law states that the current through any conductor is directly proportional to potential difference between its ends

$$I \propto V$$

$$I = \frac{1}{R} \cdot V \Rightarrow \boxed{V = RI}$$

Circuit : A circuit is a closed path through which electric current passed through it.

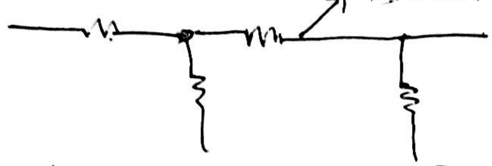
Node :- Node is a junction in a circuit where two or more ckt element are connected together. → node



Branch

Branch is a part of Network which lies between two junction.

→ Branch



loop

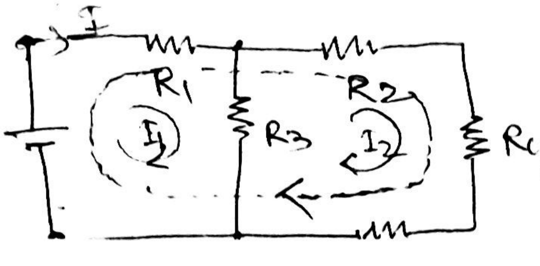
it is a closed path in a ckt in which no element or node is encountered more then once.

OR

A path which contains more then two mesh is called loop.

Mesh Any path which contains no other paths within it is called mesh

Here 6 nodes



Here 2 mesh 3 - loop

BASIC ELECTRICAL ENGG

SIGN CONVERSION

(i) 

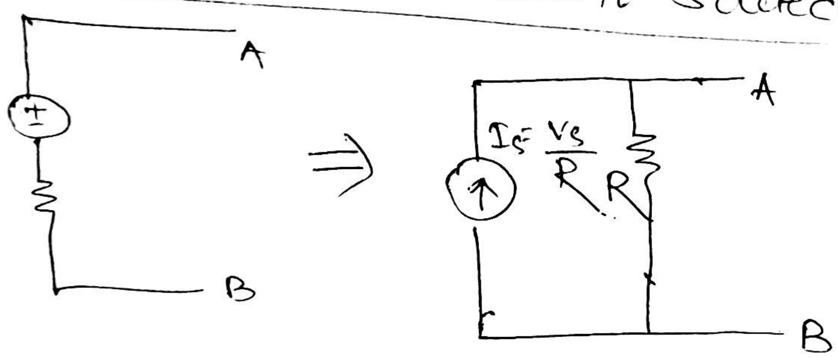
→ Fall in potential.

(ii) 

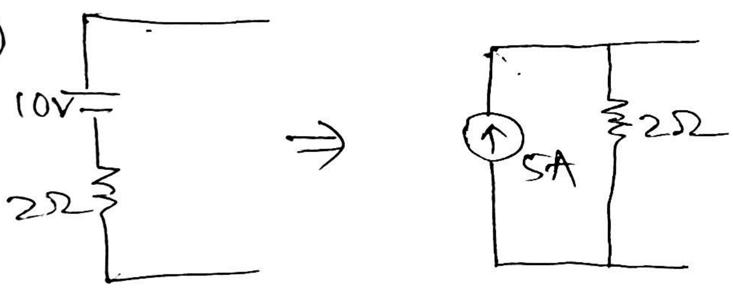
← Rise in potential

Convert

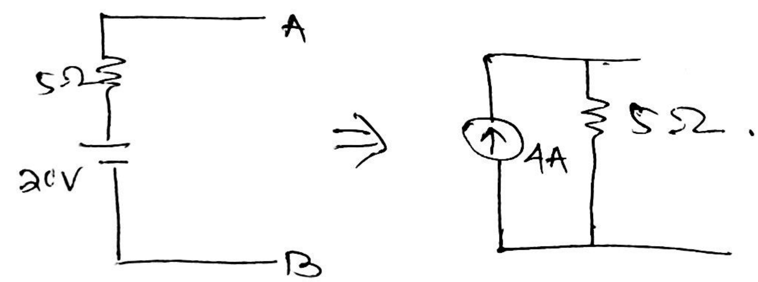
voltage source → current source



Ex (i)



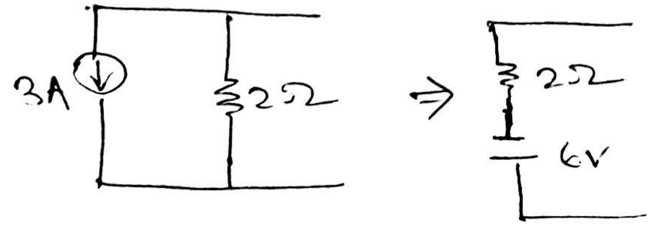
Ex (ii)



Convert

current source to voltage source

Ex (i)



Kirchoff's law

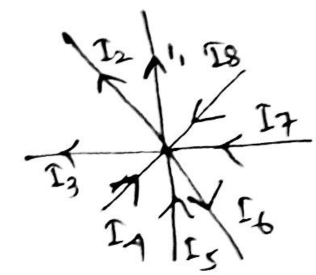
- Basically Kirchoff's two law

(1) Kirchoff's current law.

(2) Kirchoff's voltage law

Kirchoff's current law

The Algebraic sum of current meeting at any junction in an electric ckt is zero.



$$I_1 + I_2 + I_3 + I_6 = I_8 + I_7 + I_4 + I_5$$

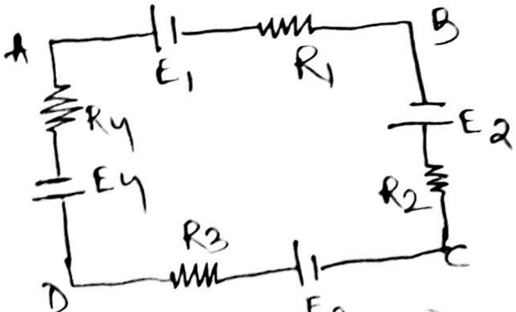
$$I_1 + I_2 + I_3 + I_6 + (-I_8) + (-I_7) + (-I_4) + (-I_5) = 0$$

$$\boxed{\Sigma I = 0}$$

Kirchoff's voltage law

In any closed ckt, the algebraic sum of the emf's and the sum of the product of current & Resistance of each part of the ckt is equal to zero.

Mathematically $\Sigma IR + \Sigma emf = 0$.

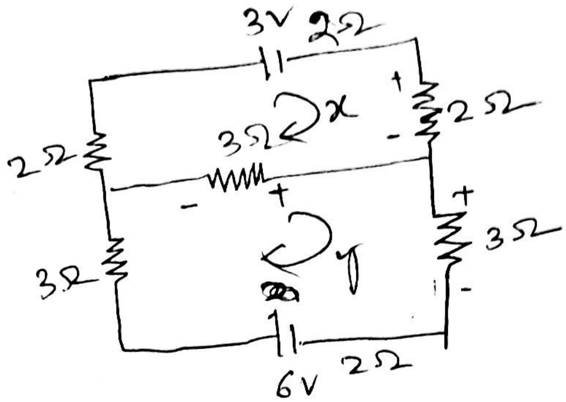


Apply KVL to the closed ckt ABCD.

$$-E_1 - IR_1 + E_2 - iR_2 + E_3 - IR_3 - E_4 - IR_4 = 0$$

Problem

(1) By Apply mesh analysis find p.d across AB,



Soln mesh - 01

$-2x - 2x - 3 - 2x - 3(x-y) = 0$

$-9x + 3y = 3$

$y = 3x + 1$ — (1)

mesh - 02

$-3(y-x) - 3y + 6 - 3y - 2y = 0$

$-11y + 3x = -6$

$11y - 3x = 6$ — (2)

Putting the value of y in eqn (2)

$11(3x+1) - 3x = 6$

$x = \frac{-5}{30} = -\frac{1}{6}$ Amp.

$y = 3x+1 = 3(-\frac{1}{6}) + 1 = \frac{1}{2}$

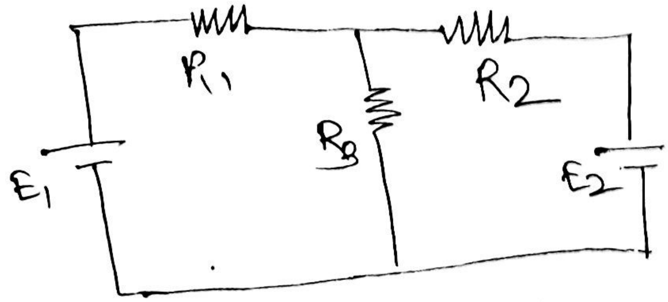
current $AB = \frac{1}{6} + \frac{1}{2} = \frac{2}{3}$ A

p.d across $AB = 3 \times \frac{2}{3}$

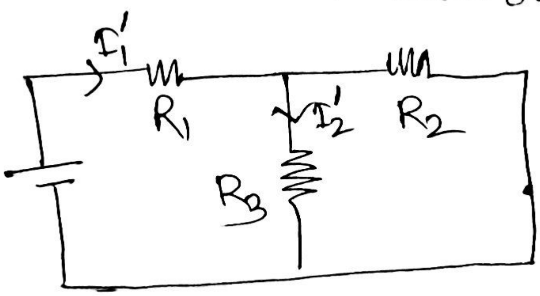
$= 2$ Volt.

Super position Theorem

Statement :- In a linear bilateral N/w containing more than one energy sources, the Resultant current in any Branch is the Algebraic sum of the currents that would be provided by each energy source acting alone.



Step-01 Consider the voltage source E_1 & source E_2 is short circuited



Let I_1' current from E_1

$$I_1' = \frac{E_1}{R_{eq}} = \frac{E_1}{(R_2 \| R_3) + R_1} \quad \text{--- (1)}$$

$$R_{eq} = (R_2 \| R_3) + R_1$$

$$= \left(\frac{R_2 R_3}{R_2 + R_3}\right) + R_1$$

$$R_{eq} = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1 + R_3} \quad \text{--- (2)}$$

Putting this value in equⁿ (1)

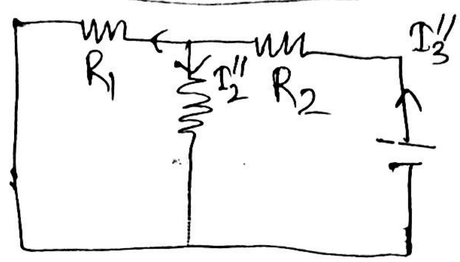
$$I_1' = \frac{E_1 (R_2 + R_3)}{R_1 R_2 + R_2 R_3 + R_3 R_1}$$

$$I_2' = I_1' \left\{ \frac{R_2}{R_2+R_3} \right\}$$

$$I_2' = \frac{E_1 \cancel{(R_2+R_3)}}{R_1R_2+R_2R_3+R_3R_1} \times \frac{R_2}{\cancel{R_2+R_3}}$$ putting the value of I_1'

$$\boxed{I_2' = \frac{E_1 R_2}{R_1R_2+R_2R_3+R_3R_1}}$$

Step-02



$$I_3'' = \frac{E_2}{R_{eq}} \quad \text{—— } (*)$$

$$R_{eq} = (R_1 \parallel R_3) + R_3 = \left(\frac{R_1R_3}{R_1+R_3}\right) + R_2$$

$$= \frac{R_1R_2+R_2R_3+R_3R_1}{R_1+R_3}$$

putting the value in equ^n (*)

$$I_3'' = \frac{E_2(R_1+R_3)}{R_1R_2+R_2R_3+R_3R_1}$$

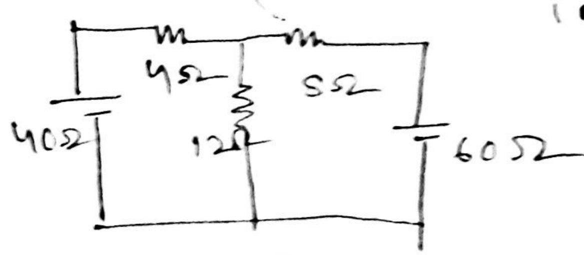
$$I_2'' = I_3'' \left\{ \frac{R_1}{R_1+R_3} \right\}$$

$$= \frac{E_2\cancel{(R_1+R_3)}}{R_1R_2+R_2R_3+R_3R_1} \times \frac{R_1}{\cancel{(R_1+R_3)}}$$

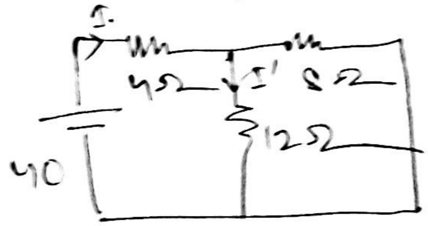
$$\boxed{I_2'' = \frac{E_2 R_1}{R_1R_2+R_2R_3+R_3R_1}}$$

$$\boxed{\text{Total current} = I_2' + I_2''}$$

Problem (SPT) Find the current 12Ω Resistor in the ckt using SPT.



Step-1

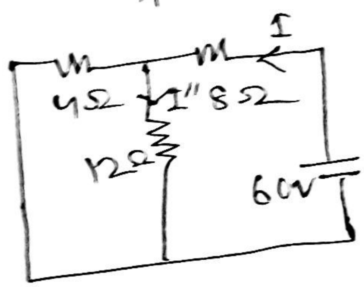


$$I = \frac{V}{R_{eq}} = \frac{40}{(12 \| 8) + 4} = \frac{50}{11} \text{ A.}$$

$$I' = \frac{50}{11}\left\{\frac{8}{12+8}\right\}$$

$$= \frac{20}{11}$$

Step-02



$$I = \frac{60}{(12 \| 4) + 8} = \frac{60}{11} \text{ Amp.}$$

$$I'' = I\left\{\frac{4}{12+4}\right\}$$

$$= \frac{\cancel{60}^{15}}{11}\left\{\frac{\cancel{4}}{\cancel{16}_{4}}\right\} = \frac{15}{11} \text{ Amp.}$$

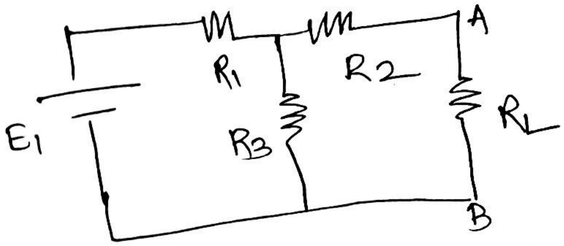
Hence total current

$$I = \frac{20}{11} + \frac{15}{11} = \frac{35}{11} = 3.19 \text{ Amp.}$$

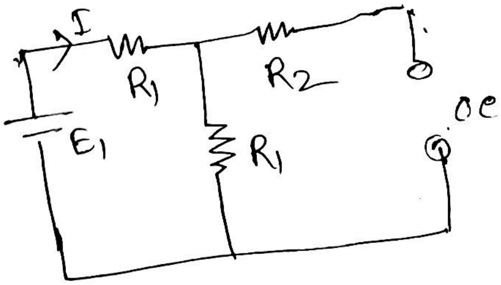
Thevenin's Theorem

Any Linear active (DC) N/W can be represen by an equivalent source called as Thevenin's Voltage (V_{TH})

Which is obtained by open ckt the load Resistance and another series resistance is Thevenin equivalent Resistance (R_{TH}) will be added to it. This Resistance being the Internal Resistance of that looking from open ckt (OC) load terminal.



Step-1



$$I = \frac{E_1}{R_1 + R_3}$$

$$V_{TH} = I R_3$$

$$= \left(\frac{E_1}{R_1+R_3}\right) R_3 = \frac{E_1 R_3}{R_1 + R_3}$$

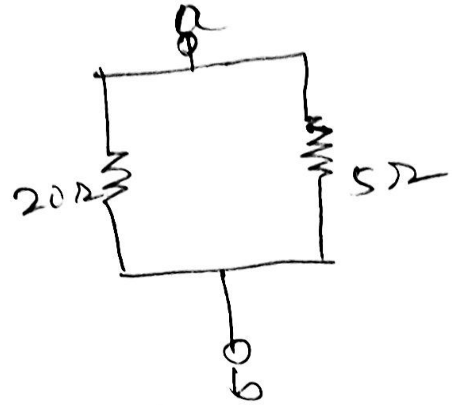
$$\boxed{V_{TH} = \frac{E_1 R_3}{R_1 + R_3}}$$

Step-02

R_{TH} found looking from the O.C load Resistance. Replacing the Battery Source.

Soln :-

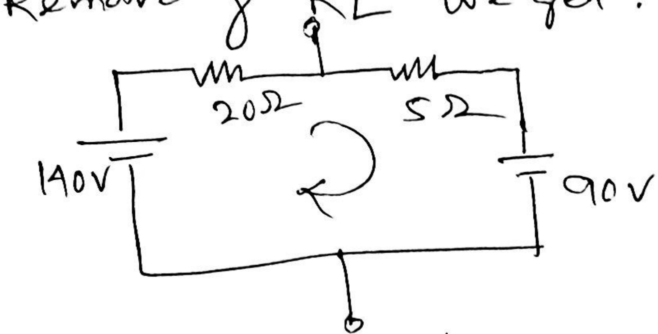
On replacing voltage source by zero internal Resistance & removing R_L



$$R_{TH} = (5 \parallel 20) = \frac{5 \times 20}{5+20} = 4\Omega.$$

Calculation V_{TH}

On Removing R_L we get.



Applying KVL we get

$$-20I - 5I - 90 + 140 = 0.$$

$$-25I = -50 \Rightarrow \boxed{I = 2A}$$

$$V_{TH} = \text{P.d across a and b}$$

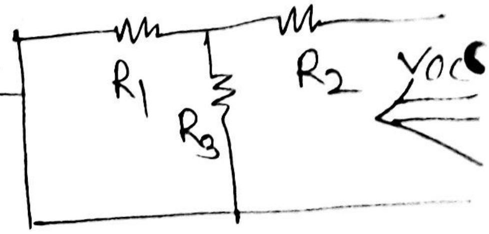
$$= 140 - 20I$$

$$= 140 - 20 \times 2 = 100$$

$$I = \frac{V_{TH}}{R_{TH} + R_L}$$

$$= \frac{100}{4+6} = \frac{100}{10} = 10A.$$

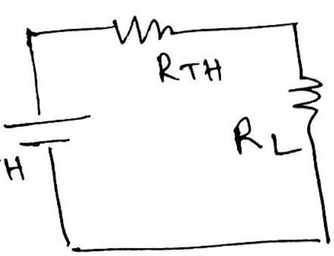
$$R_{TH} = (R_1 \parallel R_3) + R_2$$



$$= \left(\frac{R_1 R_3}{R_1 + R_3}\right) + R_2$$

$$= \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1 + R_3}$$

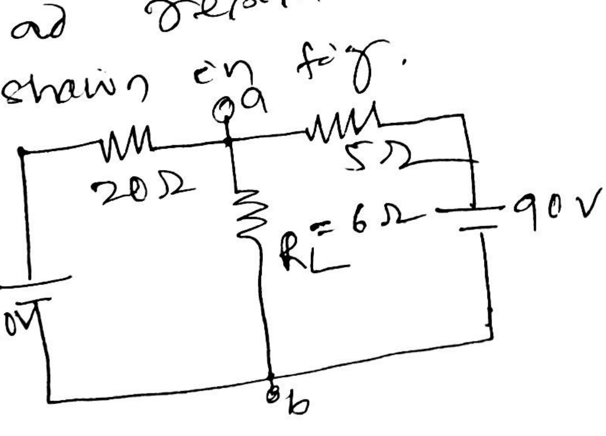
Step-03



Now Thevenin equivalent ckt to be drawn in fig.

$$\boxed{I_X = \frac{V_{TH}}{R_{TH} + R_L}}$$

Problem :- Using Thevenin's theorem determine the value of current in load resistance $R_L = 6\,\Omega$ as shown in fig.



A.C. Theory

(AC) Alternating current :- Alternating current is that current which alters both in value & direction periodically it is denoted as a.c

→ This current increase from zero to max. value & then decreases from zero to max. value & then decrease to zero. in one direction.

→ It is symbollically represent by (~)

→ AC Can be ~~converted~~ Converted by Rectifier

DC :- Direct current

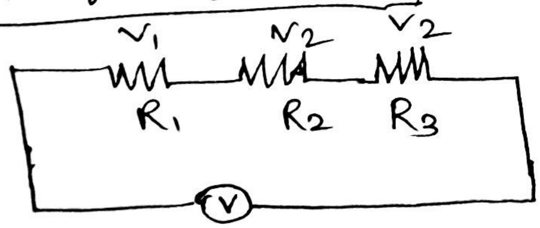
It is a current which always flow in one direction it is known as contenous current or Unidirectional current

→ It is denoted as d.c

→ It is found from battery cell.

→ DC Can be converted into AC by inverter.

voltage division



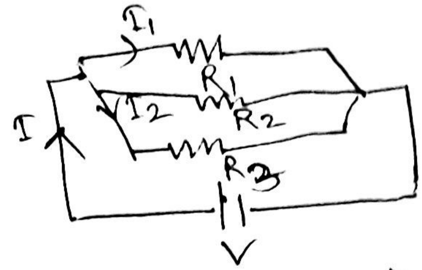
$$R_{eq} = R_1 + R_2 + R_3$$

$$V_1 = V\left\{\frac{R_1}{R_1+R_2+R_3}\right\}$$

$$V_2 = V\left\{\frac{R_2}{R_1+R_2+R_3}\right\}$$

$$V_3 = V\left\{\frac{R_3}{\quad}\right\}$$

Current division



$I \to$ main current

$$I_1 = I\left\{\frac{R_2R_3}{R_1R_2+R_2R_3+R_3R_1}\right\}$$

$$I_2 = I\left\{\frac{R_1R_3}{R_1R_2+R_2R_3+R_3R_1}\right\}$$

$$I_3 = I\left\{\frac{R_2R_3}{R_1R_2+R_2R_3+R_3R_1}\right\}$$

Question

(2) Kirchhoff's voltage law is concerned with

(a) IR drop
(b) battery emf
(c) Junction voltage.
(d) Both (a) & (b)

Ans :- (c)

* What is form factor

Ans :- It is defined as ratio of rms value to the avg. value any alternating quantity.

$$K_f = \frac{\text{r.m.s value}}{\text{avg. value}} = \frac{0.707\, I_m}{0.637\, I_m} = 1.1$$

* power in Capacitor is ______

(a) C_1V, (b) $\frac{1}{2}CV$, (c) $\frac{1}{2}CV^2$ (d) $\frac{1}{2}C^2V^2$

*

$$\boxed{C_T = \frac{1}{C_1} + \frac{1}{C_2}}$$

Question

1. In a Series RLC ckt. at Resonance the Voltage across resistor is 10V. than the Voltage across Inductor will be ___ time across the capacitor

Ans :- Equal time (In Resonance
$X_L = X_C$
$IX_L = IX_C \Rightarrow \boxed{V_L = V_C}$

2. If 1 Amp. current flowing in a ckt the number of electrons flowing through this ckt is $\underline{1.6 \times 10^{-19}}$ coulombs.

3. The practical current source ifer Ideal source Internal Resistance

4. In RC series ckt total voltage is 10V & voltage across Resistor is 6V then voltage across the Capacitor is

Ans :- $V_T = 10V$

$V_R = 6V$

$V_C = ?$

$(V_T)^2 = (V_R)^2 + (V_C)^2$

$(10)^2 = (6)^2 + (V_C)^2$

$100 = 36 + V_C^2 \Rightarrow V_C = \sqrt{64} = 8V.$

5. Resistance of Copper were of $R\,\Omega$. This were stretched to double length. New Resistance is $\left(\frac{R}{2}\right)$

Ans :- $R = \rho \frac{l}{A}$ — (1)

$R = \rho \frac{2l}{A} \Rightarrow \frac{R}{2} = \frac{\rho l}{A}$

$\Rightarrow \boxed{\frac{R}{2} = R_1}$

Convert rectangular to polar form

① Let $P = 3 + j4$ Convert to polar form.

$|P| = \sqrt{(3)^2 + (4)^2} = \sqrt{25} = 5$

$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{4}{3}\right) = \tan^{-1}(1.33)$

$= 53.13$

polar form $= 5\angle 53.13$

Convert polar form to Rectangular form

---

* Q:- $10\angle 30$

Here magnitude 10, phase angle 30

Real Compoment $= 10\cos 30°$

$= 10 \times 0.866$

$= 8.66$

Quadrature Component

$= 10\sin 30°$

$= 10 \times \frac{1}{2} = 5$

Rectangular form is

$8.66 + 5j$

(*) The avg. power in purely Inductive ckt One complete cycle is

(a) $E_{rms} I_{rms}$ (b) Zero (c) $E_{max} I_{max}$ (d) $E_{max} I_{max}/2$

(1) Define Unilateral

Ans:- Unilateral element conduct unequally in two directions.

Eg:- Vacuum diodes, metal rectifiers.

(2) Define bilateral. All elements which are [illegible]

bilateral element are those conducting equally well in two directions.

Ans:- High conductivity material.

(3) Question
In series R-L-C network are the values
R = 10Ω, L = 0.1 H & C = 0.36 μF
what is Q factor.

Ans:- $Q_0 = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{10}\sqrt{\frac{0.1}{0.36}} = \frac{1}{15}$

Question

(1) An impedance is given by 20∠30. Find resistance value.

Ans:- $Z = 20\angle 30$

$R = Z\cos\theta$
$= 20 \times \cos 30$
$= 20 \times \frac{\sqrt{3}}{2}$
$= 10\sqrt{3}$
$= 17.32\Omega$

(2) An alternating current expressed $5 + 10\sin 100\pi t$
Find avg. value & r.m.s. value

Ans :-

$$I = 5 + 10\sin 100\pi t$$

$$I_{av} = I_{dc} = 5\,Amp.$$

$$I_{rms} = \sqrt{5^2 + \left(\frac{10}{\sqrt{2}}\right)^2}$$

$$= 25 + \frac{100}{2} = \sqrt{75} = 8.6\,Amp.$$

(Q) An Impedance given by $20\angle 30$ find resistance.

Ans :- $Z = 20\angle 30$

$$R = Z\cos 30$$

$$= 20 \times \cos 30 = 20 \times \frac{\sqrt{3}}{2}$$

$$= 10\sqrt{3}$$

Q :- In Inductor of resistance 10Ω & Inductance 100 mH is in parallel with 10nF Capacitor find the resonant Angular frequency, Q-factor, & B.W.

Ans :- $R = 10\,\Omega$

$L = 100\,mH = 100 \times 10^{-3}\,H.$

$C = 10\,nF = 10 \times 10^{-9}\,F.$

$$\omega_0 = \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

$$= \sqrt{\frac{1}{100 \times 10^{-3} \times 10 \times 10^{-9}} - \frac{10^2}{(100 \times 10^{-3})^2}}$$

$= 3.16 \times 10^4$ rad/s

Q factor $= \frac{\omega_0 L}{R} = \frac{3.16 \times 10^4 \times 100 \times 10^{-3}}{10}$

$= 316$

B.W $= \frac{\omega_0}{Q} = \frac{3.16 \times 10^4}{316} = 100$ rad/sec.

Q:- Difference between parallel ckt & series ckt

Series ckt	Parallel ckt
(1) It is an acceptor ckt	(1) it is a rejector ckt.
(2) Resonant frequency $f_0 = \frac{1}{2\pi\sqrt{LC}}$	(2) same.
(3) At resonant frequency, the Impedance of the ckt minimum $Z = R$	(3) AT Resonant frequency the Impedance Z of the ckt is max,
(4) $X_L = X_C$	(4) Inductive Susceptance = Capacitive Susceptance.

Question

Ex — A 10 Ω resistance of 15.9 mH Inductor & 159 μF capacitor are connected in parallel 200 V supply of 50 Hz. Calculate current & power factor.

Ans:- $X_L = WL$

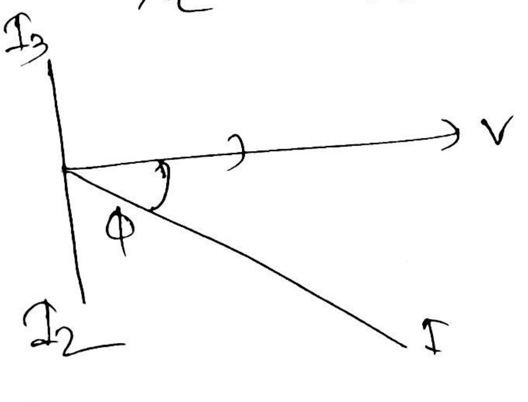
$= 2\pi f L = 2\pi \times 50 \times 15.9 \times 10^{-3}$

$= 5\Omega$.

$I_1 = \frac{V}{R} = \frac{200}{10} = 20A$.

$I_2 = \frac{V}{X_L} = \frac{200}{5} = 40A$.

$I_3 = \frac{V}{X_C} = \frac{200}{20} = 10A$.



According phasor diagram.

$I = \sqrt{I_1^2 + (I_2 - I_3)^2}$

$= \sqrt{(20)^2 + (40-10)^2} = 36A$.

$P.F = \cos\phi = \frac{I_1}{I}$

$= \frac{20}{36} = 0.56$ lag

Q. Under what condition ckt is said to be Resonance

Ans :- $X_L - X_C = 0$

Or $\boxed{\text{Net reactance} = 0}$

Q) what is Power factor

Ans :- ratio of Resistance to the Impedance

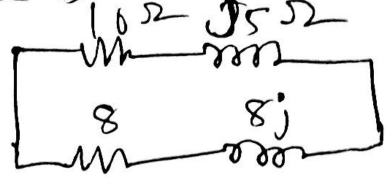
$$\cos\phi = \frac{R}{Z}$$

→ It has no Unit.

Q :- what is the effect of low power factor

Ans :- Draw more current.

Q :- Two Impedance $Z_1 = (10 + j5)$
$Z_2 = 8 + j6$ are connected
across the voltage $V = 200 + j0$
Calculate ckt current ; its phase & branch current.



Soln

Branch A

$$Y_1 = \frac{1}{Z_1} = \frac{1}{10 + j5}$$

$$Y_1 = \frac{10-j5}{(10+j5)(10-j5)}$$

$$Y_1 = \frac{10-j5}{100+25} = 0.08 - j0.04 \text{ Siemens.}$$

Branch - B

$$\frac{1}{Z_2} = \frac{1}{8+j6}$$

$$= \frac{8-j6}{(8+j6)(8-j6)}$$

$$Y_2 = \frac{8-j6}{64+36} = 0.08 - j0.06 \text{ Siemens}$$

$$Y_0 = (0.08 - j0.04) + (0.08 - j0.06)$$

$$= 0.16 - j0.1 \text{ Siemens.}$$

$$V = 200\angle 0^\circ = 200 + j0$$

$$I = VY = (200+j0)(0.16 - j0.1)$$

$$= 32 - j20 = 37.74\angle -32^\circ$$

$$I_1 = VY_1 = (200+j0)(0.08 - j0.04)$$

$$= 16 - j8 = 17.88\angle -26.32$$

$$I_2 = VY_2 = (200+j0)(0.08 - j0.06)$$

$$= 16 - j12 = 20\angle -36^\circ.46$$

Q:- An alternating ~~current~~ voltage. $V = 200\sin(314t)$ what will be effective value of voltage.

Sol^n) $V_m = 200$

$$V_{effective} = V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$= \frac{200}{\sqrt{2}} = 100\sqrt{2} = 141.4 \text{ volt.}$$

Q:- A series RLC Ckt which Resonants at $f_0 = 500$ KHZ has. $L = 100\mu H$, Resistance $25\,\Omega$ & Capacitance $1000\,pF$. find Quality factor

Ans:- $$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$= \frac{1}{25}\sqrt{\frac{100 \times 10^{-6}}{1000 \times 10^{-12}}}$$

$$= 12.6$$

STUDY MATERIAL

SUBJECT : BASIC ELETRICAL ENGG. (BEE)

(MODULE – II)

SEMESTER : 1ST /2ND

BRANCH : MECH/CE/EE/EEE/CSE/ETC

DEPARTMENT OF ELECTRICAL ENGINEERING

SRINIX COLLEGE OF ENGINEERING, BALASORE

(www.srinix.org)

Basic Electrical Engg

module. 02

(1) In a 3-ϕ Balance load wattmeter. read 2000 watts and 500 watts respectively find p.F of the ckt?

Ans :-

$$W_1 + W_2 = 2000 + 500 = 2500W.$$

$$W_1 - W_2 = 2000 - 500 = 1500W.$$

$$\tan\theta = \sqrt{3} \left\{ \frac{W_1 - W_2}{W_1 + W_2} \right\}$$

$$= 1.73 \left\{ \frac{1500}{2500} \right\}$$

$$\tan\theta = 1.0392$$

$$\theta = \tan^{-1}(1.0392) = 46.6^{\circ}$$

$$\cos\theta = 0.6394$$

(2) Difference between Star & Delta System -

Ans -

Stare Connection	Delta Connection
(1) Y connection neutral is available	(1) neutral is not available.
(2) power(W) = $\sqrt{3} V_L I_L \cos\theta$	(2) powere = $\sqrt{3} V_L I_L \cos\theta$.
(3) Line voltage $\sqrt{3}$ time more than phase voltage $V_L = \sqrt{3} V_p$	(3) Line voltage & phase voltage is same. $V_L = V_p$
(4) Line current & phase current is same. $I_L = I_p$	(4) line current is $\sqrt{3}$ times more than phase current. $I_L = \sqrt{3} I_p$.
(5) Two types of voltage is available. i.e between phase & neutral &	(5) only single voltage is available.

(4) What are different methods to measure 3-ϕ power.

Ans:- (1) Single wattmeter method.

(2) Two wattmeter method.

(3) 3-wattmeter method.

(5) What do you mean by Balanced & Unbalanced load.

Ans:- When the current in each phase is equal then it is a Balanced load. & if not equal it is Un Balanced load.

(6) What is the relation between line & phase current in case of Delta Connection.

Ans:- In Delta Connection, line current equal to $\sqrt{3}$ time of phase current.

$$\boxed{I_L = \sqrt{3}\, I_P}$$

(7) How the power factor can be calculated by two wattmeter method.

Ans:- $\cos\theta = \sqrt{3}\left\{\dfrac{W_1 - W_2}{W_1 + W_2}\right\}$

(8) Write down formula for power in star & Delta Connection.

Ans:- In Star Connection.

Power $= \sqrt{3}\, V_L I_L \cos\theta$.

In case of Δ Connection.

power = $\sqrt{3} V_L I_L \cos\theta$.

(9) Define phase voltage

Ans:-→ The voltage across single phase. is Called phase voltage.

→ It always measure between phase & neutral.

→ symbol is (V_P)

(10) Define. phase current?

Ans:- The current flowing in any one phase is Called phase current.

→ Symbol is I_P.

(11) Define Line voltage.

Ans:- The voltage across two phase. is called Line voltage.

→ It alway measure between. two phase.

→ It always more than phase voltage.

→ Symbol is (V_L)

(12) Define line current?

Ans:- The current flow in each line. Called as line current

→ in (Y) Connection.

$\boxed{I_{ph} = I_{line}}$

(Q) Three Impedances each having Resistance of 30Ω of Inductive reactance 15Ω are connected on 400V - 3φ supply. Calculate (i) line current, power factor & power consume?

Ans:- $Z_{ph} = 30 + j15\ \Omega$.

$V = 400V$.

$V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 231V$.

$I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{231\angle 0}{30 + j15}$

$= 6.80 \angle -26.56$

In Star Connection.

$I_{ph} = I_L = 6.80$ Amp.

(ii) power factor = $\cos\theta$

$= \cos(26.56)$

$= 0.894$

(iii) power Consume = $\sqrt{3}\, V_L I_L \cos\theta$

$= \sqrt{3} \times 400 \times 6.80 \times 0.89$

$= 4261$ watt.

(14) 3 equal Independence having resistance 25Ω of reactance of 400Ω are Connected in Star. to a 400V, 3-ϕ, 50HZ System. Calculate

(1) phase current.

(2) Line current.

(3) power factor.

(4) power Consume

Given Data.

Ans:- $Z = 25 + j\,400$

$V_L = 400V$.

$f = 50HZ$.

$$V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 230.92V.$$

$$I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{230.92\angle 0}{25 + j400}$$

$$I_{ph} = 0.573\angle -86.42.$$

$$\boxed{I_{ph} = I_L}$$

(ii) $I_L = 0.573\,Amp.$

(iii) power factor $\cos\theta = \cos(86.42)$

$= 0.062$

(iv) power Consume.

$= 3 \times V_{ph} \times I_{ph} \times \cos\theta.$

$= 3 \times 230.92 \times 0.573 \times 0.062$

(15) A Delta Connection. Balanced 3ϕ load is supply from. 3-ϕ, 400v supply. If line current is 20 Amp. & power consumed by the load 10KW. Then. find (1) Phase current. ~~...~~

(2) power factor.

(3) power consume of the same load connection in star

Ans:-

$V_L = 400v.$

$I_L = 20 \text{ Amp}.$

$\text{Power} = 10 \times 10^3 \text{ watt}$

$$I_{ph} = \frac{I_L}{\sqrt{3}} = \frac{20}{\sqrt{3}} = 11.54 \text{ Amp}.$$

$$P = \sqrt{3} \times V_L \times I_L \cos\phi.$$

$$10 \times 10^3 = \sqrt{3} \times 400 \times 20 \times \cos\phi.$$

$$\cos\phi = \frac{10 \times 10^3}{\sqrt{3} \times 400 \times 20}$$

$$\cos\phi = 0.721$$

$V_{ph} = 400V$

$$\boxed{V_L = V_{ph}}$$

$$Z_{ph} = \frac{V_{ph}}{I_{ph}} = \frac{400}{11.54} = 34.66\Omega$$

3φ load
upply.
10KW
Then.

in Y Connection

$V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{400}{\sqrt{3}} = 230.94$

$I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{230.94}{34.66}$

$= 6.66 \text{ Amp}$.

If the
on. in star.

$\text{Power} = 3 \times 230.94 \times 6.66 \times 0.721$

$= 3.326 \text{ KW}$.

(16) Three Identical Coils are Connected in star Connection. 400V. 50 HZ, 3-φ supply. each coil. Consuming 300 W. of the power factor 0.8 lag. Calculate.

1Amp.

(1) Line current.

φ.

(2). Impedance.

(3) Resistance. & Inductance.

G.D
Ans:- $V_L = 400 V$.

$f = 50 HZ$.

$\text{Power} = 300 W$.

$\cos\phi = 0.8 \text{ lags}$.

$I_{ph} = \frac{V_L}{\sqrt{3}}$

:652

$= \frac{400}{} = 230.92 \text{ Volt}$.

$$(\text{Power})_{ph} = I_{ph} \times V_{ph} \times \cos\phi.$$

$$= \frac{300}{230.92 \times 0.8}$$

$$\boxed{I_{ph} = 1.62 \text{ Amp}}$$

In Star Connection.

(1) $I_L = I_{ph}.$

$I_L = 1.62 \text{ Amp}.$

(2) $Z_{ph} = \frac{V_{ph}}{I_{ph}} = \frac{230.92}{1.62} = 142.54$

(3) $\cos\phi = \frac{R}{Z}$

$R = \cos\phi \times Z$

$= 142.54 \times 0.8 = 114\Omega.$

~~X_L~~ $\sin\phi = \frac{X_L}{Z}$

$X_L = Z\sin\phi.$

$= 142.54 \times \sin(\cos^{-1} 0.8)$

$= 85.52\Omega.$

$Z_{ph} = (114 + j85.52)\Omega$

: cos ϕ.

7) Three similar coil each having Resistance 10 Ω & Capacitance of 20 μF are connected in delta to 400 V, 3-ϕ. 50 HZ supply. Calculate line current & total power absorbs.

Ans:- Capacitive Reactance.

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$$

$$= \frac{1}{2\pi \times 50 \times 200 \times 10^{-6}}$$

$$= 15.97\ \Omega.$$

$2 = 8142.54$

$$R_{ph} = 10\ \Omega.$$

$$Z_{ph} = \sqrt{R^2 + X_C^2}$$

$$= \sqrt{10^2 + 15.97^2} = 18\ \Omega$$

$$\text{power factor} = \frac{R_{ph}}{Z_{ph}}$$

$$= \frac{10}{8} = 0.55.$$

$5.8 = 114\ \Omega.$

phase voltage = 400 v = V_{ph}.

$$I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{400}{18}$$

$\sin(\cos^{-1} 0.8)$

$$= 22.22\text{A}.$$

2.

$$I_L = \sqrt{3}\, I_{ph} = \sqrt{3} \times 22.22$$

$$= 38.48\text{ A}.$$

Power absorbed = $\sqrt{3}\, V_L I_L \cos\phi$.

$$= \sqrt{3} \times 400 \times 38.48 \times 0.55$$

(18) A Balanced, 3-ϕ Star Connected load of 450 kW. takes a leading current of 100A. With a line Voltage 110V, 50Hz. Find the ckt Constants of the load per phase.

Ans:- $Z_{ph} = \dfrac{V_{ph}}{I_{ph}} = \dfrac{\frac{1100}{\sqrt{3}}}{100}$

$= 6.35\Omega.$

$\text{power/phase} = I^2R = \dfrac{450\,kW}{3}$

$= 150\,kW.$

$(100)^2 \times R = \dfrac{150 \times 10^3}{3}$

$R = \dfrac{150 \times 10^3}{3 \times (100)^2}$

$= 5\Omega.$

$X = \sqrt{Z^2 - R^2}$

$= \sqrt{(6.35)^2 - (5)^2}$

$= 3.9\Omega.$

connected.
leading
line.
he ckt.
phase.

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

$$3.9 = \frac{1}{2\pi f \times C}$$

$$\cancel{C = 3.9 \times 2\pi \times 50}$$

$$C = \frac{1}{2\pi \times 50 \times 3.9}$$

$$= 810\ \mu F.$$

(19) Three similar Coil each having a resistance 10Ω & Inductance of $0.04H$. are Connected in Star Connection & Delta Connection. 400V, 3-ϕ, 50 Hz. Supply. Calculate line current, phase current, Power factor, Total power absorbed ?

Ans:- $R = 10\Omega$

$L = 0.04\ H.$

$$Z_{ph} = R + jX_L$$

$$= R + j\omega L$$

$$= 10 + j(2\pi f)L$$

$$= 10 + j12.56,$$

$$Z_{ph} = \sqrt{(10)^2 + (12.56)^2}$$

$$= 16\Omega.$$

$\frac{150\ kW}{3}$

03

$0)^2$

$$I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{\frac{V_L}{\sqrt{3}}}{Z_{ph}}$$

$$= \frac{\frac{400}{\sqrt{3}}}{16} = 14.4A.$$

$$I_L = I_{ph} = 14.4A.$$

$$\text{power factor} (\cos\phi) = \frac{R_{ph}}{Z_{ph}}.$$

$$= \frac{10}{16} = 0.625$$

$$\text{Power} = \sqrt{3}\, V_L I_L \cos\phi.$$

$$= \sqrt{3} \times 400 \times 14.4 \times 0.625$$

$$= 6235.2 \text{ watt}$$

<u>Delta</u>

$$V_L = 400V = V_{ph}.$$

$$I_{ph} = \frac{V_{ph}}{Z_{ph}} = \frac{400}{16} = 25A$$

$$\text{Line current } I_L = \sqrt{3} \times I_{ph}.$$

$$= \sqrt{3} \times 25$$

$$= 43.3A.$$

$$\text{power Absorbed} = \sqrt{3}\, V_L I_L \cos\phi.$$

$$= \sqrt{3} \times 1...$$

STUDY MATERIAL

SUBJECT : BASIC ELETRICAL ENGG. (BEE)

(MODULE – III)

SEMESTER : 1ST /2ND

BRANCH : MECH/CE/EE/EEE/CSE/ETC

DEPARTMENT OF ELECTRICAL ENGINEERING

SRINIX COLLEGE OF ENGINEERING, BALASORE

(www.srinix.org)

What is Residual magnetism?

Ans :- The magnetism remain in the magnetic material after removing the magnetizing force is called Residual Magnetism.

→ When current is passed through a coil wound on a soft iron. it will become magnet & when current is reduced to zero, there is still some magnetism left in the soft iron piece that is called residual magnetism

→ Define Magnetic flux density?

Ans :- Magnetic flux per unit area is called Magnetic flux density.

→ It is denoted as B

→ $B = \frac{\text{Magnetic flux}}{\text{Area}} = \frac{\phi}{A}$

→ Unit is Wb/m^2

→ Define MMF?

Ans :- It is a force which drives the magnetic lines of force in a magnetic field

→ Unit is Ampere' turn.

Q :- Find the Reluctance of a magnetic field having core length 50 cm & crosssectional area $10\ cm^2$. Assume relative permeability 1500 for the core.

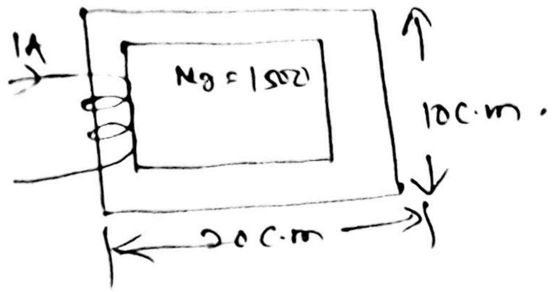
Soln

$$\text{Reluctance} = (R) = \frac{l}{\mu A} = \frac{l}{\mu_0 \mu_r A}$$

$$= \frac{l}{4\pi \times 10^{-7} \times 1500 \times 10 \times 10^{-4}} = 2.65 \times 10^5\ AT/Wb$$

2)

Example :- find the net magnetic flux in the core for simple magnetic ckt shown in fig. Assume that the core has uniform crossection throughout equal to 1 cm^2. The coil has 200 turns.



$$l = 20 + 10 + 20 + 10 = 60\,cm = 0.6\,m.$$

$$A = 1\,cm^2 = 10^{-4}\,m^2$$

$$\mu = \mu_0 \mu_r = (4\pi \times 10^{-7}) \times 1500 = 6\pi \times 10^{-4}\ H/m$$

$$R = \frac{l}{\mu A} = \frac{0.6}{6\pi \times 10^{-4} \times 10^{-4}}$$

$$= 3.18 \times 10^{6}\ AT/Wb.$$

$$mmf = NI = 200\,AT$$

$$\phi = \frac{mmf}{R} = \frac{200}{3.18 \times 10^{6}} = 62.9 \times 10^{-6}\,wb$$

Ex :- A coil is would uniformly with 300 turn over a steel ring of relative permeability 900 having a mean circumference 40 cm & crossectional Area of 5 cm^2. If the coil has resistance 100 Ω & is connected to 230v dc supply. Calculate (i) mmf (ii) field strength (iii) Reluctance of ring (iv) permeance.

Sol^n

Current carrying by a coil $(I) = \frac{V}{R} = \frac{250}{100} = 2.5A$

(i) mmf of coil = $NI = 300 \times 2.5 = 750 AT$.

(ii) field strength $= (H) = \frac{NI}{l} = \frac{750}{0.4} = 1875\ AT/m$.

(iii) flux density $B = \mu_0 \mu_r H$

$= 4\pi \times 10^{-7} \times 900 \times 1875$

$= 2.12\ Wb/m^2$

Total flux $(\phi) = B \times a = 2.12 \times 5 \times 10^{-4}$

$= 10.6 \times 10^{-4} Wb$

(iv) Reluctance $= S = \frac{mmf}{flux}$

$= \frac{750}{10.6 \times 10^{-4}}\ AT/Wb.$

(v) permeance $= \frac{1}{S} = \frac{1}{70.75 \times 10^{4}}$.

$= 1.4 \times 10^{-6}\ Wb/AT.$

Q:- Find the Number of turn required to produce a flux density of 2T in the core of mean magnetic length of 260cm when the coil carries a current of 5A. Assume the permeability of the core is 1000.

Sol^n :- $N = ?$ $B = 2$ tesla. $l = 20c.m.$

$I = 5A$ $\mu_r = 1000.$

We know that field strength $H = \frac{B}{\mu}$

$H = \frac{B}{\mu_0 \mu_r} = \frac{B}{4\pi \times 10^{-7} \times 1000}$

$= \frac{2 \times 10^{-7} \times 10^{-3}}{4\pi}$

$= \frac{1}{2\pi} \times 10^{-4} \frac{AT}{m}.$

A)

but

$$H = \frac{NI}{l}$$

$$\frac{1}{2\pi} \times 10^4 = \frac{N \times 5}{20 \times 10^{-2}}$$

$$\Rightarrow N = \frac{10^4 \times 20 \times 10^{-2}}{2\pi \times 5} = 64$$

Q:- Define Relative permeability?

Ans:- The ratio of the absolute permeability of magnetic material to the absolute permeability of non-magnetic material is called Relative permeability?

→ it is denoted as μ_r

→ $$\boxed{\mu_r = \frac{\mu}{\mu_0}}$$

Q:- An Iron ring has mean circumference length 20cm & Crosssectional of 1 cm². It is would with 100turns. Uniformely & Carries a current of 0.05A. The flux is 3 μweber. find (a) flux density

(b) field Intensity

(c) permeabity

(d) Relative permeability.

(e) Reluctance.

<u>Sol</u>

Soln :-

$l = 20cm = 0.2m.$

$A = 1cm^2 = 1 \times 10^{-4} m^2$

$I = 0.05 Amp.$

flux $\phi = 3\mu weber = 3 \times 10^{-6} weber.$

$N = 100$ turn.

Soln

Flux density $B = \dfrac{\text{flux}}{\text{Area of cross section}}$

$$= \frac{3 \times 10}{1 \times 10^{-4}} = 0.03\, wb/m^2$$

Field Intensity $= H = \dfrac{NI}{l} = \dfrac{100 \times 0.05}{0.2} = 25\, AT/m.$

permeability $(\mu) = \dfrac{B}{H}$

$$= \frac{0.03}{25} = 1.2 \times 10^{-3} \text{ henery/m}$$

Relative permeability

$$\mu_r = \frac{\mu}{\mu_0} = \frac{1.2 \times 10^{-3}}{4\pi \times 10^{-7}} = 954.92.$$

Reluctance

$$= \frac{25}{3 \times 10^{-6}} = 8.33 \times 10^{6}\, AT/web.$$

Q) Determine the flux density at a point 60 mm. in air form a long straight conductor carrying a current of 500A.

Soln

$d = 60\,mm = 60 \times 10^{-3} m$

$I = 500A.$

$$H = \frac{I}{A} = \frac{500}{2\pi d} = \frac{500}{2\pi \times 60 \times 10^{-3}}$$

$$B = \mu_0 H = 4\pi \times 10^{-7} \times \frac{500}{2\pi \times 60 \times 10^{-3}}$$

$$= 1.67 \times 10^{-3}\, T$$

Q: A coil of Insulated wire of 500 turns & of Resistance 4Ω is closely wound on an Iron ring. The ring has a mean diameter 0.25m & Uniform crosssectional area of 700 mm². calculate total flux in the ring when a d.c supply at 6 V. is applied to the end of the winding. Assume a relative permeability of 550.

Soln

$$I = \frac{V}{R} = \frac{6}{4} = 1.5A.$$

$N = 500$, $l = \pi d = \pi \times 0.25 m.$

$a = 700 mm^2 = 700 \times (10^{-3} m)^2 = 700 \times 10^{-6} m^2$

$= 7 \times 10^{-4} m^2$

$$H = \frac{IN}{l} = \frac{1.5 \times 500}{\pi \times 0.25} = 955 A/m.$$

$B = \mu_0 \mu_r H = 4\pi \times 10^{-7} \times 550 \times 955$

$= 0.66 T$

$\phi = Ba = 0.66 \times 7 \times 10^{-4}$

$= 0.462 mWb.$

Q:- Define ohm's law in Magnetic ckt & Electric ckt.

Ans:- magnetic ckt $= \frac{mmf}{Reluctance}$

$$\boxed{Current = \frac{mmf}{Resistance}}$$

The Electric ckt -

Q:- A mild steel ring having crossectional area of 500mm² & mean circumference of 400mm has coil of 200 turns wound uniformly over it. Calculate (a) Reluctance of the ring (b) current to produce 80 μ weber in the ring. Assume relative permeability of the material 1000.

Soln Reluctance $S = \frac{l}{\mu_0 \mu_r A}$

$$= \frac{1}{4\pi \times 10^{-7} \times 100 \times 500 \times 10^{-6} m^2}$$

$$= 63.6 \times 10^{4} AT/Wb.$$

$$\text{current}(NI) = \frac{mmf}{N} = \phi S$$

$$\Rightarrow NI = mmf = \phi S$$

$$\Rightarrow NI = \phi S$$

$$I = \frac{\phi S}{N} = \frac{80 \times 10^{-6} \times 63.6 \times 10^{4}}{200}$$

$$= 2.54 A.$$

Q:- What are factor on which the reluctance depends.

Ans:- (1) Directly proportional to the length of flux path.

(2) Inversely proportional to Crossectional Area.

(3) $S = \left(\frac{l}{\mu_0 \mu_r A}\right) AT/web.$

* What are the classes of maget

Ans:- magnets are classified into two classes

(a) permanent magnet

(b) Electro-magnet.

Q:- Application of Biot - savart law

(1) magnetic field strength due to a finite length of wire.

(2) Magnetic field strength along the axis of a square coil.

(3) magnetic force on the axis of circular coil.

Q - Define Ampere turn

Ans:- → It is the unit of mmf

→ It given by the product of number of turn of magnetic ckt and the current in ampere in those turn.

$$\boxed{AT = H \times l}$$

Q - Difference between Electric ckt & magnetic ckt.

Magnetic ckt	Electric ckt
(1) flux = $\frac{mmf}{Reluctance}$	→ current = $\frac{emf}{resistance}$
→ mmf is AT	→ emf is volt.
→ fluxdensity (wb/m^2)	→ current density (A/m^2)
→ Reluctance $= \frac{l}{\mu A}$	→ Resistance $R = \rho \frac{l}{A}$
→ permeability $= \frac{1}{Reluctivity}$	→ Conductivity $= \frac{1}{Resistivity}$

STUDY MATERIAL

SUBJECT : BASIC ELECTRICAL ENGINEERING (BEE)

(MODULE – IV)

SEMESTER : 1ST / 2ND

[ALL BRANCHES]

CONTENTS :

DEPARTMENT OF ELECTRICAL ENGINEERING

SRINIX COLLEGE OF ENGINEERING, BALASORE

(www.srinix.org)

module - 04

Q:- A 10KVA 1ϕ transformer has correct turn ratio of 300/23. The primary is connected to 1500V, 60HZ supply. Find the secondary voltage on open ckt & approximately value of the current of two winding on full load. Find the max. value of the flux.

Ans:- We know that

$$E_2 = \frac{N_2}{N_1} \times E_1$$

i/p voltage = 10 KVA = 10×10^3 V.

$$= \frac{23}{300} \times 1500 = 115 \text{ volt.}$$

$$I_1 = \frac{\text{i/p KVA}}{V_1} = \frac{10{,}000}{1500} = 6.67 \text{ A.}$$

$$I_2 = \frac{V_1}{V_2} \times I_1 \Rightarrow \frac{10000}{1500} \times 6.67 = 87 \text{ A.}$$

$$\text{max flux } \phi_m = \frac{E_1}{4.44 f N_1}$$

$$= \frac{1500}{4.44 \times 60 \times 300}$$

$$= 18.75 \text{ mwb.}$$

Q:- The maximum flux density in the core 250/3000 volt, 50HZ single phase transformer 1.2 wb/m2. If the emf per turn is 8 volt. determine primary & secondary turns area of the core.

<u>Soln</u>

$E_1 = 250$,

$E_1 = N_1 \times$ emf induced / turn.

$$N_1 = \frac{250}{8} = 32$$

$N_2 = \frac{3000}{8} = 375$

(11) $E_2 = 4.44 f N_2 B_m \times A$.

$3300 = 4.44 \times 50 \times 375 \times 1.2 \times A$.

$$\boxed{A = 0.03 m^2}$$

Q:- Calculate in the two winding of 1-ϕ fully loaded Transformer of 1000/200V, 25 KVA rating, Nelect no load current in. Transformer.

Sol Given:

$V_1 = 1000V, \quad V_2 = 200V$

$V_1 I_2 = 25KVA$
$= 25000 VA$.

$I_1 = \frac{V_1 I_1}{V_1} = \frac{25000}{1000} = 25A$.

$I_2 = \frac{V_2 I_2}{V_2} = \frac{25000}{200} = 125A$.

Q:- The primary winding of a 1-ϕ Transformer is connected to a 220V, 50 HZ supply. The secondary winding has 2000 turns. If the max. value of the core flux 0.003 wb, Determine (a) no of turns in the primary winding (b) induced emf in secondary winding.

Sol :- $V_1 = 220V, f = 50HZ, \phi_m = 0.003wb$

$N_2 = 2000$

$E_1 = 4.44 f \phi_m N_1$

$\Rightarrow N_1 = \frac{220}{4.44 \times 50 \times 0.003} = 330$ turns.

Since $\frac{E_2}{E_1} = \frac{N_2}{N_1}$

$$E_2 = \left(\frac{N_2}{N_1}\right) E_1$$

$$= \left(\frac{2000}{330}\right) \times 220 = 1333v.$$

Ex :- The eddy current loss in an iron core is 1KW. when excited 200V, 50 Hz supply what will be the loss when supply frequency changed 25 HZ

Soln

$$\left(\frac{W_e}{W_e'}\right) = \left(\frac{f}{f'}\right)^2$$

G.D

$W_e = 1 KW$

$= 1 \times 10^3 W$

$$\Rightarrow \left(\frac{W_e}{W_e'}\right) = \left(\frac{\cancel{50}^{2}}{\cancel{25}}\right)^2$$

$$\Rightarrow \left(\frac{W_e'}{W_e}\right) = \left(\frac{1}{2}\right)^2$$

$$\Rightarrow \frac{W_e'}{W_e} = \frac{1}{4}$$

$$\Rightarrow W_e' = \frac{1 \times 10^3}{4} = \frac{1000}{4} = 250 \text{ Watt}$$

Ex :- A 3300/230, 50 HZ, 1-ϕ- Transformer is to be worked at maximum flux density of 1.2T in core. The effective crossectional area of a core $150 m^2$. Calculate suitable value primary & secondary turns.

$E_1 = 3300$

Ans :-

$$E_1 = 4.44 B_m A f N_1$$

$$N_1 = \frac{E_1}{4.44 \times B_m \times A \times f}$$

$$= \frac{3300}{\ldots}$$

$= 826$ turns.

$$\frac{E_2}{E_1} = \frac{N_2}{N_1} \Rightarrow N_2 = \frac{230}{3300} \times 826$$

$$= 58 \text{ turn.}$$

Q:-3 Define slip

Ans:- The difference between synchronous speed & rotor speed is called slip.

→ It is denoted as 's'

$$\% \text{ slip} = \frac{\text{Synchronous speed} - \text{Rotor speed}}{\text{Synchronous speed}} \times 100$$

$$\boxed{\% \, s = \frac{N_s - N_r}{N_s} \times 100}$$

Ex A 8 pole alternator runs at 750 rpm. & supplies power to 6 pole Induction motor. which has full load slip 3%. Find the full load speed of the Induction motor.

Soln Number of poles of alternator = 8
Speed = 750 rpm.

$$f = \frac{P \times N}{120} = \frac{8 \times 750}{120} = 50 \text{ cycle/sec.}$$

Supply frequency = 50 cycle/sec

Now the slip = 3% = 0.03

$$N_s = \frac{120 \times f}{P} = \frac{120 \times 50}{6} = 1000 \text{ rpm.}$$

rotor speed = $N_r = N_s(1-s)$

$$= 1000\,(1-0.03)$$

$$= 970 \text{ rpm.}$$

Q:- A 100 KVA, 6600/440V, 50 Hz, 1-ϕ Transformer 80 turn on low voltage winding Calculate.

(a) max. flux in a core.

(b) The number of turns on the high-voltage winding

(c) The current in each winding

Soln

$$E_2 = 4.44\,\phi_m f N_2$$

$$\phi_m = \frac{440}{4.44 \times 50 \times 80} = 24.8 \text{ mWb.}$$

or $$\frac{440}{6600} = \frac{80}{N_1}$$

$$N_1 = 1200 \text{ turns.}$$

$$I_1 = \frac{100\,KVA}{6600} = \frac{1000}{66} = 15.15A.$$

IV

$$\frac{I_1}{I_2} = \frac{V_2}{V_1} \therefore I_2 = I_1 \times \frac{V_1}{V_2}$$

$$= 15.15 \times \frac{6600}{440} = 227.27$$

* Difference between practical Transfer and Ideal Transformer

Ans

Practical T/F	Ideal Transformer
(1) Winding Resistance present	(1) Winding resistance neglected.