Index

Name: Ch Armaan

Sub: BEEE (Assignment - 1 to 6)

Std.: BTech CSE (AI&ML) 2nd Sem (1st yr) (BSH)

Div.: Sec - M

Roll No.: 23CSEAIML023

Serial No.	Date:	Name of the Experiment	Page No	Marks Awarded	Remarks
1	21.02.24	Assignment 1			
2	14.03.24	Assignment 2			
3	19.03.24	Assignment 3			
4	09.04.24	Assignment 4			
5	09.04.24	Assignment 5			
6	18.04.24	Assignment 6			

Dt :- 21·02·2024

ASSIGNMENT-01.

1. Short Questions :

1. A Resistance R is connected across a potential difference of 110 volts and dissoipales energy at the rate of 220 Watts. Calculate the value of resistance R.

Soln:- Given, $V = 110\ V$

$P = 220$

$R = ?$

$P = \frac{V^2}{R}$

$\Rightarrow R = \frac{V^2}{P}$

$= \frac{(110)^2}{220}$

$\boxed{R = 55\Omega}$ (Soln)

2. A resistor 12Ω is connected across a potential difference of 60 Volts. Calculate the power dissipated and the energy transferred to heat in 4 minutes.

Soln Given, $R = 12\Omega$

$V = 60V$

$t = 4$ minutes $= 240$ secs

$E = \frac{V^2 t}{R}$

$= \frac{(60)^2 \times \cancel{240}^{20}}{\cancel{12}}$

$= 3600 \times 20$

$= 72000\ J$

$\boxed{E = 72\ KJ}$

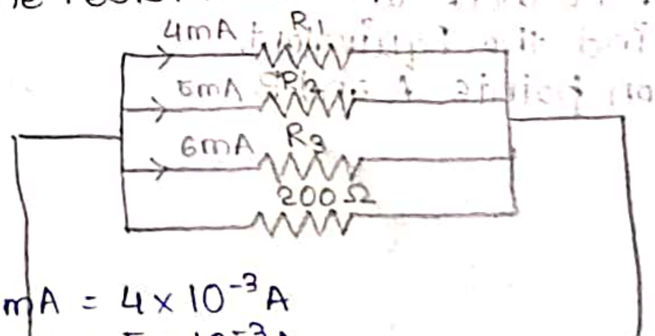
$P = \frac{V^2}{R}$

$= \frac{(60)^2}{12}$

$= \frac{3600}{12}$

$\boxed{P = 300\ Watt}$

3. Four resistors are in parellel. The currents in the first three resistors are 4 mA, 5 mA and 6 mA respectively. The voltage drop across the fourth resistor is 200 volts. The total power dissipated is 5 watts. Determine the values of the resistances of the branches and the total resistance.



Given, $I_1 = 4mA = 4 \times 10^{-3} A$

$I_2 = 5mA = 5 \times 10^{-3} A$

$I_3 = 6mA = 6 \times 10^{-3} A$

Sol^n Let R_1, R_2, R_3, R_4 are the four resistors are in parellel as all are in parellel so Potential difference across all the resistors are same.

$\Rightarrow V_1 = V_2 = V_3 = V_4$

$\Rightarrow I_1R_1 = I_2R_2 = I_3R_3 = I_4R_4 = 200\,V$

$\Rightarrow R_1 = \left(\frac{200}{I_1}\right) = \frac{200}{4\times10^{-3}} = \frac{2\times10^5}{4} = 50000\,\Omega = 50\,K\Omega$

$R_2 = \left(\frac{200}{I_2}\right) = \frac{200}{5\times10^{-3}} = \frac{2\times10^5}{5} = 40000\,\Omega = 40\,K\Omega$

$R_3 = \left(\frac{200}{I_3}\right) = \frac{200}{6\times10^{-3}} = \frac{2\times10^5}{6} = 33333.33\,\Omega = 33.33\,K\Omega$

according to $P = \frac{V^2}{R}$

$R_{net} = \frac{V^2}{P}$

$= \frac{200\times200}{5} = 8000\,\Omega$ (40)

$R_{net} = 8000\,\Omega$

$\boxed{R_{net} = 8\,K\Omega}$

as $\frac{1}{R_{net}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$R_4 = \frac{1}{1/R_1 + 1/R_2 + 1/R_3}$

$R_4 = \frac{1}{50+40+33.33}$

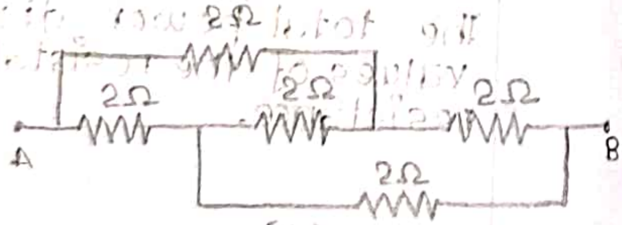
$R_4 = 20000\,\Omega$

$\boxed{R_4 = 20K\Omega}$ (Sol^n)

$\therefore R_1 = 50K\Omega;\ R_2 = 40K\Omega,\ R_3 = 33.33\,K\Omega,\ R_4 = 20\,K\Omega$

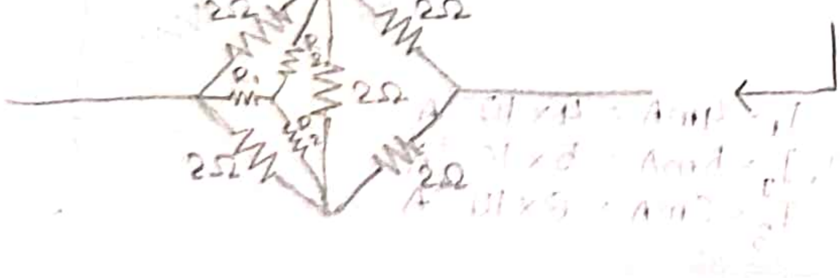
$\boxed{R_{net} = 8\,K\Omega\ (7.999\,K\Omega)}$ (Sol^n)

4. Five equal resistors each of 2Ω are connected in a network as shown in Fig 1 Find the Equivalent resistance between points A and B.



(A)

Sol^n:-

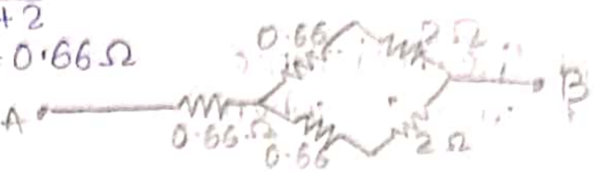


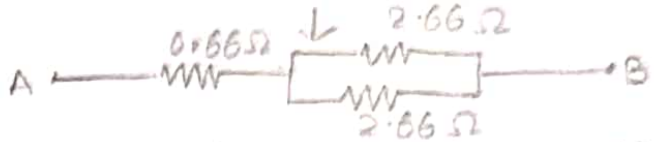
According to Figure (2)
Using Star & Delta method,

$$R_1 = \frac{2\times2}{2+2+2} = \frac{4}{6} = 0.66\,\Omega$$

$$R_2 = \frac{2\times2}{2+2+2} = 4/6 = 0.66\,\Omega$$

$$R_3 = \frac{2\times2}{2+2+2} = 4/6 = 0.66\,\Omega$$





$$R_{AB} = 0.66 + ((0.66+2) \| (0.66+2))$$
$$= 0.66 + 1.33$$
$$\boxed{R_{AB} = 1.99\,\Omega}$$ (Sol^n)

5. An Aluminium wire 5m long and 2mm daimeter is connected in parellel with a wire 3 m long. The total current in 4 A and that is in the aluminium wire is 2.5 A. find the daimeter of the copper wire. The respective rosistivities of copper and aluminium are 1.7 and 2.6 μΩm.

Sol^n:- As they are in parellel $I = I_a + I_c$

$$I_c = 4 - 2.5 = 1.5\,A$$

An V across then is same

As we know $R = \frac{\rho l}{A}$

$$R_A = \rho_a \frac{l_a}{A_a} \Rightarrow \frac{V}{I_a} = 2.6\times10^{-6} \times \frac{5}{\pi r_a^2}$$

$$R_c = \rho_c \frac{l_c}{A_c} \Rightarrow \frac{V}{I_c} = 1.7\times10^{-6} \times \frac{3}{\pi r_c^2}$$

From (i) & (ii)

$$2.6\times10^{-6} \times \frac{5}{\pi r_a^2} \times I_a = 1.7\times10^{-6} \times \frac{3}{\pi r_c^2} \times I_c$$

$$\frac{r_c^2}{r_a^2} = \frac{1.7\times3\times1.5}{2.6\times5\times2.5}$$

$$\frac{r_c}{r_a} = \sqrt{\frac{7.65}{32.5}}$$

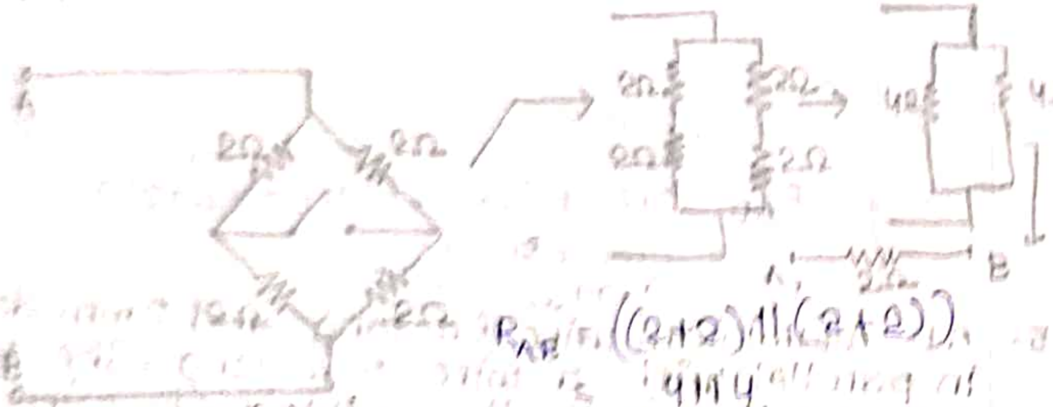
$$\frac{r_c}{r_a} = 0.4851$$

$$r_c = 0.4851 \times (0.001)\,m$$

$$r_c = 0.485\ mm$$

Daimeter of Copper $= 2r_c = 2 \times 0.485 = 0.97mm.$

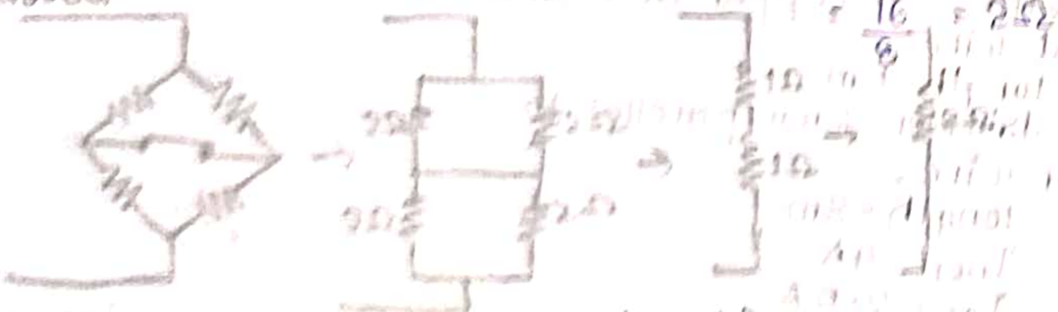
6. In the circuit 'A' find the resistance between terminals 'A' and 'B' when switch is
a) open.



circuit "A".

$R_{AB} = ((2+2) \| (2+2))$
$= 4 \| 4$
$= \frac{4 \times 4}{4+4}$
$= \frac{16}{8} = 2\Omega$

b) closed

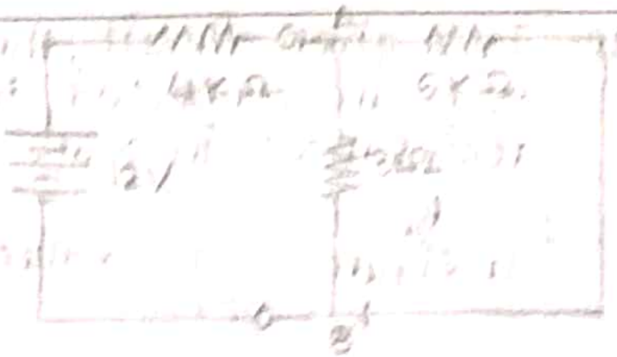


$R_{AB} = ((2 \| 2) + (2 \| 2)) = \left(\frac{4}{4} + \frac{4}{4}\right) = 1+1 = 2\Omega$
$= \left(\left(\frac{2 \times 2}{2+2}\right) + \left(\frac{2 \times 2}{2+2}\right)\right)$

7. Find the current and power ~~subjected~~ supplied by the battery to the circuit
i) under normal conditions
ii) when a short occurs across terminals 'A' and 'B'. All resistances are in kilo-ohm.

Soln- For normal condition:

$R = (4 + (6 \parallel 3))$
$= \left(4 + \left(\frac{6 \times 3}{6+3}\right)\right)$
$= \left(4 + \left(\frac{18}{9}\right)\right)$
$= 4 + 2$
$= 6\Omega \times 10^3$

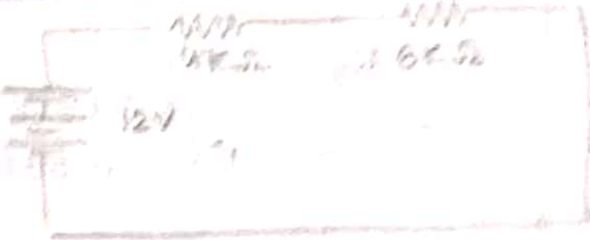


$I = \frac{V}{R} = \frac{12}{6 \times 10^3}$
$= 2 \times 10^{-3} A$
$= 2 mA$

$P = \frac{V^2}{R} = \frac{(12)^2}{6 \times 10^3} = \frac{144}{6000} = 0.024$ watt $= 24 \times 10^{-3}$ watt

For a short occurs across terminals 'A' and 'B':

$R = 4 + 6$
$= 10\Omega \times 10^3 = 10 K\Omega$



$I = \frac{V}{R} = \frac{12}{10 \times 10^3}$
$= 1.2 \times 10^{-3} A$

$P = \frac{V^2}{R} = \frac{144}{10 \times 10^3} = 0.0144$ watt
$= 14.4 \times 10^{-3}$ watt

8. Explain current division rule in dc network?

Soln- According to current division Rule the current across the resistor 'R_1'

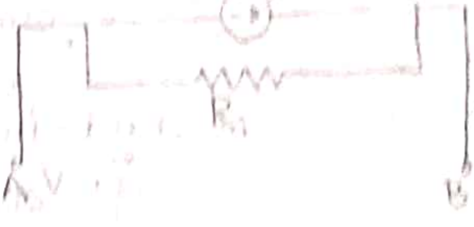
i.e. $i_1 = \frac{i \times G_1}{G_1 + G_2}$

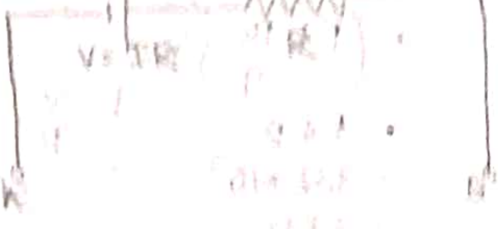
where, G = conductance unit = mho, ℧, ohm^{-1}

It is only applicable for parallel connections.
The unit of conductance is ohm^{-1}, ℧, mho.

9. Explain how the current source with a source resistance can be converted into an equivalent resistances in star.

According to source convertion method we can convert current source with a source resistance can be be converted into an equivalent resistances by shifting the same resistance to series and changing the dc source to voltage source by the ohm's law $\boxed{V = IR}$.





10. In a given circuit, three identical resistances each of value 20 Ω are connected in delta. Find the equivalent resistances in star.

R_{eq} =

In figure 'A' the value of

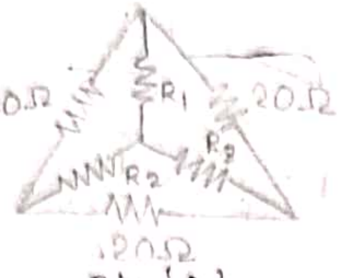


Fig 'A'

$$R_1 = \frac{20 \times 20}{20+20+20} = \frac{400}{60} = 6.666\,\Omega$$

$$R_2 = \frac{20 \times 20}{20+20+20} = \frac{400}{60} = 6.666\,\Omega$$

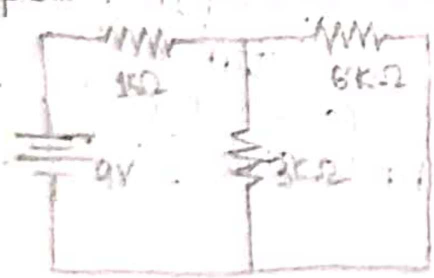
$$R_3 = \frac{20 \times 20}{20+20+20} = \frac{400}{60} = 6.666\,\Omega$$

11. Differentiate between an ideal voltage and a practical voltage source.

Soln:-

Ideal Voltage Source	Practical Voltage Source
1) Internal Resistance is absent in Ideal Voltage Source	1) Internal Resistance is present in ~~ideal~~ Practical Voltage source
2) Denoted by —||—	2) Denoted by —||—/\/\/\— (V, R)
3) There is no power loss	3) Power loss occurs
4) Only possible theoritically	4) Practically possible.

12. Compute the values of battery current I and voltage drop across 6 KΩ resistor when switch 'S' is (a) closed and (b) open. All resistances values are in kilo ohm.



Soln a) $R = (1 + (6 \| 3))$

$$= \left(1 + \left(\frac{6 \times 3}{6+3}\right)\right)$$

$$= \left(1 + \left(\frac{18}{9}\right)\right)$$

$$= 1 + 2$$

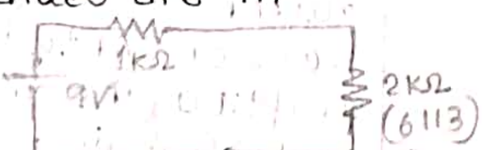
$$= 3\,\Omega \times 10^3$$

$$= 3\,K\Omega$$

$$I = \frac{V}{R} = \frac{9}{3 \times 10^3}$$

$$= 3A \times 10^{-3}$$

$$= 3\,mA$$



$$V_{2K\Omega} = \frac{0.009 \times 2}{1+2}$$

$$= \frac{0.009 \times 2}{3}$$

$$= 0.006$$

As 6 KΩ is in parellel

$$\boxed{\therefore V_{6K\Omega} = 6\,V}$$

current through 6KΩ resistor $= \frac{3 \times 6}{9} = 2mA$

voltage drop $= I \times R = 6 \times 10^3 \times 2 \times 10^{-3}$

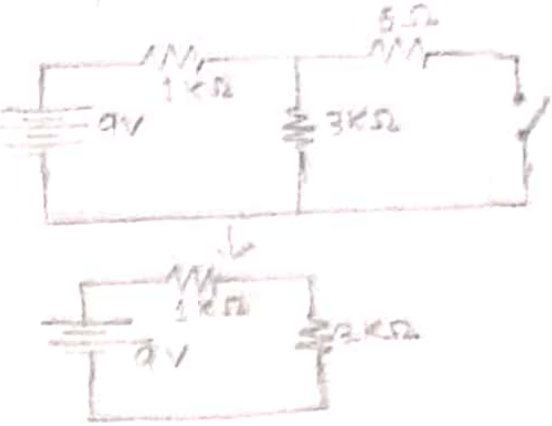
$= 12 V.$

b) switch is open

$R = 1 + 3 \ K\Omega$

$= 4 K\Omega$

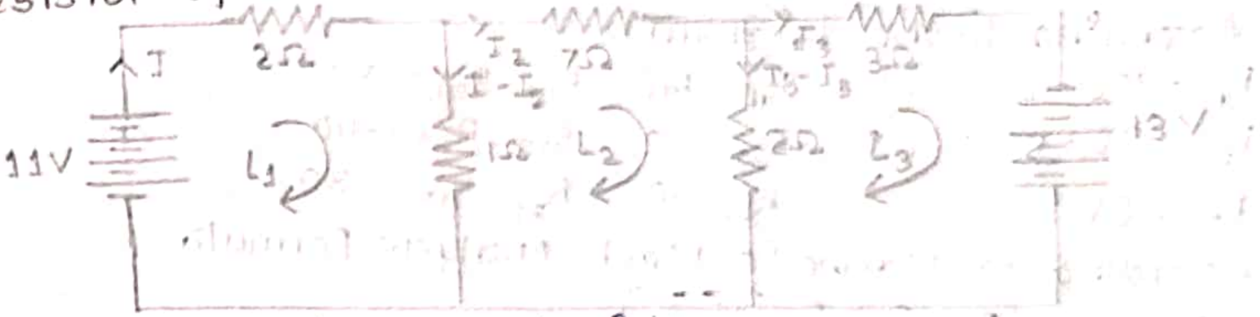
$I = V/R = \frac{9}{4 \times 10^3} = 2.25 \ mA$



→ As the circuit is open the current will not flow through 6Ω resistor hence voltage drop is '0' in open circuit

LONG QUESTIONS.

1. By applying Mesh Analysis find current in the 7Ω resistor of the network.



According to Mesh Analysis

$E_{11} = 11V \quad R_{11} = 3\Omega \quad R_{12} = R_{21} = -1\Omega$

$E_{22} = 0 \quad R_{22} = 10\Omega \quad R_{23} = R_{32} = -2\Omega$

$E_{33} = 13V \quad R_{33} = 5\Omega \quad R_{31} = R_{13} = 0$

By using Maxwell's Mesh Matrix formula

$$\begin{bmatrix} E_{11} \\ E_{22} \\ E_{33} \end{bmatrix} = \begin{bmatrix} R_{11} & R_{12} & R_{13} \\ R_{21} & R_{22} & R_{23} \\ R_{31} & R_{32} & R_{33} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

$$\begin{bmatrix} 11 \\ 0 \\ 13 \end{bmatrix} = \begin{bmatrix} 3 & -1 & 0 \\ -1 & 10 & -2 \\ 0 & -2 & 5 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

Equations are

$3I_1 - I_2 + 0I_3 = 11 \quad — (1)$

$-I_1 + 10I_2 - 2I_3 = 0 \quad — (2)$

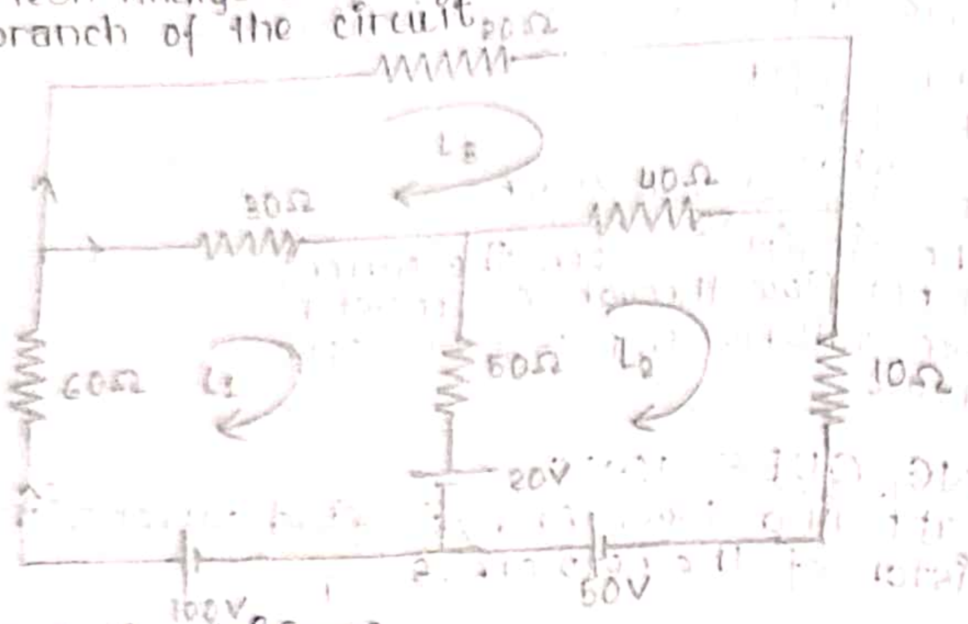
$0I_1 - 2I_2 + 5I_3 = 13 \quad — (3)$

After solving equations using Calculator

$I_1 = 4A, \ I_2 = 1A; \ I_3 = 3A$

The current through 7Ω resistance is 1A (Ans)

2. Using Mesh Analysis calculate the current in 30Ω and 10Ω branch of the circuit



According to the daigram.

$E_{11} = 100 - 20 = 80V$ $\quad R_{11} = 140$ $\quad R_{12} = R_{21} = -50$

$E_{22} = 20 + 50 = 70V$ $\quad R_{22} = 100$ $\quad R_{32} = R_{23} = -40$

$E_{33} = 0V$ $\quad R_{33} = 90$ $\quad R_{31} = R_{13} = -30$

According to Maxwell's Mesh Analysis formula

$$\begin{bmatrix} E_{11} \\ E_{22} \\ E_{33} \end{bmatrix} = \begin{bmatrix} R_{11} & R_{12} & R_{13} \\ R_{21} & R_{22} & R_{23} \\ R_{31} & R_{32} & R_{33} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

$$\begin{bmatrix} 80 \\ 70 \\ 0 \end{bmatrix} = \begin{bmatrix} 140 & -50 & -30 \\ -50 & 100 & -40 \\ -30 & -40 & 90 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}.$$

$140I_1 - 50I_2 - 30I_3 = 80$ ——— (1)

$-50I_1 + 100I_2 - 40I_3 = 70$ ——— (11)

$-30I_1 - 40I_2 + 90I_3 = 0$ ——— (111)

solving the above equations we get,

$I_1 = 1.6489$ A

$I_2 = 2.1214$ A

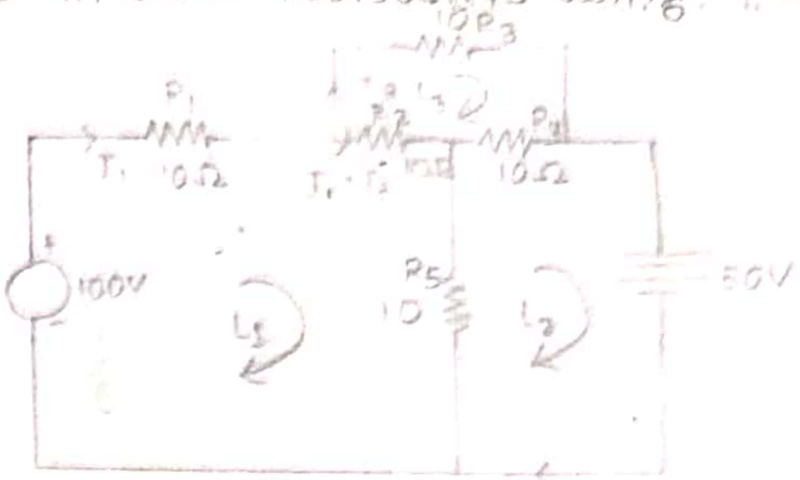
$I_3 = 1.4925$ A

∴ Current through 30Ω resistor $= 1.6489 - 1.4925$

$= 0.1564$ A

current through 10Ω resistor is 2.12 A

3. A network is arranged as in the circuit 'A'. Determine the current in each resistance using Mesh Analysis.



Sol^n:- $E_{11} = 100V$ $\quad R_{11} = 30 \quad R_{12} = R_{21} = -10$

$E_{22} = 50V \quad R_{22} = 20 \quad R_{23} = R_{32} = -10$

$E_{33} = 0 \quad R_{33} = 30 \quad R_{13} = R_{31} = -10$

According to the Maxwell's Mesh Analysis Formula.

$$\begin{bmatrix} E_{11} \\ E_{22} \\ E_{33} \end{bmatrix} = \begin{bmatrix} R_{11} & R_{12} & R_{13} \\ R_{21} & R_{22} & R_{23} \\ R_{31} & R_{32} & R_{33} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

$$\begin{bmatrix} 100 \\ -50 \\ 0 \end{bmatrix} = \begin{bmatrix} 30 & -10 & -10 \\ -10 & 20 & -10 \\ -10 & -10 & 30 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

$30I_1 - 10I_2 - 10I_3 = \cancel{100}$ —(i)

$-10I_1 + 20I_2 - 10I_3 = -50$ —(ii)

$-10I_1 - 10I_2 + 30I_3 = 0$ —(iii)

The current's values are

$I_1 = 3{\cdot}75A$, $I_2 = 0A$, $I_3 = 1{\cdot}25A$

The current through resistance R_1 = 3·75 A

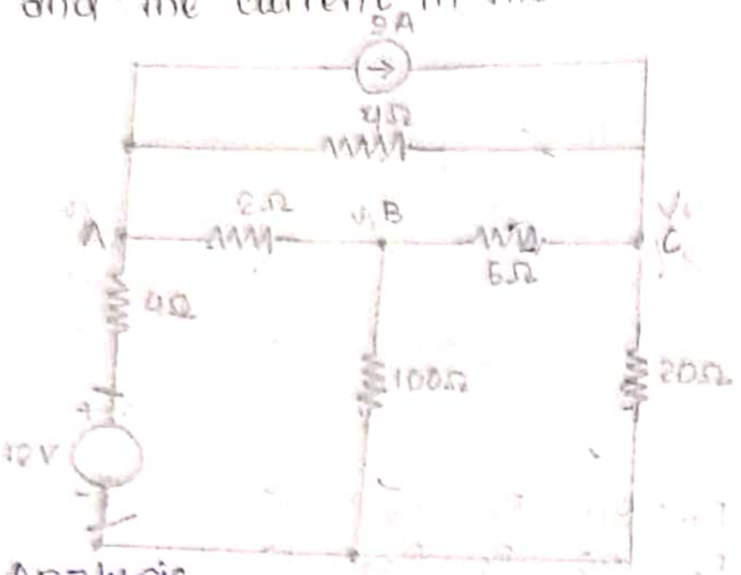
The current through R_2 = 2·5 A

The current through R_3 = 1·25 A

The current through R_4 = 1·25 A

The current through R_5 = 3·75 A

4. Use Nodal Analysis to determine the voltage across 5 Ω resistance and the current in the 12 V source.



Using Node Analysis

At focusing on Node 'A'

$$V_1\left(\frac{1}{2}+\frac{1}{4}+\frac{1}{4}\right)-\frac{V_2}{2}-\frac{V_3}{4}=\frac{12}{4}-9$$

$$V_1-\frac{V_2}{2}-\frac{V_3}{4}=-6 \quad \text{—— (1)}$$

Focusing at Node 'B'

$$V_2\left(\frac{1}{2}+\frac{1}{5}+\frac{1}{100}\right)-\frac{V_1}{5}-\frac{V_1}{5}=0$$

$$\frac{V_1}{2}-\frac{71V_2}{100}+\frac{V_3}{3}=0 \quad \text{—— (II)}$$

Focusing at Node 'C'

$$-V_3\left(\frac{1}{5}+\frac{1}{20}+\frac{1}{4}\right)-\frac{V_2}{5}-\frac{V_1}{4}=9$$

$$\frac{V_1}{4}+\frac{V_2}{5}-\frac{V_3}{2}=-9 \quad \text{—— (III)}$$

Solving Equations 1, II & III we get

$V_1 = 6.35\ V$

$V_2 = 11.76\ V$

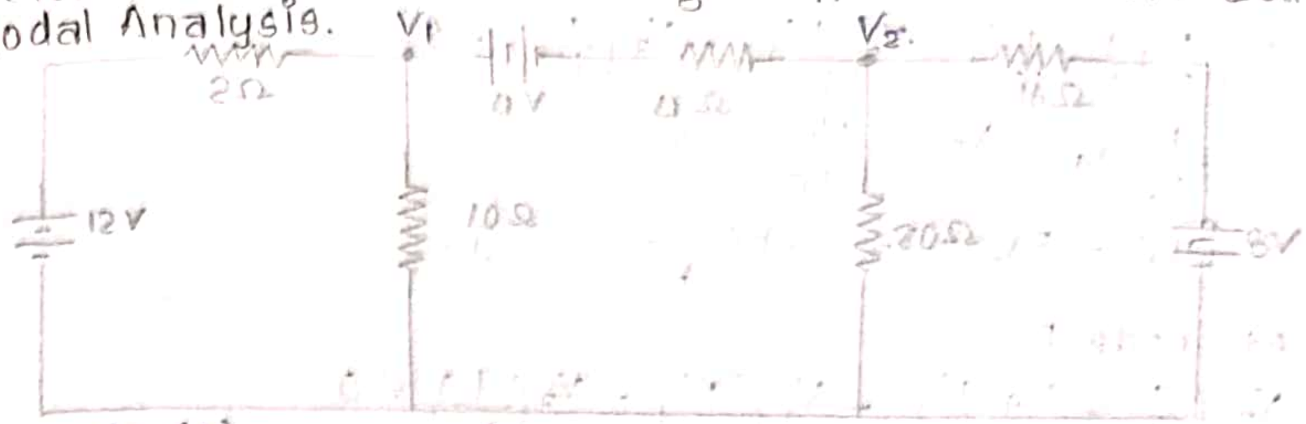
$V_3 = 25.80\ V$

V at 5 Ω resistor $= V_3 - V_2 = 14.18\ V$

I in 12 V Source =

$$= \frac{12-6.35}{4} = \frac{5.65}{4} = 1.412\ V$$

5 Determine the current through different resistors using Nodal Analysis.



At node (1)

$$V_1\left(\frac{1}{2}+\frac{1}{10}+\frac{1}{4}\right) - \frac{V_2}{4} - \frac{12}{2} - \frac{4}{4} = 0 \Rightarrow \frac{17}{20}V_1 - \frac{V_2}{4} = 7 \quad \text{(I)}$$

At node (2)

$$V_2\left(\frac{1}{16}+\frac{1}{20}+\frac{1}{4}\right) - \frac{V_1}{4} - \frac{8}{16} + \frac{4}{4} = 0$$

$$\frac{V_1}{4} - \frac{24}{80}V_2 - \frac{1}{2} = 0 \quad \text{(II)}$$

From eq^n (I) & (II)

$V_1 = 9.82\text{ V}$, $V_2 = 5.39\text{ V}$

current through $2\Omega\ (I_{2\Omega}) = \frac{12-9.82}{2} = 1.36\text{ A}$

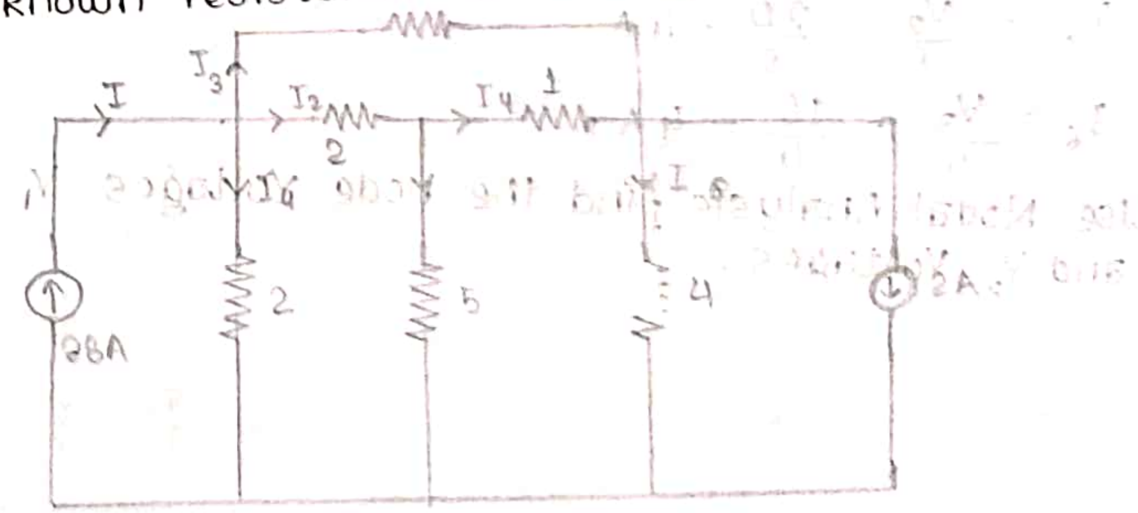
$I_{10\Omega} = \frac{9.82}{10} = 0.98\text{ A}$

$I_{4\Omega} = \frac{9.82-4-5.39}{4} = 0.43\text{ A}$

$I_{16\Omega} = \frac{8-5.36}{16} = 0.16\text{ A}$

$I_{20\Omega} = \frac{5.34}{20} = 0.26\text{A}$

6. Use Nodal Analysis method to find currents in the various resistors of the circuit shown below. (Take unknown resistance as 10Ω)



At node 'A'

$$V_1\left(\frac{1}{2}+\frac{1}{2}+\frac{1}{10}\right) - V_2\left(\frac{1}{2}\right) - V_3\left(\frac{1}{10}\right) = 28$$

$$\Rightarrow \frac{11}{10}V_1 - \frac{V_2}{2} - \frac{V_3}{10} = 28$$

$$\Rightarrow \boxed{11V_1 - 5V_2 - V_3 = 280} \text{ —— (I)}$$

At node 'B'

$$V_2\left(\frac{1}{2}+\frac{1}{1}+\frac{1}{5}\right) - V_1\left(\frac{1}{2}\right) - V_3\left(\frac{1}{1}\right) = 0$$

$$\boxed{17V_2 - 5V_1 - 10V_3 = 0} \text{ —— (II)}$$

Applying nodal analysis at node 'C'

$$V_3\left(\frac{1}{4}+\frac{1}{1}+\frac{1}{10}\right) - \frac{V_2}{1} - \frac{V_1}{10} = -2$$

$$\frac{27}{20}V_3 - V_2 - \frac{V_1}{10} = -20$$

$$\boxed{27V_3 - 20V_2 - 2V_1 = -40} \text{ —— (III)}$$

By solving the three equations (I), (II) & (III)

$V_1 = 36\text{ V}$, $V_2 = 20\text{ V}$, $V_3 = 16\text{ V}$.

$$I_1 = \frac{36}{2} = 18\text{ A}$$

$$I_2 = \frac{V_1 - V_2}{2} = \frac{36-20}{2} = 8\text{ A}$$

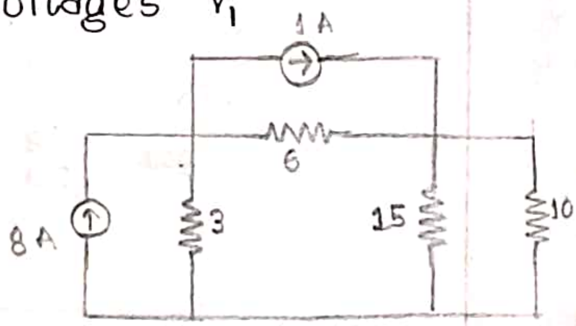
$$I_3 = \frac{V_1 - V_3}{10} = \frac{36-16}{10} = 2\text{ A}$$

$$I_4 = \frac{V_2 - V_3}{10} = \frac{20-16}{} = 4\text{ A}$$

$$I_5 = \frac{V_2}{5} = \frac{20}{5} = 4\text{ A}$$

$$I_6 = \frac{V_3}{4} = \frac{16}{4} = 4\text{ A}.$$

7. Use Nodal Analysis find the node Voltages V_1 and V_2 Voltages.



At node 1,

$$V_1\left(\frac{1}{3}+\frac{1}{6}\right)-\frac{V_2}{6}=8-1$$

$$\boxed{\frac{V_1}{2}-\frac{V_2}{6}=7} \quad \text{——— (1)}$$

At Node 2

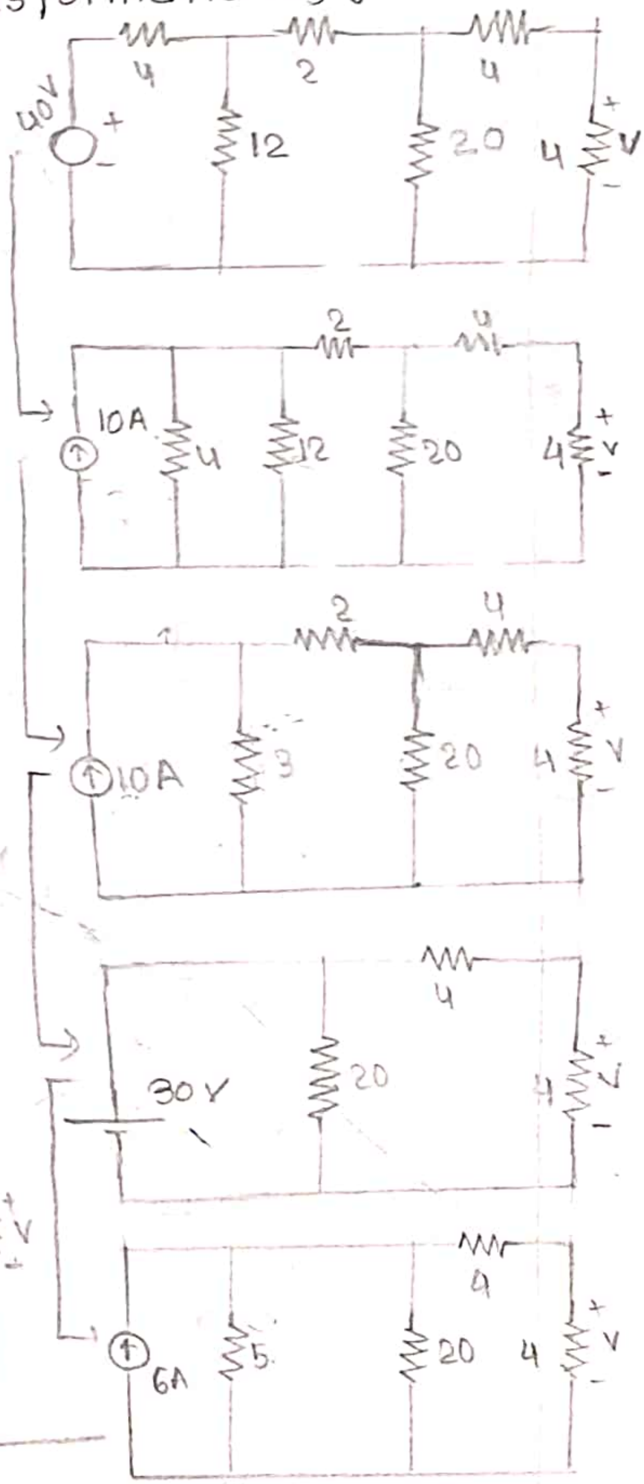
$$V_2\left(\frac{1}{15}+\frac{1}{6}+\frac{1}{10}\right)-\frac{V_1}{6}=1$$

$$\frac{V_1}{6}-\frac{V_2}{3}=-1 \quad \text{——— (II)}$$

Solving (1) & (II) we get

$V_1 = 18\,V$, $V_2 = 12\,V$

8. By using repeated source transformations, find the value of voltage 'V'.



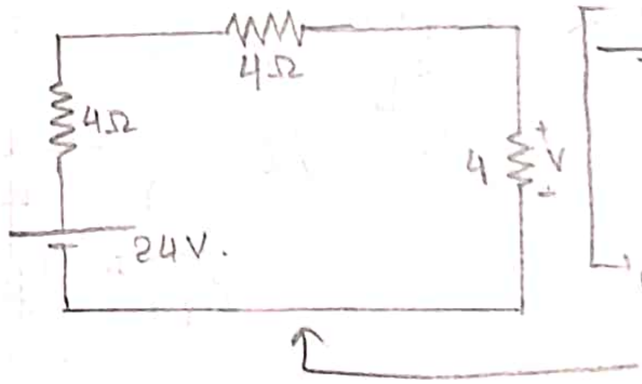
According to the Daigram.

$$I=\frac{V}{R_{eq}}$$

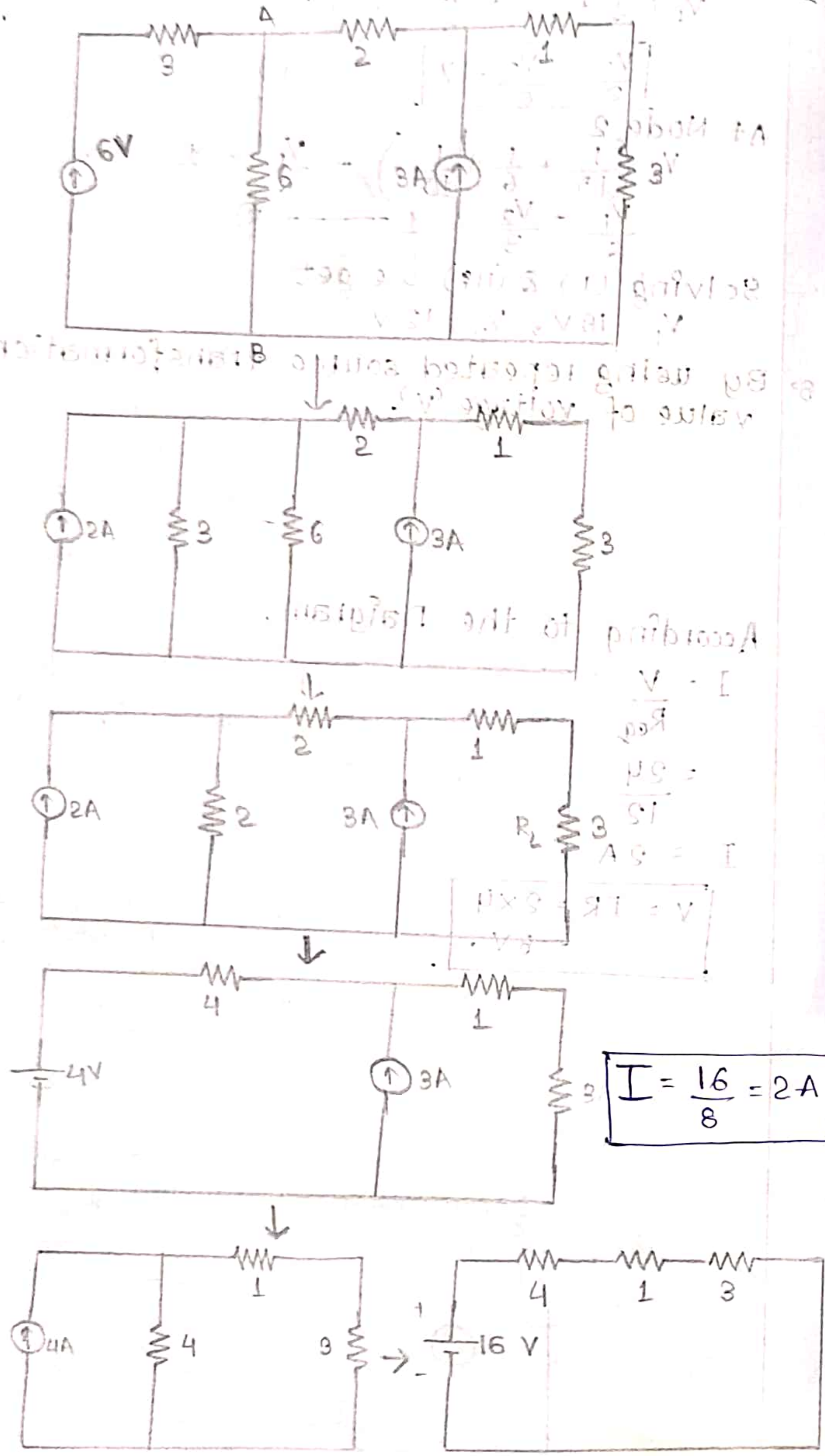
$$=\frac{24}{12}$$

$$I = 2\,A$$

$$\boxed{V = IR = 2\times 4 = 8\,V.}$$

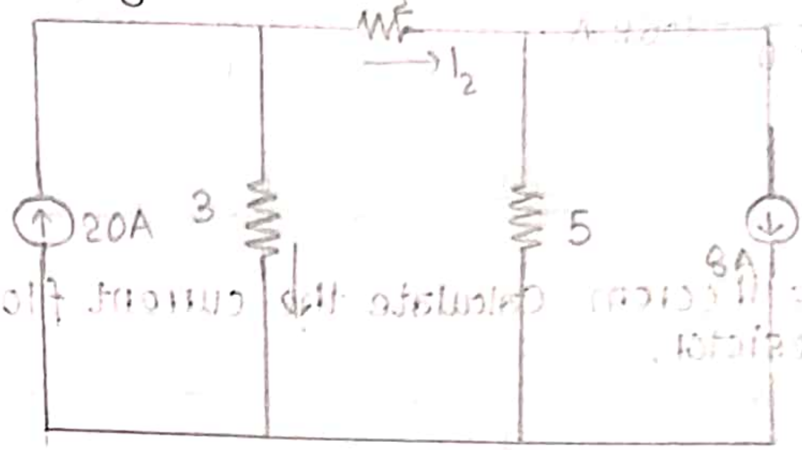


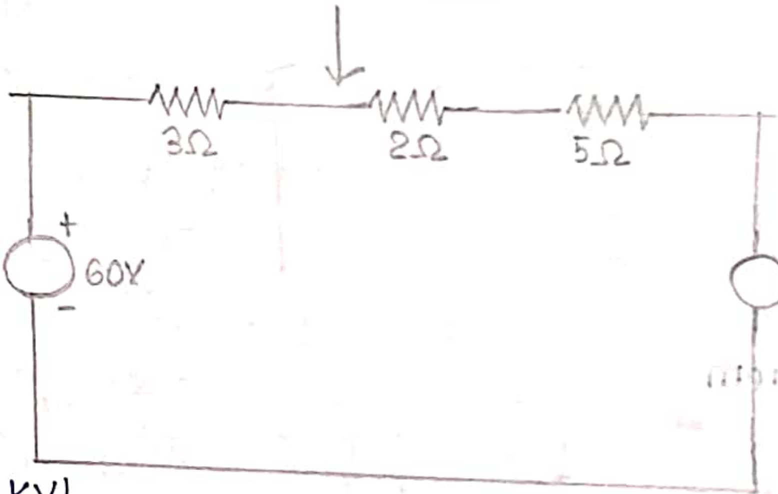
9. Use Source Conversion technique to find the load current I in the circuit.



$$\boxed{I = \frac{16}{8} = 2A}$$

10. Use source transformations technique to find the current flowing through the 2Ω resistor.





Applying KVL

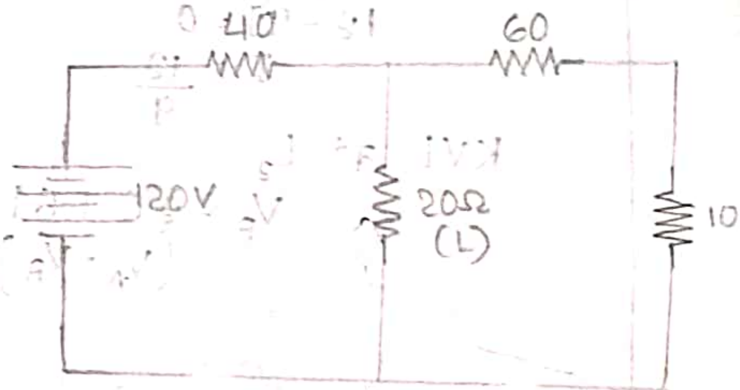
or =

$$60 - 3I - 2I - 5I + 40 = 0$$

$$I = 10\ A$$

Current through 2Ω is 10 A

11. Determine current in the 20Ω resistor of the network using thevenin's Theorem.

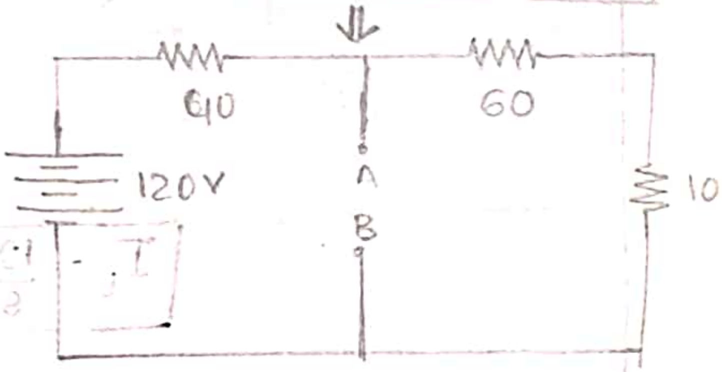


Now, for $V_{th} = 120 - 40I_1 - V_{th} = 0$

$$V_{th} = 120 - 40I_1$$

$$= 120 - 40 \times \frac{12}{11}$$

$$\boxed{V_{th} = 76.36\ V}$$



KVL in loop

$$120 - 60I - 40I - 10I = 0.$$

$$I = \frac{12}{11}$$

For $R_{th} = (40 \parallel (60 + 10))$

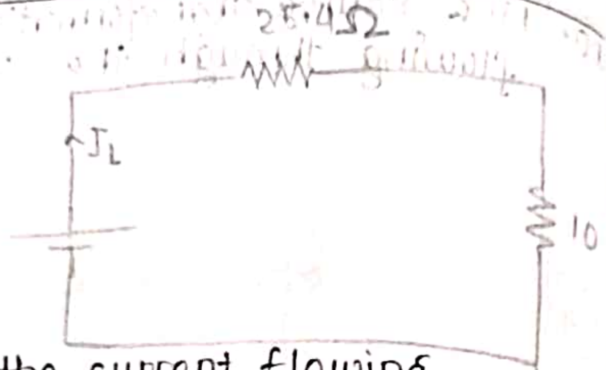
$$= 40 \parallel 70$$

$$= \frac{40 \times 70}{40 + 70}$$

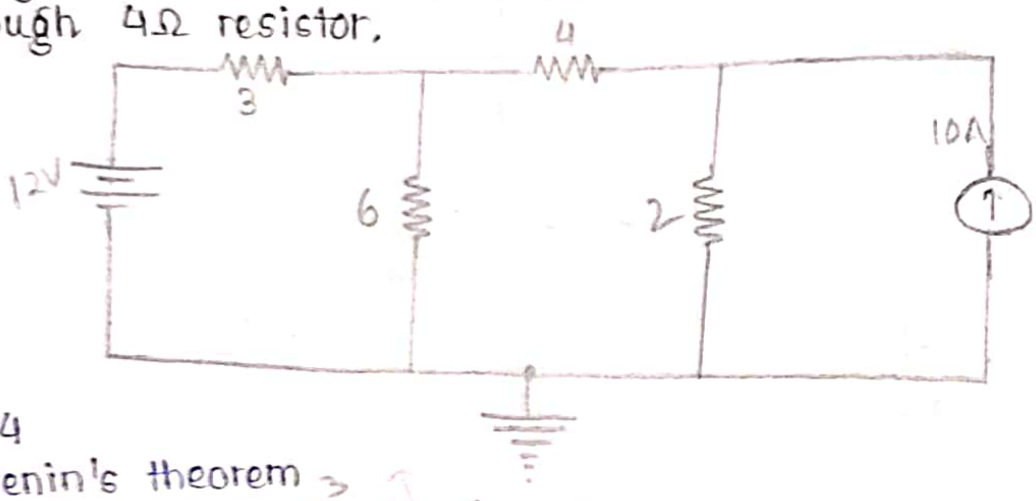
$$= 25.45\Omega.$$

Thevenin's Circuit

$$I_L = \frac{76.36}{25.46+20} = 1.68\ A.$$

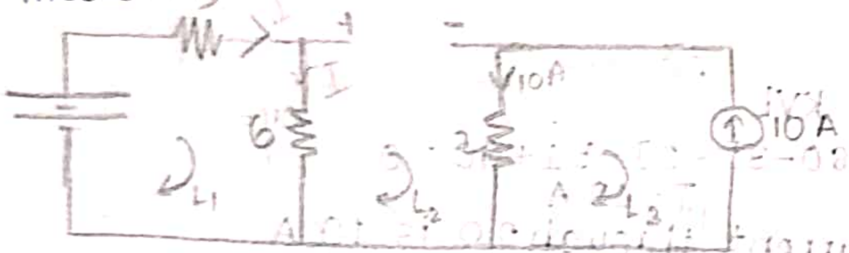


12. Using thevenin's theorem Calculate the current flowing through 4Ω resistor.



$R_L = 4$

Thevenin's theorem →



KVL at L_1

$$12 - 9I = 0$$

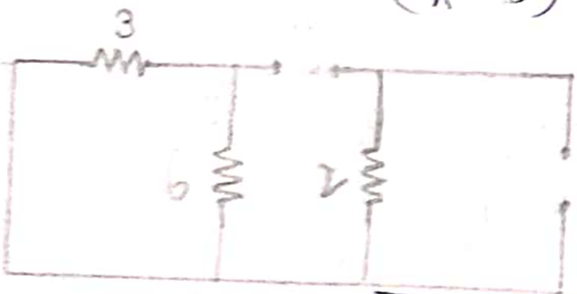
$$I = \frac{12}{9}$$

KVL at L_2

$$V_B - 20 + 6I - V_A = 0$$

$$(V_A - V_B) = 6 \times \frac{12}{9} - 20 = 8 - 20$$

$$= -12V.$$



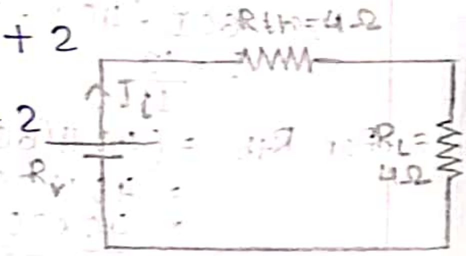
$$R_{th} = (3 \| 6) + 2$$

$$= \frac{6 \times 3}{6+3} + 2$$

$$= \left(\frac{18}{9}\right) + 2$$

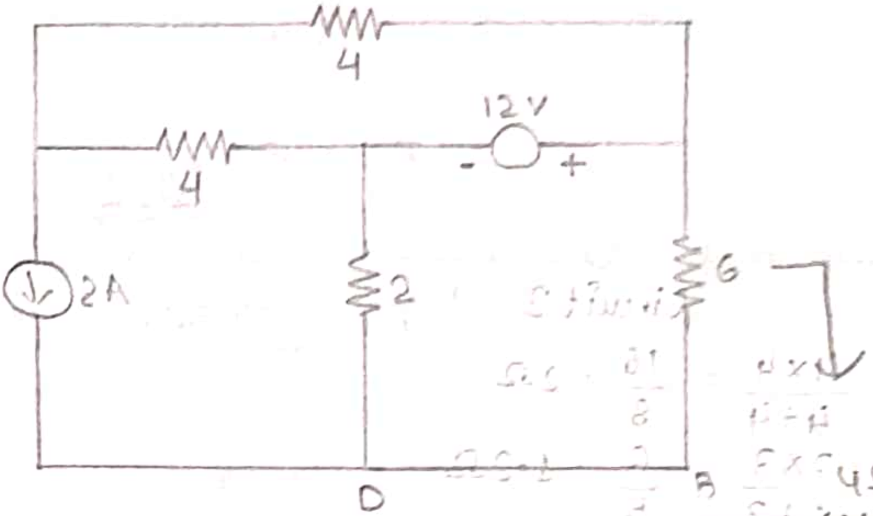
$$= 2 + 2$$

$$= 4\Omega$$



$$\boxed{I_L = \frac{12}{8} = 1.5A}$$

13. Use Thevenin's theorem to find the current through 6Ω resistor of the network shown in below figure. All resistances are in ohm.

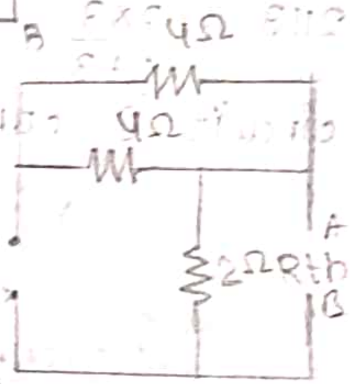


$R_1 = 6\Omega$

Using KVL in ABEDCA (for V_{th})

$$-2(2) + 12 - V_{th} = 8$$

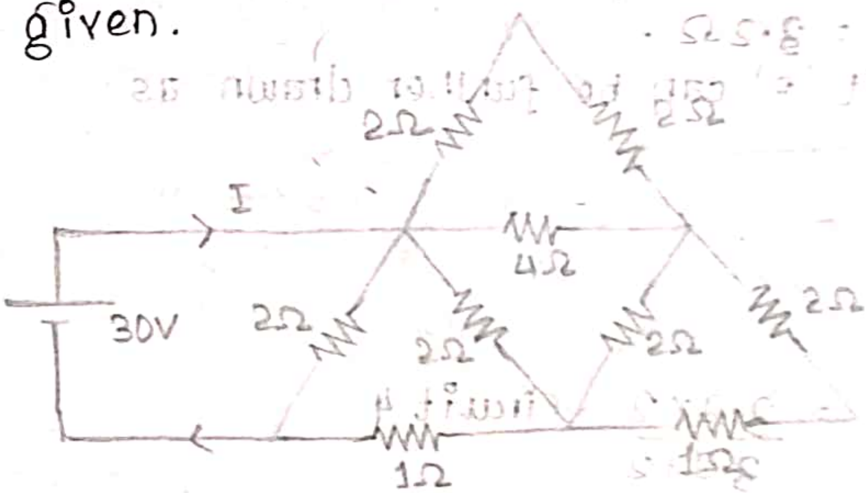
$$\boxed{V_{th} = 8}$$



For $R_{th} = 2\Omega$

$$I_L = \frac{V_{th}}{R_{th} + R_L} = \frac{8}{2+6} = 1\text{ A}$$

14) find the current supplied by the DC source in the circuit given.

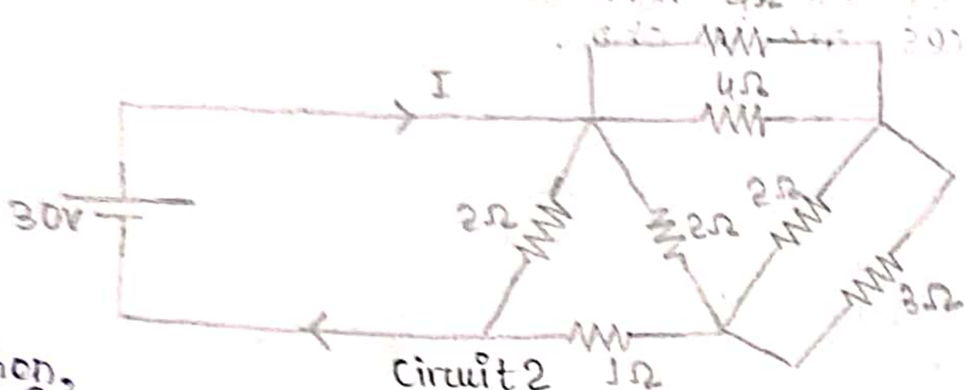


Circuit-1

$R_{22} = 2+2$
$= 4\Omega$

$R_{21} = 2+1$
$= 3\Omega$

The circuit 1 can further be drawn



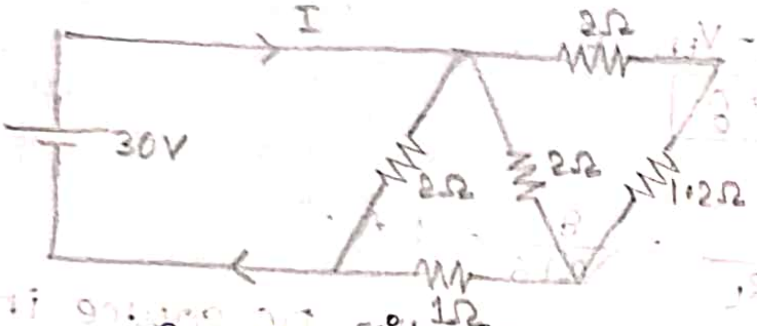
Circuit 2

Then,

$$R_{4\|4} = \frac{4\times4}{4+4} = \frac{16}{8} = 2\Omega$$

$$R_{2\|3} = \frac{2\times3}{2+3} = \frac{6}{5} = 1{\cdot}2\Omega$$

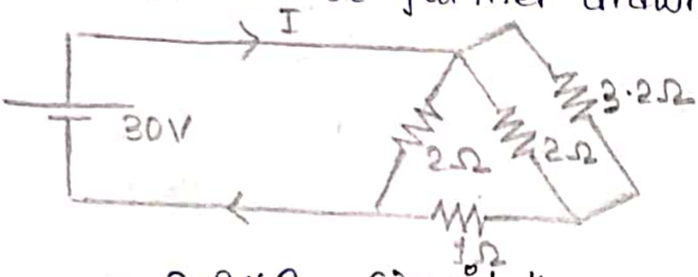
The circuit '2' can be further drawn as:



$$R_{2+1\cdot2} = 2+1{\cdot}2 = 3{\cdot}2\Omega.$$

circuit 3

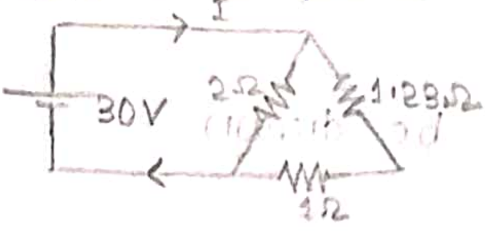
The circuit '3' can be further drawn as



circuit 4

$$R_{3\cdot2\|2} = \frac{3{\cdot}2\times2}{3{\cdot}2+2} = \cancel{1{\cdot}047\Omega}\ 1{\cdot}23\Omega$$

The circuit '4' can further drawn as

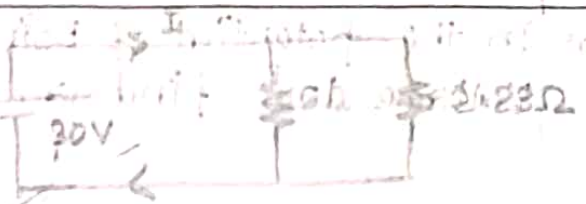


$$R_{1\cdot23+1} = 1{\cdot}23+1 = 2{\cdot}23$$

Now, $R_{eq} = 2 \| 2.23$

$= \frac{2 \times 2.23}{2 + 2.23}$

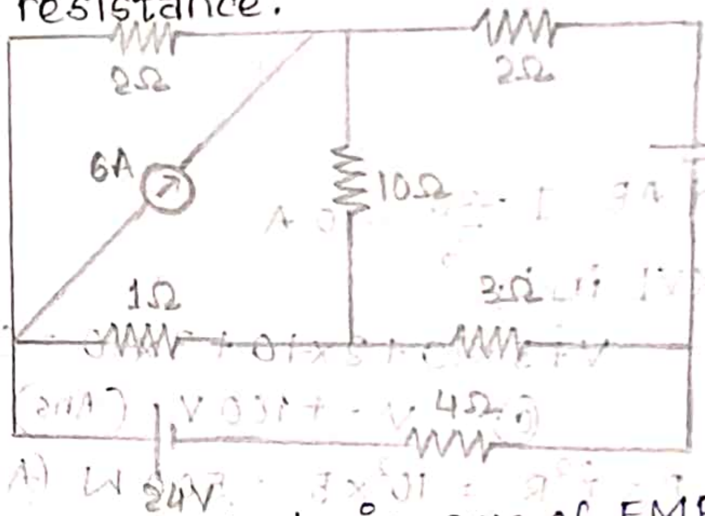
$= 1.05 \Omega$



$I = \frac{V}{R} = \frac{30}{1.05} = 28.57A$

$\boxed{I = 28.57A}$

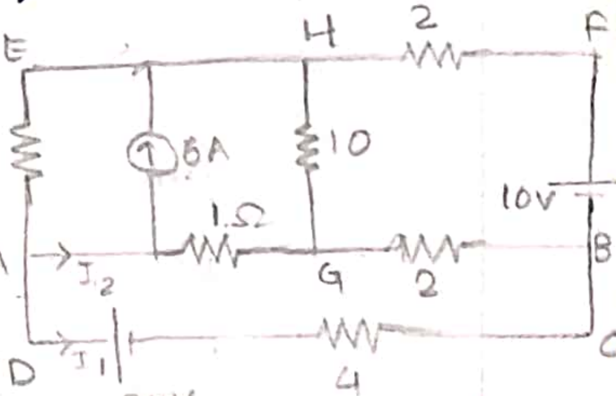
15. State Kirchoff's law Using KVL determine current through 4Ω resistance.



KVL States that the algebraic sum of EMFs and the algebraic sum of product of current and resistance in a closed electric circuit is equal to zero.

$-4I_1 - 24 - (I_2 - 6) - 3(I_2 + I_3 - 6) = 0$

$-4I_1 + 4I_2 + 3I_2 = 48$ —(1)



KVL in EHGA

$-2(I_1 - I_2) - 10I_3 + (I_2 - 6) = 0$

$-2I_1 + 3I_2 - 10I_3 = 6$ —(11)

Applying KVL in HFBGH.

$-2(I_1 - I_2 - I_3 + 6) - 10 + 3(I_2 + I_3 - 6) + 10I_3 = 0$

$-2I_1 + 5I_2 + 15I_3 = 40$ —(111)

Solving eq^n (1) (11) & (111)

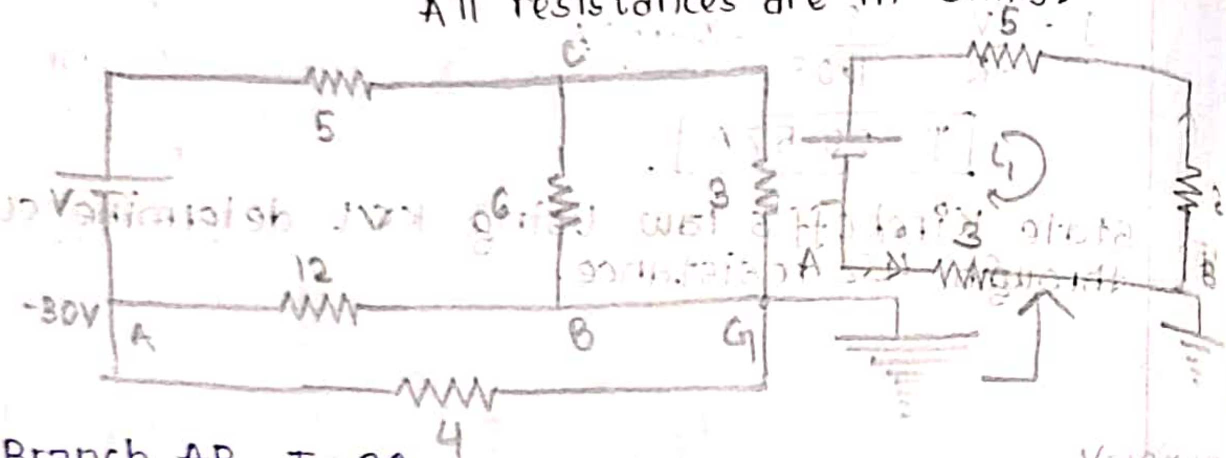
$I_1 = 4.10\ A$, $I_2 = 7.81\ A$, $I_3 = -0.77A$

and $I_4 = 4.10\ A$.

16. In the potential of point 'A' is -30 V, Using ~~th~~ Kirchoff's Voltage law find (a) Value of V and

(b) power dissipated by 5Ω resistance.

All resistances are in ohms.



In Branch AB $I = \frac{-30}{3} = -10$ A

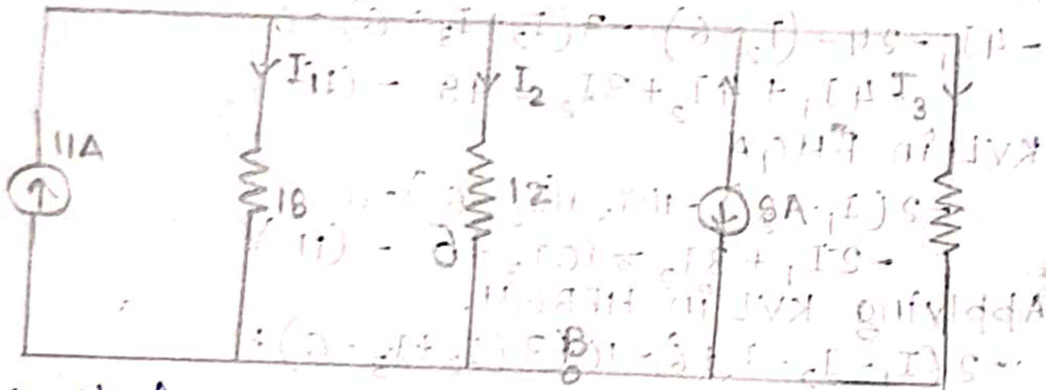
Applying KVL in L_1

$$V + 5 \times -10 + 2 \times -10 + 3 \times -10 = 0$$

(a) $V = +100$ V (Ans)

(b) $P = i^2 R = 10^2 \times 5 = 500$ W (Ans).

17. Using KCL, find the values V_{AB}, I_1, I_2 and I_3 in the circuit. All resistances are in ohms.



Using KCL at A

$$11 - I_1 - I_2 - 8 - I_3 = 0$$

$$\Rightarrow I_1 + I_2 + I_3 = 3 \quad \text{---} \quad (1)$$

Let Voltage across branches is V

I_{eq} $\quad \frac{V}{18} + \frac{V}{12} + \frac{V}{9} = 3$

$$\Rightarrow \frac{V}{4} = 3$$

$$\Rightarrow V = 12 \text{ V}$$

$I_1 = 12/18 = 0.66$ A

$I_2 = \frac{12}{12} = 1$ A

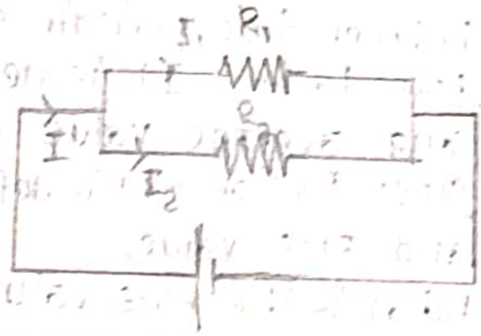
$I_3 = \frac{12}{9} = 1.33$ A.

Short Answers

8. Explain the Current division Rule in DC Network?

Sol^n Current division Rule is only ~~opposite~~ applicable in parellel connection, because in parellel connected voltage remains same but current get divided.

→ According to Current Divider Rule the current across resistor



R_1 – $I_1 = \dfrac{I \times R_2}{R_1 + R_2}$

Similarly, $I_2 = \dfrac{I \times R_1}{R_1 + R_2}$

Dt:- 14.03.2024

ASSIGNMENT : 02

1. Define the following Terms :

i) Time Period :- It is defined as the time taken by the signal to complete one cycle....

ii) Phase difference :- It is the measure of the shift in position between two periodic signals within one full cycle.

iii) Form Factor :- It is defined as the ratio between rms value and average value of an alternating current.

iv) Crest Factor :- It is defined as the ratio between maximum value and RMS value.

2. What is the rms value of an AC Quantity? Obtain expression for the R.M.S value of a ~~sinos~~ sinusoidal current in terms of its maximum value.

Soln:- ~~The average value and rms value of an AC Quantity is~~

$$I_{avg} = \int_0^{\pi}$$

The rms value of an AC Quantity or current which would generate the Same amount of heat in given resistance is given time, as is done by A.C. current, when maintained across the same resistance for the same time.

Then the rms value of sinusodial signal can be calculated as

$i = I_m \sin\theta = I_m \sin\omega t$

$$I_{rms} = \sqrt{\frac{1}{\pi}\int_0^{\pi} i^2(\theta)\, d\theta}$$

$$= \sqrt{\frac{1}{\pi}\int_0^{\pi} I_m^2 \sin^2\omega t\, d\theta}$$

$$= \sqrt{\frac{I_m^2}{\pi}\int_0^{\pi} \frac{1-\cos 2\theta}{2}\, d\theta}$$

$$= \sqrt{\frac{I_m^2}{2\pi}\left[\theta - \frac{\sin 2\theta}{2}\right]_0^{\pi}}$$

$$= \sqrt{\frac{I_m^2}{2\pi}(\pi-0)-(0-0)}$$

$$= \sqrt{\frac{I_m^2}{2\cancel{\pi}} \times \cancel{\pi}}$$

$$= \sqrt{\frac{I_m^2}{2}} = \frac{I_m}{\sqrt{2}} \qquad \therefore I_{rms} = \frac{I_m}{\sqrt{2}} = 0.707 \times I_m$$

3. An alternating current varying sinusoidally with a frequency of 50 Hz has an RMS value of 20 A. Write down the equation for the instantaneous value and find this value a) 0.0025 s b) 0.0125 secs after passing through a positive maximum value. At what time, measured from a positive maximum value, will the instantaneous current be 14.14 A?

Sol^n:- $I_{rms} = 20$ A

$f = 50$ Hz

$2\pi f = 2 \times 3.14 \times 50$
$= 314$ or
$2 \times \pi \times 50$
$= 100\pi$

$I_{rms} = \frac{20}{\sqrt{2}}$
$= 20\sqrt{2}$
$= 28.28.$

Then the equation can be written as;

$i(t) = 28.28 \sin 100\pi t \quad \therefore i(t) = I_m \sin \omega t$

Since time values are given from point 'A' where voltage has +ve & maximum value, the equation may itself be referred to point 'A'.

Now the equation becomes.

$i(t) = 28.28 \cos 100\pi t$

at $t = 0.0025$ s
$= 28.28 \cos 45°$
$= 19.996$ A

at $t = 0.0125$ s
$= 28.28 \cos 100\pi t$
$= 28.28 \cos 225$
$= -20$ A

given, $14.14 = 28.28 \cos 100\pi t$

$\frac{14.14}{28.28} = \cos 100\pi t$

$\cancel{\cos} \frac{1}{2} = \cos 100\pi t$

$\cos \pi/3 = \cos 100\pi t$

$\pi/3 = 100\pi t$

$t = \frac{1}{300} = \cancel{100\pi t}\ 0.03$ secs

4. An alternating current of frequency 50 Hz has a maximum value of 100 A. Calculate (a) its value 1/600 second after the instant the current is zero and its value decreasing thereafter b) how many seconds after the ~~last~~ instant current is zero (increasing thereafter wards) will the current attain the value of 86.6 A?

Sol^n $f = 50\,Hz$, $I = 100\,A$

a) $t = \frac{T}{2} = \frac{1}{2f} = \frac{1}{2\times 50} = 0.01\ sec$

$t_1 = \frac{1}{100} + \frac{1}{600} = \frac{7}{600} = 0.116\ sec.$

$i = I \sin\omega t$

$i = 100 \sin(2\times 180 \times 50 \times 0.0116)$

$i = -50\ A.$

b) $60 = 2\times 180 \times 50 \times t$

$t = \frac{60}{2\times 180 \times 50}$

$= \frac{60}{18000}$

$= \frac{1}{300}$

$= 3.3\times 10^{-3}\ sec$

5. Determine the r.m.s value of the voltage defined by

$e = 5 + 5\sin(314t + \pi/6)$

Sol^n:- According to the Question,

Given eq^n $= e = 5 + 5\sin(314t + \pi/6)$

$V_{rms} = \sqrt{(V_{DC})^2 + (V_{AC})^2}$

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

$= \sqrt{25 + \frac{25}{2}}$

$= \sqrt{\frac{100+25}{2}}$

$= 6.12\ V.$

6. The following three vectors are given : $A = 20 + J20$, $B = 30\angle -120^\circ$ and $C = 10 + J0$. Perform the following indicated operations :
i) $\frac{AB}{C}$ and (ii) $\frac{BC}{A}$

Soln:- $A = 20 + J20$

A in polar form = $28.2842\angle 45$

$B = 30\angle -120^\circ$

B in rectangular form = $-15 - J25.980$.

$C = 10 + J0$

C in polar form = $10\angle 0^\circ$

i) $\frac{AB}{C}$

$$= \frac{(28.2842\angle 45)(30\angle -120^\circ)}{(10\angle 0^\circ)}$$

$$= \frac{848.4\angle -75}{10\angle 0^\circ}$$

$$= 84.84\angle -75^\circ$$

ii) $\frac{BC}{A}$

$$= \frac{(30\angle -120)(10\angle 0^\circ)}{(28.2842\angle 45^\circ)}$$

$$= \frac{300\angle -120}{28.2842\angle 45}$$

$$= 10.606\angle -165^\circ$$

7. Two impedences of $Z_1 = (5 + J7)$ and $Z_2 = (8 - J2)\Omega$ are connected in ll'el. Find out the net Impedance of the combination in polar form.

Soln:- Given, $Z_1 = 5 + J7\ \Omega$

$Z_2 = 8 - J2\ \Omega$

$$Z_1 \| Z_2 = \frac{Z_1 \times Z_2}{Z_1 + Z_2}$$

$$= \frac{(5 + J7)(8 - J2)}{(5 + J7) + (8 - J2)}$$

$$= \frac{(8.602\angle 54.46) \times (8.246\angle -14.036)}{13 + J5}$$

$$= \frac{(8.602\angle 54.46)(8.246\angle -14.036)}{(13.928\angle 21.037)}$$

$$= \frac{70.932 \angle 40.424}{13.928 \angle 21.037}$$

$$\boxed{Z_{net} = 5.092 \angle 19.387}$$

8. An A.C Voltage (80 + J60) volts is applied to a circuit and the current flowing is (-4 + J10) amperes. Find
i) Impedence of the circuit
ii) power consumed
iii) Phase angle

Sol^n:- Given, $V = 80 + J60$

$I = -4 + J10$

i) As ATQ,

$$Z = \frac{V}{I}$$

$$= \frac{80 + J60}{-4 + J10}$$

$$= \frac{100 \angle 36.869}{10.7703 \angle 111.801}$$

$$Z = 9.284 \angle -74.932$$

ii) Power consumed $= VI\cos\phi$

$$= \frac{100}{\sqrt{2}} \cdot \frac{10.77}{\sqrt{2}} \cdot \cos(-74.94)$$

$$= \frac{1077}{2} \times 0.259$$

$$= \frac{278.84}{2} = 139.47\ W.$$

iii) Phase angle $= \phi$

$$= -74.932°$$

9. A 50-μF capacitor is connected across a 230 V, 50-Hz supply. Calculate (a) the reactance offered by the capacitor
b) the maximum current
c) the rms value of the current drawn by the capacitor.

Sol^n:- a) Given, $V = 230\ V$

$F = 50\ Hz$

$C = 50\ \mu F$

a) $X_c = \frac{1}{\omega_c}$

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

$$X_c = \frac{1}{2\times 3.14\times 50\times 10^{-6}}$$

$$X_c = \frac{1}{1570\times 10^{-6}}$$

$$X_c = 63.694\,\Omega$$

b) Maximum current $= \frac{V_{max}}{X_c} = \frac{\sqrt{2}\cdot V_{rms}}{X_c}$

$$= \frac{\sqrt{2}\times 230}{63.69} = 5.10\,A$$

$$\boxed{I_m = 5.10\,A}$$

c) $I_{rms} = \frac{I_m}{\sqrt{2}} = \frac{5.10}{\sqrt{2}} = 3.606\,A$

$$\boxed{I_{rms} = 3.606\,A}$$

10. Define power factor.

Power factor is the phase angle between voltage and current is called as powe factor angle (ϕ) and the cosine of angle between voltage & current is called power factor.

Mathematically,

Power factor can be defined as.

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

11. Deduce an expression for average power in a 1-phase series R-L circuit.

Solⁿ:- $P = VI$

$V = V_m \sin\omega t$

$I = I_m \sin\omega t - \phi$

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

$$= \frac{V_m I_m}{2} \times 2\sin\omega t \cdot \sin(\omega t - \phi)$$

$$= \frac{V_m I_m}{2} \times \left[\cos(\omega t - \omega t + \phi) - \cos(\omega t + \omega t - \phi)\right]$$

$$= \frac{V_m I_m}{2}\cos\phi - \frac{V_m I_m}{2}\cos(\cancel{2\omega t} + \phi)$$

$$\boxed{P = I_{rms}\cdot V_{rms}\cos\phi}$$ Ans.

12. A Choke coil takes a current of 2 A lagging 60° behind the applied voltage of 200 V at 50 Hz. Calulate the inductance, resistance and impedence of the coil. Also, determine the power consumed when it is connected across 100 V, 25 Hz supply.

$Z_{coil} = \frac{200}{2}$

$= 100\Omega$;

$R = Z\cos\phi$

$= 100\cos 60°$

$= 50\Omega$

$X_L = Z\sin\phi = 100\sin 60°$

$= 86.602\Omega$

$X_L = \omega L$

$L = \frac{X_L}{\omega} = \frac{86.6}{2\pi f} = \frac{86.6}{2\times 3.14\times 50} = 0.275$ H.

Now the coil's power consumed when it is connected across 100 V, 25 Hz supply.

$X_L = \omega L = 2\pi FL = 2\times 3.14\times 25\times 0.275$

$\boxed{X_L = 43.3\Omega}$

$Z = \sqrt{R^2 + X_L^2}$

$= \sqrt{(50)^2 + (43.3)^2}$

$z' = 66.1\Omega$

$I = \frac{V}{Z'} = \frac{100}{66.1} = 1.5$ A

Powerfactor $= \cos\varphi = \frac{R}{Z} = \frac{50}{66.1} = 0.75$

Power consumed by the coil,

$P = VI\cos\varphi$

$P = 100\times 1.5\times 0.75$

$P = 112.5$ W.

13. When a voltage of 100 V at 50 Hz is applied to a choking coil A, the current taken is 8 A and the power is 120 W. When applied to a coil B, the current is 10 A and the power is 500 W. What current and power will be taken when 100 V is applied to the two coils connected in series?

Given, $V = 100$ V | for coil B
$f = 50$ Hz | $I_2 = 10$ A
$I_1 = 8$ A | $P_2 = 500$ W
$P_1 = 120$ W

$$Z_1 = \frac{100}{8} = 12.5\Omega \quad (\text{coil A})$$

$$P_1 = VI_1 = I_1^2 R_1$$

$$R_1 = \frac{P_1}{I_1^2} = \frac{120}{64} = 1.875\Omega$$

$$X_1 = \sqrt{Z_1^2 - R_1^2} = \sqrt{(12.5)^2 - (1.875)^2}$$

$$= X_1 = 12.36\Omega$$

$$Z_2 = \frac{V}{I_2} = \frac{100}{10} = 10\Omega \quad (\text{coil B})$$

$$R_2 = \frac{P_2}{I_2^2} = \frac{500}{100} = 5\Omega$$

$$X_2 = \sqrt{10^2 - 5^2} = 8.66\Omega$$

$$Z_{eq} = Z_1 + Z_2$$

$$= 12.5 + 10$$

$$= 22.5\Omega$$

$$I = \frac{V}{Z_{eq}} = \frac{100}{22.5} = 4.44A$$

$$I = 4.44A$$

$$P = I^2 R$$

$$= (4.44)^2 \times (R_1 + R_2)$$

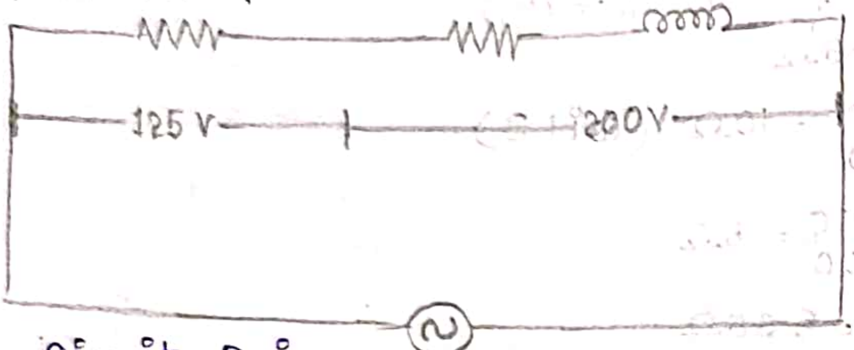
$$= (4.44)^2 \times (1.875 + 5)$$

$$\boxed{P = 135.53 \text{ Watt}}$$

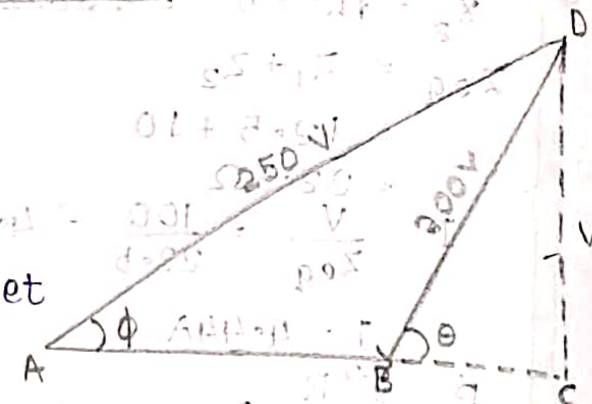
13. When a voltage of 100 V at 50 Hz is applied to a choking coil A, the current is 8 A and the power is 120 W. When applied to a coil B, the current is 10 A and the power is 500 W. What current and power will be taken when 100 V is applied to the two coils connected in series?

14. A current of 5 A follows through a non-inductive resistance in series with a choking coil when supplied at 250 V, 50 Hz. If the voltage across the resistance is 125 V and across the coil 200 V. calculate (a) Impedance, reactance and resistance of the coil b) the power absorbed by the coil and c) the total power. Draw the vector daigram.

Sol^n



Circuit Daigram.



vector daigram.

According to the vector diagram,

$BC^2 + CD^2 = BD^2$

$BC^2 + CD^2 = 200^2$

$(125 + BC)^2 + CD^2 = 250^2$

Subtracting eq^n (I) from (II), we get

$(125 + BC)^2 - (BC)^2 = 250^2 - 200^2$

$BC^2 + 125^2 + 250\,BC - BC^2 = 22500$

$250\,BC = 22500 - 15.625$

$BC = \frac{6875}{250} = 27.5$

$BC = 27.5$ V

$CD^2 = 200^2 - BC^2$

$CD = \sqrt{200^2 - (27.5)^2}$

$CD = 198.1$ V

Hence, of the coil

$Z = \frac{V}{I} = \frac{200}{5} = 40\Omega$

$\boxed{Z = 40\Omega}$

$V = IR = BC$

$5R = BC = 25.5$

$R = \frac{27.5}{5} = 5.5\Omega$

$R = 5.5\Omega$

$R = \frac{V}{I} = 5.5\Omega$

Also, $V_L = IX_L = 6D = 198.1$

$X_L = \frac{198.1}{5}$

$= 39.62\Omega$

$X_L = 39.62\Omega$

Power absorbed by the coil is $= I^2R$

$P = B^2 \times 5.5 = 137.5$ W

$\boxed{P = 137.5 \text{ W}}$

c) Total power $= VI\cos\varphi$

$= 250 \times 5 \times \frac{AC}{AD}$

$= 250 \times 5 \times \frac{125 + 27.5}{250}$

$\boxed{P = 762.5 \text{ W}}$

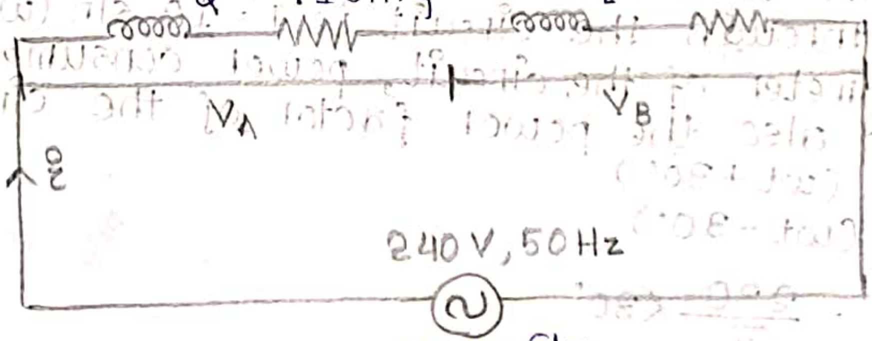
15. Two coils A and B are connected in series across a 240 V 50 Hz, supply. The resistance of A is 5Ω and the inductance of B is 0.015H. If the input from the supply is 3 KW and 2 KVAR, find the inductance of A and the resistance of B. Calculate the voltage across each coil.

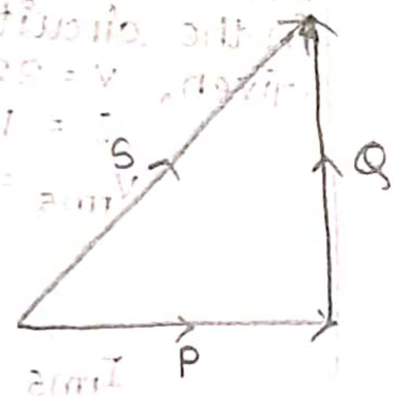
Given, $P = 3$ KW

$P = VI\cos\varphi = I^2R = 3$ KW

$Q = 2$ KVAR

$Q = VI\sin\varphi = I^2X_L = 2$ KVAR





From the power triangle

$S = \sqrt{P^2 + Q^2}$

$S = 3.60$ KVA

$S = VI = 3.60$ KVA

$I = \frac{3.60 \times 10^3}{V}$

$= \frac{3.60 \times 10^3}{240} = 15$ A

$\boxed{I = 15 \text{ A}}$

$P = I^2(R_A + R_B)$
$3000 = 1125 + 225R_B$
$225R_B = 1875$
$R_B = \frac{1875}{225}$
$= 8.33\Omega$
$Q = I^2(X_A + X_B)$
$2000 = 225(X_A + 2\pi \nu L_B)$
$X_A = 4.17\Omega$
$X_A = 2\pi \nu L_A$
$= 4.17$
$L_A = \frac{4.17}{2\pi \cdot 50}$
$= 0.013\,H.$
$\boxed{L_A = 0.013\,H}$
$V_A = I|Z_A|$
$= 15\sqrt{5^2 + 4.17^2}$
$V_A = 97.66\,V$
$V_B = I|Z_B|$
$= 15\sqrt{(8.33)^2 + (2\pi\nu L_B)^2}$
$\boxed{V_B = 143.55\,V}$ (Ans)

16. The Voltage applied to a circuit is $V = 230 \sin(\omega t + 30°)$ and the current through the circuit is $I = 10 \sin(\omega t - 30°)$. Determine the parameter of the circuit, power consumed in the circuit and also the power factor of the circuit.

Given, $V = 230 \sin(\omega t + 30°)$
$I = 10 \sin(\omega t - 30°)$

$V_{rms} = \frac{V_m}{\sqrt{2}} = \frac{230}{\sqrt{2}} \angle 30°$
$= 162.63 \angle 30°\,V$

$I_{rms} = \frac{I_m}{\sqrt{2}} = \frac{10}{\sqrt{2}} \angle -30°$
$= 7.07 \angle -30°\,A$

$Z = \frac{V}{I} = \frac{162.63 \angle 30°}{7.07 \angle -30°}$
$\boxed{Z = 23.00 \angle 60°}$

$$\boxed{Z = 11.5 + j\,19.91\,\Omega}$$

$\varphi = 60^\circ$

$p.f = \cos\varphi = \cos 60^\circ = \frac{1}{2} = 0.5$

As the current lags the voltage by 60° so, this is an inductive circuit.

where, $R = 11.5\,\Omega$

$X_L = 19.91\,\Omega$

we know,

$X_L = \omega L$

$L = \frac{X_L}{\omega}$

Power consumed in the circuit,

$P = VI\cos\phi$

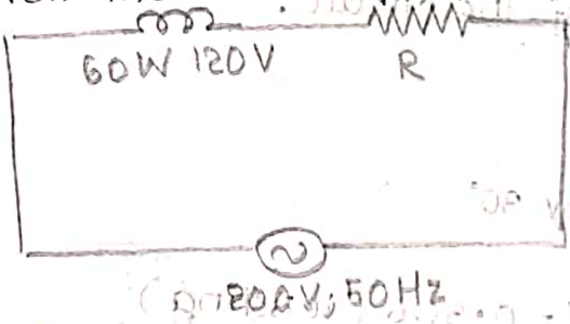
$= 162.63 \times 7.07 \times \cos 60^\circ$

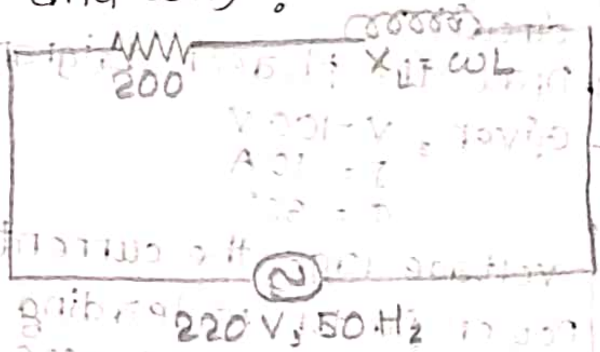
$= 162.63 \times 7.07 \times 0.5$

$\boxed{P = 574.69\ W}$ Ans.

17. A 120-V, 60 W lamp is to be operated on 220-V, 50 Hz supply mains. Calculate the what value of a non-inductive resistance, b) pure inductance would be required in order that lamp is run on current voltage. which method is preferable and why?

Soln





$R = \frac{V^2}{P} = \frac{120 \times 120}{60}$

$\boxed{= R = 240\,\Omega}$

$P = VI$

$I = \frac{60}{120}$

$\boxed{I = 1/2\ A}$

$I = \frac{220}{240 + R}$

$R = 200\,\Omega$

As we know,

$$I = \frac{V}{Z}$$

$$\frac{1}{2} = \frac{200}{\sqrt{(240)^2 + (X_L)^2}}$$

$$X_L^2 = 193600 - 5760 \cdot 0$$

$$X_L = 368 \cdot 78 \Omega$$

$$X_L = 2\pi F L$$

$$L = \frac{X_L}{2\pi F}$$

$$= \frac{368 \cdot 78}{2 \times 3 \cdot 14 \times 50}$$

$$\boxed{L = 1 \cdot 1744 \ H}$$

18. In a circuit, the applied voltage is 100 V and is found to lag the current of 10 A by 30°. (i) Is the p.f lagging or leading?

ii) What is the value the p.f?

iii) Is the circuit inductive or capacitive?

iv) What is the value of active and reactive power in the circuit?

c) Draw the phasor daigram of the circuit.

Sol^n:- Given, $V = 100$ V

$I = 10$ A

$\phi = 30°$

voltage lags the current by 30°

i) Power factor is leading

ii) Power factor $= \cos\phi = \cos 30° = 0 \cdot 806$ (leading)

iii) Circuit is capacitive

iv) Active power in the circuit

$$P = VI\cos\phi = 100 \times 10 \times \cos 30°$$

$$= 1000 \times 0 \cdot 8660$$

$$= 866 \cdot 025$$

Reactive power in the circuit

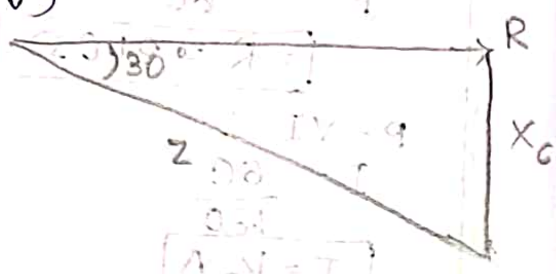
$$Q = VI\sin\phi$$

$$= 100 \times 10 \times \sin 30°$$

$$= 1000 \times \frac{1}{2}$$

$$\boxed{Q = 500 \ VAR}$$ Ans

v)



19. A pure resistance of 50 ohms is in series with a pure capacitance of 100 microfarads. The series combination is connected across 100-V, 50 Hz supply.
Find a) the Impedance
b) Current
c) power factor
d) Voltage across resistor
e) voltage across capacitor
f) Draw the vector daigram.

Sol^n:- Given, $R = 50\Omega$

$C = 100\mu F$

$= 100 \times 10^{-6} F$

$f = \nu = 50 Hz$

$V = 100 V$

$$X_c = \frac{1}{\omega C} = \frac{1}{2\pi f C} = \frac{1}{2 \times 3.14 \times 50 \times 100 \times 10^{-6}}$$

$X_c = 31.84\Omega$

A) $Z = \cancel{X_L} \sqrt{R_c^2 + X_c^2}$

$= \sqrt{(50)^2 + (31.84)^2}$

$= 59.277\Omega$

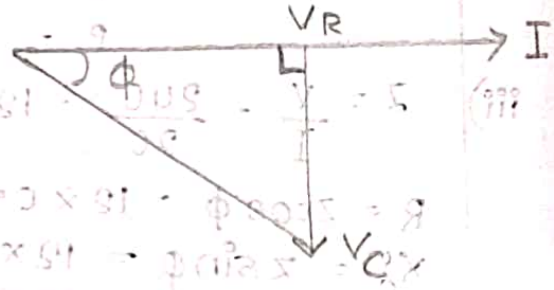
$\boxed{Z = 59.277\Omega}$

B) $I = \frac{V}{Z} = \frac{100}{59.27} = 1.68 A$

C) $PF = \cos\varphi = \frac{R}{Z}$

$= \frac{50}{59.27} = 0.843$

$\boxed{PF = 0.843}$



d) Phase angle

$\varphi = \cos^{-1}(0.843)$

$= 32.54°$

$\boxed{\varphi = 32.54}$

e) Voltage across resistor

$V_R = IR = 1.68 \times 50$

$\boxed{V_R = 84 V}$

f) Voltage across capacitor

$V_c = IX_c = 1.68 \times 31.84$

$\boxed{V_c = 53.99 V}$

20. A 240-V, 50 Hz series R-C circuit takes an RMS current of 20 A. The maximum value of the current occurs $\frac{1}{900}$ second before the maximum value of the voltage. Calculate i) the power factor ii) average power. iii) the parameters of the circuit.

Sol^n:- Given, $V = 240\,V$

$\nu = 50\,Hz$

$T = \frac{1}{50}\,s$

$\frac{1}{50} - 2\pi = 360^\circ$

$\frac{1}{900} \rightarrow \frac{360^\circ \times 50}{900} = 20^\circ$

a) $X_c = \frac{1}{2\pi FC} = \frac{1}{2 \times 3.14 \times 50 \times 100 \times 10^{-3}} = 31.84\Omega$

$Z = \sqrt{R^2 + X_c^2}$

$= \sqrt{50^2 + (31.84)^2}$

$\boxed{Z = 59.27\Omega}$

b) $I = \frac{V}{Z} = \frac{100}{59.27}$

$I = 1.68\,A$

i) Power factor $= \cos\phi = \cos 20^\circ = 0.939$ (lead)

$\boxed{PF = 0.9397}$

ii) average power $= VI\cos\phi$

$P = 240 \times 20 \times \cos 20^\circ$

$P = 240 \times 20 \times 0.9397$

$P = 4510\,W$

iii) $Z = \frac{V}{I} = \frac{240}{20} = 12\Omega$

$R = Z\cos\phi = 12 \times 0.9397 = 11.28\Omega$

$X_c = Z\sin\phi = 12 \times \sin 20^\circ$

$= 12 \times 0.342$

$= 4.1\Omega$

we know,

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

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

$C = \frac{1}{\omega X_c} = \frac{1}{2\pi\nu X_c}$

$$= \frac{1}{2\times 3.14\times 50\times 4.1}$$

$C = 7.767 \times 10^{-4}$

$C = 776 \times 10^{-6} F$

$\boxed{C = 776 \mu F}$ Ans

21. A two element series circuit consumes 700 W and has a p.f = 0.707 leading. If applied voltage is $V = 141.1 \sin(314t + 30°)$, find the circuit constants.

Sol^n:- Given, PF = 0.707 (leading)

We know,

$PF = \cos\phi = 0.707$

$\phi = \cos^{-1}(0.707) = 45°$ (leading)

current leading voltage by 45°

$\therefore$ Reactance is capacitive

Given,

$V = 141.1 \sin(314t + 30°)$

$V = \frac{141.1}{\sqrt{2}} \angle 30°$

$\boxed{V = 99.77 \angle 30°}$

$\cos\phi = \frac{Power}{VI}$

$0.707 = \frac{700}{99.77 \times I}$

$I = \cancel{0.707 \times 99.} \frac{700}{99.77 \times 0.707}$

$\boxed{I = 9.9 A}$

$\boxed{I = 9.9 A \sim 10 A}$

$I = 10 \angle (45° + 30°)$

$\boxed{I = 10 \angle 75°}$

Impedence, $Z = \frac{V}{I} = \frac{99.77 \angle 30°}{10 \angle 75°} = 9.9 \angle -45°$

$Z = 7 - j7$

$X_c = 7 \Omega$

$R = 7 \Omega$

we know, $X_c = \frac{1}{\omega C}$

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

$C = \frac{1}{2\times 3.14 \times 50 \times 7}$

$C = 4.54 \times 10^{-4}$

$C = 454 \times 10^{-6} F$ $\boxed{\Rightarrow C = 454 \mu F}$ Ans

22. A resistance of 20Ω, an inductance of 0.2 H and a capacitance of $100\mu F$ are connected in series across 220 V, 50 Hz mains. Determine the following

a) Impedance

b) current

c) Voltage across R, L and C

d) power in watts and VA

e) power factor and power factor angle.

Soln:- Given,

Resistance, $R = 20\Omega$ Inductance $L = 0.2H$.

Capacitance, $C = 100\mu F = 100 \times 10^{-6} F$.

$V = 220\ V$, $f = 50\ Hz$.

$X_L = \omega L = 2\pi f L$

$= 2 \times 3.14 \times 50 \times 0.2$

$$\boxed{X_L = 62.8\ \Omega}$$

$$X_c = \frac{1}{\omega C} = \frac{1}{2\pi f C} = \frac{1}{2 \times 3.14 \times 50 \times 100 \times 10^{-6}}$$

$$\boxed{X_c = 31.84\Omega}$$

We know,

$$Z = \sqrt{R^2 + (X_L - X_c)^2}$$

$$= \sqrt{20^2 + (62.8 - 31.84)^2}$$

$$Z = 36.85\Omega$$

b) $I = \frac{V}{Z} = \frac{220}{36.85} = 5.97A$

$$\boxed{I = 5.97A}.$$

Voltage Across $R = V_R = IR$

$V_R = 5.97 \times 20 = 119.4\ V$

$$\boxed{V_R = 119.4V}$$

$V_L = X_L I = 62.8 \times 5.97$

$$\boxed{V_L = 374.91\ V}$$

$V_c = X_c I = 5.97 \times 31.84$

$$\boxed{V_c = 190.08\ V}$$

d) Power in watts

$P = VI\cos\phi$

$$P = 220 \times 5.97 \times \frac{R}{Z}$$

$$= 220 \times 5.97 \times \frac{20}{36.85}$$

$$P = 712.83 \text{ wt}$$

power in VA

$$P = VI = 220 \times 5.97$$

$$\boxed{P = 1313.4 \text{ VA}}$$

e) $P.F = \cos\varphi = \frac{R}{Z} = \frac{20}{36.85} = 0.54$

$$\boxed{P.F = 0.54}$$

$$\boxed{\phi = \cos^{-1}(0.54) = 57.31}$$

Dt:- 19.03.2024. **ASSIGNMENT-03**

0 **UNIT II THREE PHASE AC CIRCUIT.**

Short Questions.

1. Three Identical impedances connected in the star connection draw a line current of $5\angle -30$ A, when connected across a 400 V, 50 Hz, three phase AC supply. Find the resistance and reactance of impedance per phase.

Sol^n Given, $I_L = 5\angle -30^\circ$

$= 4.33 - J2.5$

$V_L = 400$ V

$f = 50$ Hz

$$Z = \frac{V_{Ph}}{I_{Ph}} = \frac{\frac{V_L}{\sqrt{3}}}{I_{Ph}} = \frac{\frac{400}{\sqrt{3}}\angle 0^\circ}{5\angle -30^\circ} = 46.18\angle 30^\circ$$

$Z = 46.18\angle 30^\circ$

$= 39.99 + J23.09\ \Omega$

$\boxed{R = 39.99\Omega}$

$\boxed{X = 23.09\Omega}$ Sol^n

As the current is lagging, hence the reactance is inductive reactance,

2. Write the expression for Active power, reactive power and complex power for 3-phase system.

Sol^n Active power $= 3V_{Ph}I_{Ph}\cos\phi$ Watt

$\boxed{P = \sqrt{3}V_L I_L \cos\phi \text{ Watt}}$ Sol^n

Reactive power $= 3V_{Ph}I_{Ph}\sin\phi$ VAR

$\boxed{Q = \sqrt{3}V_L I_L \sin\phi \text{ VAR}}$ Sol^n

Complex power $= P + JQ$

where $\boxed{S = \sqrt{P^2+Q^2}}$ Sol^n

4. A balanced 3 phase star connected load of 100kW takes a lagging current of 100 Amp when connected to 440 V & 50 Hz supply. Find the Impedance for load per phase.

Sol^n Given, $P = 100$ KW $= 100\times10^3$ W

$I_L = 100$ A

$V_L = 440$ V

$f = 50$ Hz

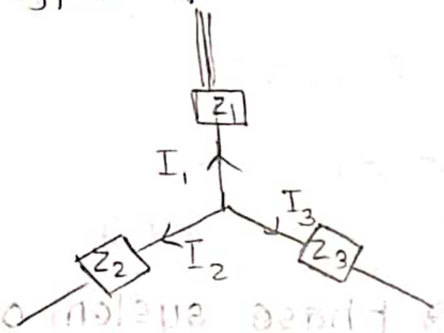
$$Z = \frac{V_{Ph}}{I_{Ph}} = \frac{\frac{V_L}{\sqrt{3}}}{I_{Ph}} = \frac{\frac{440}{\sqrt{3}}}{100} = \frac{4.4}{\sqrt{3}} = 2.54\,\Omega$$

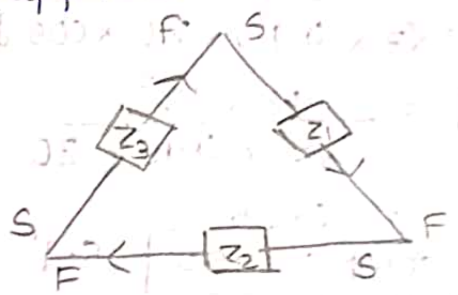
$z = 2.54\,\Omega$

Hence the value of z is $2.54\,\Omega$.

3. Describe the relationship between 3 phase power of Star and Power of Delta for a same load.

Sol^n:- Star and Delta connections are two types of electrical connections used in three-phase power systems. In a star connection, three phases are connected at a central point, while in delta connection, the three phases are connected in loop. The choice between these connections depends on the power requirement and types of load being supplied.





5. What do you mean by phase sequence? How can be the phase sequence can be reversed.

Phase sequence is the order in which phase rotation or phase sequence 3-phase A·C sourse the voltage waveform of a reaches their respective peaks.

The mathematical formulation of various phase in ac can be determined as

$$V_1 = V_m \sin\omega t$$

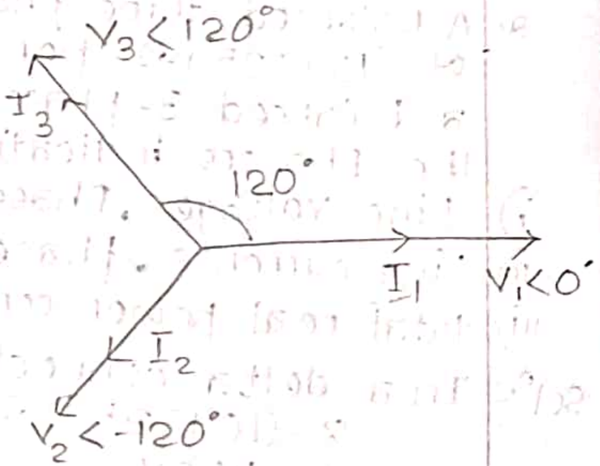
$$V_1 = \frac{V_2}{\sqrt{2}} \angle 0^\circ$$

$$V_2 = V_m \sin(\omega t - 120^\circ)$$

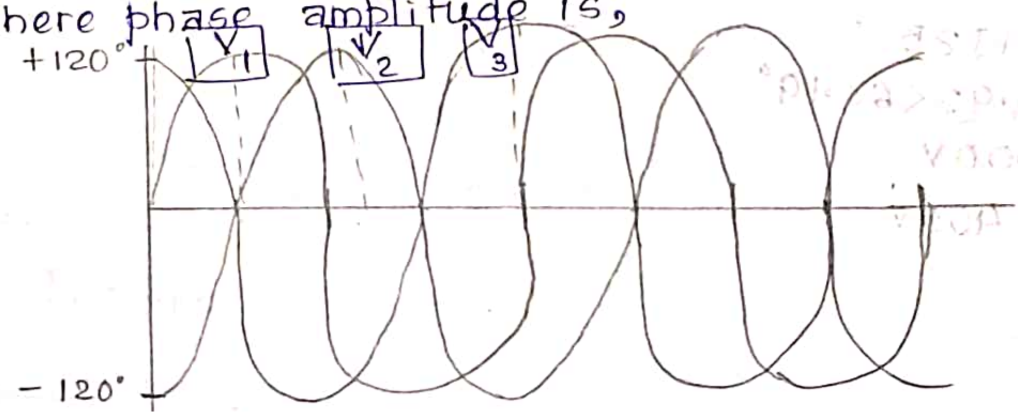
$$V_2 = \frac{V_m}{\sqrt{2}} \angle -120^\circ$$

$$V_3 = V_m \sin(\omega t + 120^\circ)$$

$$V_3 = \frac{V_m}{\sqrt{3}} \angle +120^\circ$$



Where phase amplitude is,



6. A three phase balanced load supplied from 440 V, 50 Hz supply takes a current of 20 A & draws a power of 10 kW. What is the p.f of the circuit?

Solⁿ:- Given, $V_L = 440V$

$f = 50 Hz$

$I_L = 20A$

$P = 10 KW = 10 \times 10^3$ Watt

As we know,

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

$$P = \sqrt{3} \times 440 \times 20 \times \cos\phi$$

$$\cos\phi = \frac{10 \times 10^3}{\sqrt{3} \times 440 \times 20}$$

$$= 0.65$$

$$\boxed{p.f = \cos\phi = 0.65}$$ Solⁿ

7. List any two advantages of 3 phase system over 1-phase system.

Solⁿ:- It is work efficient

It requires less material and produces more power.

Long Questions

8. A balanced three phase delta load has load impedance of $(10+J25)\Omega$ per unit phase and is supplied from a balanced 3-phase 400 V, 50 Hz AC supply. Draw the Phasors indicating the values for

i) Line voltages, Phase voltages.

ii) Line currents, phase currents

iii) total real power consumed by the load

Solⁿ:- In a delta connection,

$Z = (10+J25)\Omega$

$V_L = 400V$

$f = 50 Hz$

$Z = 10+J25$

$= 26.92\angle 68.19°$

i) $V_L = 400V$

$V_{ph} = 400V$

ii) $I_{ph} = \frac{V_{ph}}{Z} = \frac{400}{26.92} = 14.85$ A

$\boxed{I_{ph} = 14.85 \text{ A}}$

$I_L = \sqrt{3} I_{ph} = 25.72$A

$\boxed{I_L = 25.72 \text{ A}}$

iii) $P = \sqrt{3} V_L I_L \cos\phi$

$= \sqrt{3} \times 400 \times 25.72 \times \frac{10}{26.92}$

$P = 6619.368$

$\boxed{P = 6619.36 \text{ Watt}}$. Sol^n

9. Three Identical Impedances connected in the delta fashion draw a line current of $2<30$ A, when connected across a 400 V, 50 Hz 3-ph AC supply, Find the phase current and total power consumed.

Sol^n:- Given, $I_L = 2<30° = 1.73 + J1$.

$V_L = 400$ V

$f = 50$ Hz.

$I_{ph} = \frac{I_L}{\sqrt{3}} = \frac{2}{\sqrt{3}} = 1.154$ A

$\boxed{I_{ph} = 1.154 \text{ A}}$

$P = \sqrt{3} V_L I_L \cos\phi = \sqrt{3} \times 400 \times 2 \times \cos(-30)°$

$\boxed{P = 1200 \text{ Watt}}$ Sol^n

10. A balanced 3 phase star load has load impedance of $(5-J10)\Omega$ per phase and is supplied from a balanced 3 phase 400V, 50 Hz AC supply, Calculate the values for the line voltages, phase voltages and line currents & Power consumption at the load. Also find the power factor.

Sol^n:- In a star connection,

$\boxed{Z = 5 - J10\,\Omega}$

$f = 50$ Hz

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

$I_L = I_{ph}$

$$I_{ph} = \frac{V_{ph}}{Z} = \frac{230.94}{11.18} = 20.65\ A$$

$$\boxed{I_{ph} = I_L = 20.65}$$

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

$$= \sqrt{3} \times 400 \times 20.65 \times \frac{R}{Z}$$

$$= \sqrt{3} \times 400 \times 20.65 \times \frac{5}{11.18}$$

$$\boxed{P = 6398.36\ \text{Watt}}$$

Power factor $= \cos\phi$

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

$$= \frac{5}{11.18}$$

$$= 0.447$$

In star connection, $I_L = I_{ph}$

$$Z = 10 + JX_L$$

$$X_L = \omega L = 2\pi F L = 2 \times 3.14 \times 50 \times 50 \times 10^{-3}$$

$$X_L = 15.7$$

$$Z = 10 + J15.7$$

$$\boxed{Z = 18.61 \angle 57.5}$$

$$V_L = 440V \quad V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{440}{\sqrt{3}} = 254.03\ V$$

$$I_{ph} = \frac{V_{ph}}{Z} = \frac{254.03}{18.61} = 13.65\ A$$

$$\boxed{I_L = I_{ph} = 13.65}$$

iii) $P.f = \cos\phi = \cos(57.5) = 0.537$

$$\boxed{P.f = 0.537}$$

iv) $P = \sqrt{3} V_L I_L \cos\phi$

$$= \sqrt{3} \times 440 \times 13.65 \times \cos(57.5)$$

$$\boxed{P = 5586.24W}$$

v) $Q = \sqrt{3} V_L I_L \sin\phi$

$$= \sqrt{3} \times 440 \times 43.65 \times \sin(57.5)$$

$$\boxed{Q = 8469.769}\ \text{VAR}$$

SINGLE PHASE TRANSFORMER.

Short Answer Questions.

1. A single phase Transformer develops 200 V at the secondary terminals on no load condition. If the secondary winding has 1000 turns, Find the maximum flux in the core. Assume a 30 V, 50 Hz single phase in the primary.

Sol:- $V_2 = E_2 = 200V$, $N_2 = 1000$ turns ; $V_1 = 30V = E_1$; $f = 50$ Hz

As we know, $E_2 = 4.44 f N_2 \phi_m$

$$\phi_m = \frac{E_2}{4.44 \times f \times N_2}$$

$$= \frac{200}{4.44 \times 50 \times 1000}$$

$$\boxed{= \phi_m = 9.009 \times 10^{-4}\ Wb}$$

2. Why the core of a transformer is laminated?

Sol:- The core of a transformer is laminated because of the following reasons,

→ It reduces the energy losses from eddy currents.

→ Eddy current are the current produced when a conducting loop experiences a changing magnetic field, it will, therefore, have small current induced in it.

3. A transformer with 40 turns on high voltage winding is used to step down the voltage from 240V to 120V. find the number of turns in low voltage winding.

Sol:-
$N_1 = 40$ turns
$V_1 = 240V$
$V_2 = 120V$.
$N_2 = ?$

According to formula, $\frac{V_2}{V_1} = \frac{N_2}{N_1}$

$$= \frac{240}{120} = \frac{N_2}{}$$

Long Answer Questions

1. State and explain working principle of a single phase Transformer.

Sol^n Transformer bascically work on the principle of faraday's law of Electromagnetic Induction.

When an AC Apply of 50 Hz frequency is applied to the primary weilding of the transformer. with N_1 turns that induced some MMF (Magnetic Motive Force)

This MMF induced some magnetic flux which changes w.r.t time hence electromotive force (emf) is induced in the primary winding of the transformer according to faraday's law of electromagnetic Induction & can be represented as,

$$\boxed{E_1 = -N_1 \frac{d\phi}{dt}}$$

For Ideal case the Induced emf in the secondary winding can be written as.

$$\boxed{E_2 = -N_2 \frac{d\phi}{dt}}$$

For Ideal transformer the transformation ratio (K) can be calulated as

$$K = \frac{E_2}{E_1} = \frac{N_2}{N_1} = \frac{V_2}{V_1} = \frac{I_1}{I_2}$$

In case of Ideal Transformer, $\boxed{P_1 = P_2}$

$$V_1 I_1 = V_2 I_2$$

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

→ According to lenz's law. the electric field is in opposite direction of Induced emf.

Q. A 220V/20V transformer has 50 turns on its low voltage side. Calculate.

i) The number of turns on the high voltage side?

ii) The turn ratio when it is used as step down transformer?

iii) the turn ratio when it is used as step up transformer?

Sol^n:- $V_1 = 220V$
$V_2 = 20V$
$N_2 = 50$

$$K = \frac{V_2}{V_1} = \frac{N_2}{N_1}$$

$$N_1 = \frac{V_1}{V_2} \times N_2 = 50 \times \frac{22\cancel{0}}{2\cancel{0}} = 550 \text{ turns}$$

$$\boxed{N_1 = 550 \text{ turns}}$$

Step ~~down~~ down, $N_2 < N_1$

$$\frac{N_2}{N_1} = \frac{20}{220} = \frac{5\cancel{0}}{55\cancel{0}} = 1/11 = 0.09$$

Step up $N_2 > N_1$

~~K = 220~~ $K = \frac{220}{20}$

$K = 11$

3 Derive an emf equation of a single phase transformer. Also find the out transformation ratio of the transformer and explain each term briefly.

Let us the single phase supply to the transformer for primary winding side is,

$$V_1 = V_m \sin\omega t$$

& the flux produced in the primary winding side can be represented as,

$$\phi = \phi_m \sin\omega t$$

Therefore the Induced emf in the primary side of transformer can be written as,

$$e_1 = -N_1 \frac{d\phi}{dt}$$

$$e_2 = -N_1 \frac{d}{dt}(\phi_m \sin\omega t)$$

$$e_1 = -N_1 \phi_m \frac{d}{dt} \sin\omega t$$

$$e_2 = -N_1 \phi_m \omega \cos\omega t$$

$$e_1 = -N_1 \phi_m \omega \sin(90 - \omega t)$$

$$e_1 = N_1 \phi_m \sin(\omega t - 90^\circ)$$

where,

e_m = maximum value of induced emf

$e_m = N_1 \phi_m 2\pi f \quad \therefore (\omega = 2\pi f)$

Then the rms value of induced emf can be as

$$E_1 = \frac{e_m}{\sqrt{2}}$$

$$= \frac{2\pi f N_1 \phi_m}{\sqrt{2}}$$

$$\boxed{E_1 = \sqrt{2}\pi f N_1 \phi_m} \; V$$

$$\boxed{E_1 = 4.44 f N_1 \phi_m} \; V$$

similarly,

$$\boxed{E_2 = 4.44 f N_2 \phi_m} \; V$$

The induced emf we can represented in terms of magnetic flux density is as follows.

The magnetic flux density can be represented as

$$B_m = \frac{\phi_m}{A} \; \frac{Wb}{m^2}$$

$$\boxed{\phi_m = B_m A}$$

Then the induced emf in the primary winding side of the transformer can be written as

$$\boxed{E_1 = 4.44 f N_1 B_m A}$$

Similarly,

$$\boxed{E_2 = 4.44 f N_2 B_m A} \; V$$

then the transformation ratio:

$$\boxed{K = \frac{e_2}{e_1} = \frac{N_2}{N_1} = \frac{V_2}{V_1} = \frac{I_1}{I_2}}$$

(4) A 25KVA sigle phone transformer has 500 turns on the primary is connected to 3000 V, 50 Hz supply, find the full load primary and secondary current the secondary emf and maximum flux in the core. Neglect leakage drops and no load primary current.

Sol^n:- $N_1 = 500$ turns, $N_2 = 50$ turns, $V_1 = 3000V$, $P = 25 \times 10^3 VA$

$$P = V_1 I_1 = I_1 = \frac{P}{V_1} = \frac{25 \times \cancel{10^3}}{30\cancel{00}}$$

$$\boxed{I_1 = 8.3333A}$$

$$\frac{N_2}{N_1} = \frac{I_1}{I_2} = I_2 = I_1 \times \frac{N_1}{N_2} = 8.33 \times \frac{\overset{10}{\cancel{500}}}{\cancel{50}}$$

$$\boxed{I_2 = 83.33A}$$

$$\phi_m = \frac{E_2}{4.44 f N_2} = \frac{300}{4.44 \times 50 \times 50}$$

$$\boxed{\phi_m = 0.027 Wb}$$

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

$$= 300\cancel{0} \times \frac{5\cancel{0}}{50\cancel{0}}$$

$$\boxed{E_2 = 300V}$$

DC MACHINES.

Short Answer Questions.

1) Write down the different method of excitations seen in DC machines

The different methods of excitations ~~of~~ seen in DC machines are as follows.

Seperately excited :- When the field windings of DC machines is excited by the seperate DC source. it is called seperately excited DC machines.

Self Excited :- In self excited DC machines, armature and field circuits and ~~exci~~ connected and no seperate DC source is required to excite field windings.

② What is the function of brush and commutator in DC Machine?

The commutator on the DC generator converts the AC into pulsating DC. The commutator assures that the ~~Average~~ current from the generator always flows in one direction.

The brushes ride on the commutator and make good electrical connections b/w generator & load.

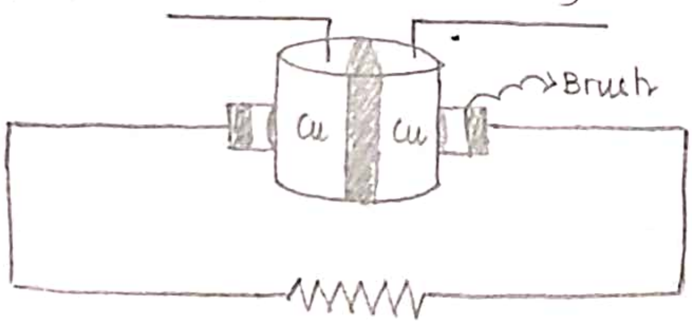
③ Explain the principle on which ~~on the principle~~ DC Motor works?

→ A DC motor works on the principle that whenever a current carrying conductor is placed in a magnetic field on the force is experienced on the conductor.

4. Explain the function of commutator in a DC Machine.

→ commutator is a cylindrical shape structure has two sections of copper seperated by a mica layer.

→ It is used to convert alternating current to DC.



5. What is armature winding? Mention different types of armature winding.

Armature winding is made up of copper and arranged at the outer peri feri of armature core. When the conductor rotates, magnetic field flux system produced by the system is cut and emf is induced.

It is of two types :-

Wave Winding :- In wave winding, the winding arranged in the such a way that each coil span overlaps two adjacent poles. The winding starts and at one end of armature and progress to other end, formulating a wave-like pattern.

Lap winding :- In lap winding, each end of the coil is connected to the adjacent commutator segments, resulting in a continuous series path around armature. Lap winding is commonly used in the high voltage, low current applications.

6. A 4pole, wave wound armature has 720 conductors and is rotated at 1000 rpm. If the useful flux is 20mwb. Calculate the generated Voltage.

$Z = 720$, $N = 1000$, $\phi = 20 \times 10^{-3}$ Wb

$P = 4$, since wave wound, $A = 2$

$$E_g = \frac{NP\phi Z}{60A} = \frac{1000 \times 4 \times 20 \times 10^{-3} \times 720}{60 \times 2}$$

$$\boxed{E_g = 480\ V}$$

LONG ANSWER QUESTIONS

~~Explain~~

Explain the principle of DC generator and hence derive the expression for generated emf.

DC generator is a device which converts mechanical energy to electrical energy.

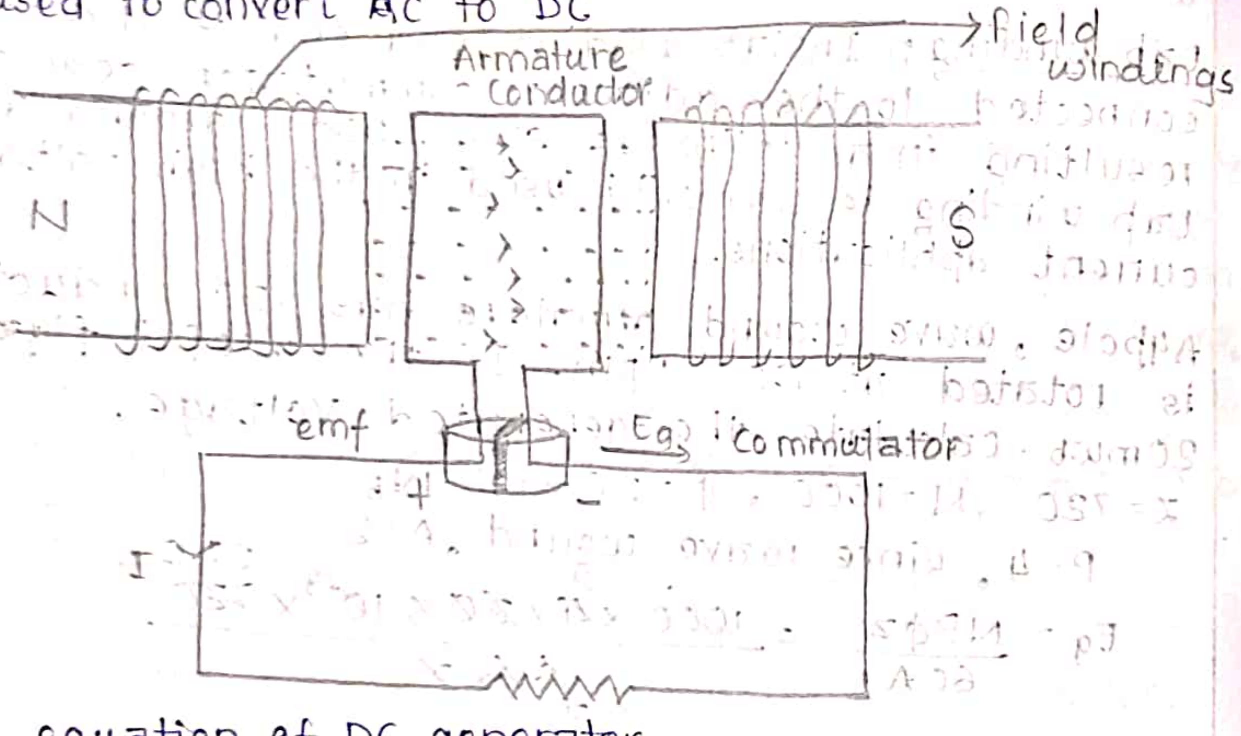
Working principle:-

→ When direct current flows through field ~~working~~ winding a consta[nt] magnetic field is ~~puted~~ ~~used~~ ~~an emf is induced at the terminals of the conductors~~ produced.

→ When the conductor rotates in the magnetic field, the flux is cut and an emf is induced at the terminals of the conductors.

→ Induced emf is alternating in nature. Hence if a load resistance is connected across the terminal an alternati[ng] current flows through the load.

→ But as a dc has to flow through load so a commutato[r] is used to convert AC to DC



emf equation of DC generator

N: Revolutions in RPM

ϕ: Flux per pole

P; No. of poles

Z; Total no. of conductors

A: No. of llel path

= 2 for wave winding

P for lap winding

for, N revolutions ⟶ 60 s

1 revolutions ⟶ $\frac{60}{N}$ sec

emf induced per conductor $= \frac{d\phi}{dt}$

As the supply is dc, so $\frac{d\phi}{dt} = 0$, so instead of $d\phi$ total flux needs to be implemented.

so, emf induced per conductor $= \frac{D\phi}{60/N} = \frac{NP\phi}{60}$

Where dt is time taken for 1 revolution emf induced in Z conductors $= \frac{NP\phi Z}{60}$

emf. induced per parellel path $= \frac{NP\phi Z}{60A}$

For wave winding, $E_g = \frac{NP\phi Z}{120}$

For lap winding, $E_g = \frac{NP\phi Z}{60}$

2. A 6 pole DC shunt generator has 1500 armature conductors in six parellel paths. The average flux per pole in the air gap is 0.065 weber. Calculate the generated emf if the generator runs at a speed of 1500 RPM. with the help of a prime mover.

Given, $P = 6$

$Z = 1500$

$A = 6$

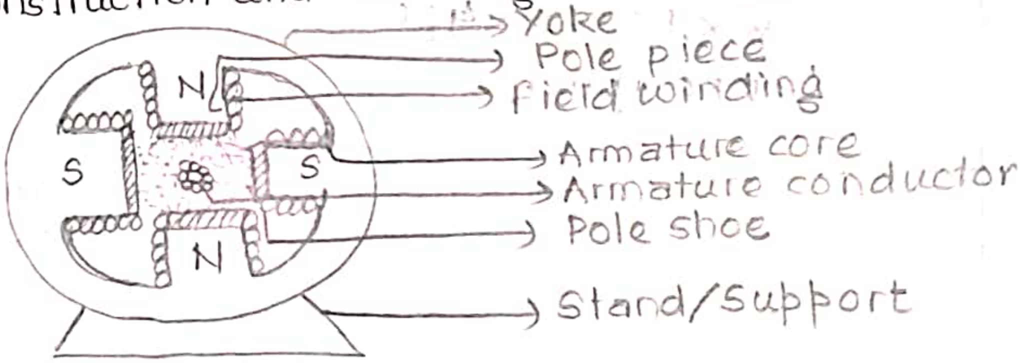
$\phi = 0.065$ Wb

$N = 1500$ RPM

$$E_g = \frac{NP\phi Z}{60A} = \frac{1500 \times \cancel{6} \times 0.065 \times 150\cancel{0}}{6\cancel{0} \times \cancel{6}}$$

$$\boxed{E_g = 2437.5\text{ V}}$$

3. Explain the construction and working DC Machine.



Yoke:- It gives complete support to the machine
Pole piece:- It is made up of laminated cast iron /cast steel with provide support to field windings
Field Winding:- Field Windings are used to generate
Armature Core:- It is made up of laminated cast iron at the outer peri-feri of armature core windings core arranged.

Armature conductor/Armature windings

It is similar made up of copper and ~~managed~~ arranged at the outer periferi of armature core. ~~winding core arranged.~~

→ When this conductor rotates, magnetic flux produced by the system is cut out and an emf is induced which is alternate in nature.

Commutator

Commutator is used to convert AC to DC.

Brushes

Brushes are made up of carbon and are used in for collect the current.

48. An 8 pole lap connected armature has 40 slots with 12 conductores per slot generates a voltage of 500 V. Determine the speed at which it is running if the flux per pole is 50 mWb.

Sol:- $P = 8$ poles

$A = P = 8$ (lap)

$Z = 12 \times 40 \quad E_g = 500\ V$

$\phi = 50 \times 10^{-3}\ Wb$

$$E_g = \frac{NP\phi Z}{60A}$$

$$= \frac{E_g \times 60 \times A}{P \times \phi \times Z}$$

$$N = \frac{500 \times 60 \times 8}{8 \times 50 \times 10^{-3} \times 480}$$

$$= 1250\ rpm.$$

5. An 8-pole generator has 500 armature conductors and has a useful flux pole of 0.065 wb. What will be the emf generated if it is lap connected and run at 1000 rpm? What ~~makes~~ must be the speed at which it is to be driven to produce the same emf if it is wave wound?

Soln:- Given, $P = 8$ Poles

$Z = 500$ V

$\phi = 0.065$ Wb

$N = 1000$ rpm

$E_g = ?$

i) $$E_g = \frac{NP\phi Z}{60A}$$

$$= \frac{1000 \times \cancel{8} \times 0.065 \times 500}{60 \times \cancel{8}}$$

$$\boxed{E_g = 541.660 \text{ V}}$$

ii) $$E_g = \frac{NP\phi Z}{60A}$$

$$N = \frac{E_g \times 60 \times A}{P \times \phi \times Z}$$

$$= \frac{541.666 \times 60 \times \cancel{8}}{\cancel{8} \times 0.065 \times 500}$$

$$= 999.99 \text{ rpm.}$$

$$\boxed{N = 999.99 \text{ rpm}}$$

6. A 4-pole, lap wound DC shunt generator has a useful flux per pole of 0.07 Wb. The armature winding consists of 220 turns each of 0.004 ohm resistance. Calculate the terminal voltage when running at 900 rpm. if the armature current is 50 A.

Soln Given, $P = 4$

$\phi = 0.07$ Wb

$I_a = 50$ A

$R = 220 \times 0.004 = 0.88\Omega$

$N = 900$ rpm

$A = 4$.

Total turns = 220

conductors = 220×2

$= 440 (Z)$

$$E_g = \frac{NP\phi z}{60A}$$

$$= \frac{900 \times 4 \times 0.07 \times 440}{60 \times 4}$$

$$\boxed{E_g = 462 \text{ Volt}}$$

$E_g = V + I_a R_a$

$V = E_g - I_a R_a$

$\frac{R_a}{\|el \text{ path}} = \frac{0.88}{4} = 0.022$

$V = 462 - (50 \times 0.055)$

$V = 459.25$ V (Ans)

For parellel path $= 0.22\Omega$

$$R_{eq} = \frac{R}{\text{No. of parellel path}} = \frac{0.22}{4} = 0.55\ \Omega$$

Dt:- 09.04.2024 ASSIGNMENT -05

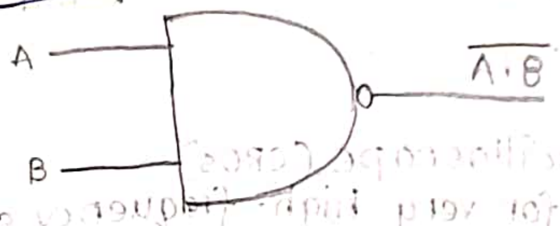
UNIT IV :- DIGITAL ELECTRONICS & ELECTRONIC INSTRUMENTATION

Short Questions.

1. What are the universal gates. Explain on Universal gate, providing its truth table as a example.

Sol^n:- Universal gates are logic gates that can be used to implement any boolean functions without requiring other gates.

NAND Gate.



Truth Table

A	B	$\overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

2. Provide examples of two practical applications for a function generator?

Sol^n:- Signal Generation :- Function generators create various waveforms (sine, square, triangle) for testing and troubleshooting electronic circuits.

Circuit Simulation :- They can simulate real-world signals to test how a circuit responds under different conditions.

3. What is the function of transducer in an instrument?

Sol^n:- Transducer converts one ~~from~~ form of energy (e.g. pressure, temperature, light) into another (usually electrical) for measurement in instruments.

Examples :- Microphone (sound pressure to electrical graph)
Thermocouple (temperature to voltage)
Light dependent resistor (light intensity to resistance)

4. What is the function of trigger circuit in a digital oscilloscope?

The trigger circuit synchronizes the oscilloscope's sweep with a specific event in the input signal. This allows stable and clear visualisation of repetitive or transient signals.

5. What are different operating modes of DSO.

Channel Mode :- Selects how multiple input channels are displayed (overlayed, seperate channel).

Trigger mode :- Sets the trigger conditions for signal acquisition (edge, level etc)

Timebase Model :- Adjusts the horizontal sweep speed to visualize different time scales of the signal.

~~5.~~ Measurement mode :- Enables automatic measurements like, voltages, frequency period etc.

6. Mention any two advantages and disadvantages of a DSO.

Sol^n Advantages of DSO.

- High accuracy and resolution for signal visualisation
- Digital storage allows for signal capture, analysis and comparison
- Advanced features like cursors, automatic measurements, and data logging.

Disadvantages of DSO.

- Higher cost compared to analog oscilloscope (CROs)
- May have limitations in bandwidth for very high-frequency signal (addressed by high-bandwidth DSOs).
- Requires a digital-to-analog converter (DAC) for signal reconstruction, which can introduce artifacts.

7. What is the function of time base generator in a CRO?

Sol^n:- The time base generator creates a sawtooth waveform that deflects the electron beam in a CRO horizontally across the screen.
The increasing voltage portion (sweep) displays the signal, and the rapid drop brings the beam back the next sweep. This creates the illusion of a continuous signal on the screen. The timebase setting controls the speed of the sweep, allowing visualisation of different time scales of the input signal.

Long Questions.

8. Convert the following

i) $(3A6 \cdot C58D)_{16}$ =

for converting $(3A6 \cdot C58D)_{16}$ in to octal we have to first convert it into binary.

so,

$$(3A6 \cdot C58D)_{16} = (001110100110 \cdot 1100010110001101)_2$$

Now the above converted number can be converted to octal

$$(001\,110\,100\,110 \cdot 110\,001\,011\,000\,110\,1)_2 = (1646 \cdot 613064)_8$$

ii) $(0 \cdot 6875)_{10} = (0 \cdot 1011)_2$

$2^{-1}\,2^{-2}\,2^{-3}\,2^{-4}\,10$

$\cancel{0} + \frac{1}{12} + \frac{1}{32} +$

$0 \cdot 6875 \times 2$

$1 \cdot 375 \times 2$

$0 \cdot 75 \times 2$

$1 \cdot 5 \times 2$

1×2

iii) $(1AD \cdot E0)_{16} = (429 \cdot 875)_{10}$

$16^2 16^1 16^0$

~~$1 \times 16^2 + A(10) \times 16^1 + D(13) \times 16^0$~~

~~$= 256$~~

~~1×16^2~~

$1 \times 16^2 + A(10) \times 16^1 + D(13) \times 16^0 = 256 + 160 + 13$

$= 429 \cdot 875)$

$\cancel{7}\cancel{14} \times \frac{1}{\cancel{16}8}$

0.875

$(1AD \cdot E0)_{16} = (655 \cdot 7)_8$

$1AD \cdot E0 = (\overline{000}\,\overline{110}\,\overline{101}\,\overline{101} \cdot \overline{111}\,\overline{000}\,\overline{000})$

$= (655 \cdot 7)_8$

iv) $(356 \cdot 15)_8 = (\quad)_2$

$(356 \cdot 15)_8 = (011101110 \cdot 001101)_2$

$(356 \cdot 15)_8 = (238 \cdot 203125)_{10}$

$\begin{matrix} 3 & 5 & 6 & \cdot & 1 & 5 \\ 8^2 & 8^1 & 8^0 & \cdot & 8^{-1} & 8^{-2} \end{matrix}$

$= 3 \times 8^2 + 5 \times 8 + 6 \times 8^0$

$= (238 \cdot 003125)_{10}$

v) $(1011011101 \cdot 10101)_2 = (409 \cdot 03125)_{10}$

$(1011011101 \cdot 10101) =$

$2^9 2^8 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0 \; 2^{-1} 2^{-2} 2^{-3} 2^{-4} 2^{-5}$

$1 \times 2^9 + 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^0$

$= 409$

$\frac{1}{2} + \frac{1}{8} + \frac{1}{32}$

$= \frac{16 + 4 + 1}{32}$

$= 0.03125$

To $(\quad)_8$

$= (\overline{001}\,\overline{011}\,\overline{011}\,\overline{101} \cdot \overline{101}\,\overline{010})$

$= (1385 \cdot 52)_8$

To $(\quad)_{16}$

$= (\overline{0010}\,\overline{1101}\,\overline{1101} \cdot \overline{1010}\,\overline{1000})$

$= (2DD \cdot A8)_{16}$

To $(\quad)_{10}$

$= 2 \times 16^2 + 13 \times 16 + 13 \times 16^0 + 10 \times 16^{-1} + 8 \times 16^{-2}$

$= (733 \cdot 65625)_{10}$

vi) Compute 1's and 2's complement of $(101010)_2$ and $(111001)_2$

i) $(101010)_2$

1s' complement = 010101
2s complement = + 1
→ 010110

ii) $(111001)_2$

1s complement = 000110
2s complement = + 1
→ 000111

vii) $(3745)_8 = (011111100101)_2$

$(3745)_8 = (011111100101)_2$

$(3745)_8 = (7E5)_{16}$

~~= (0011011110100000101)~~

$(011111100101)_2$

$(7E5)_{16}$

$(3745)_8 = ($ ~~20201~~ $2021)_{10}$

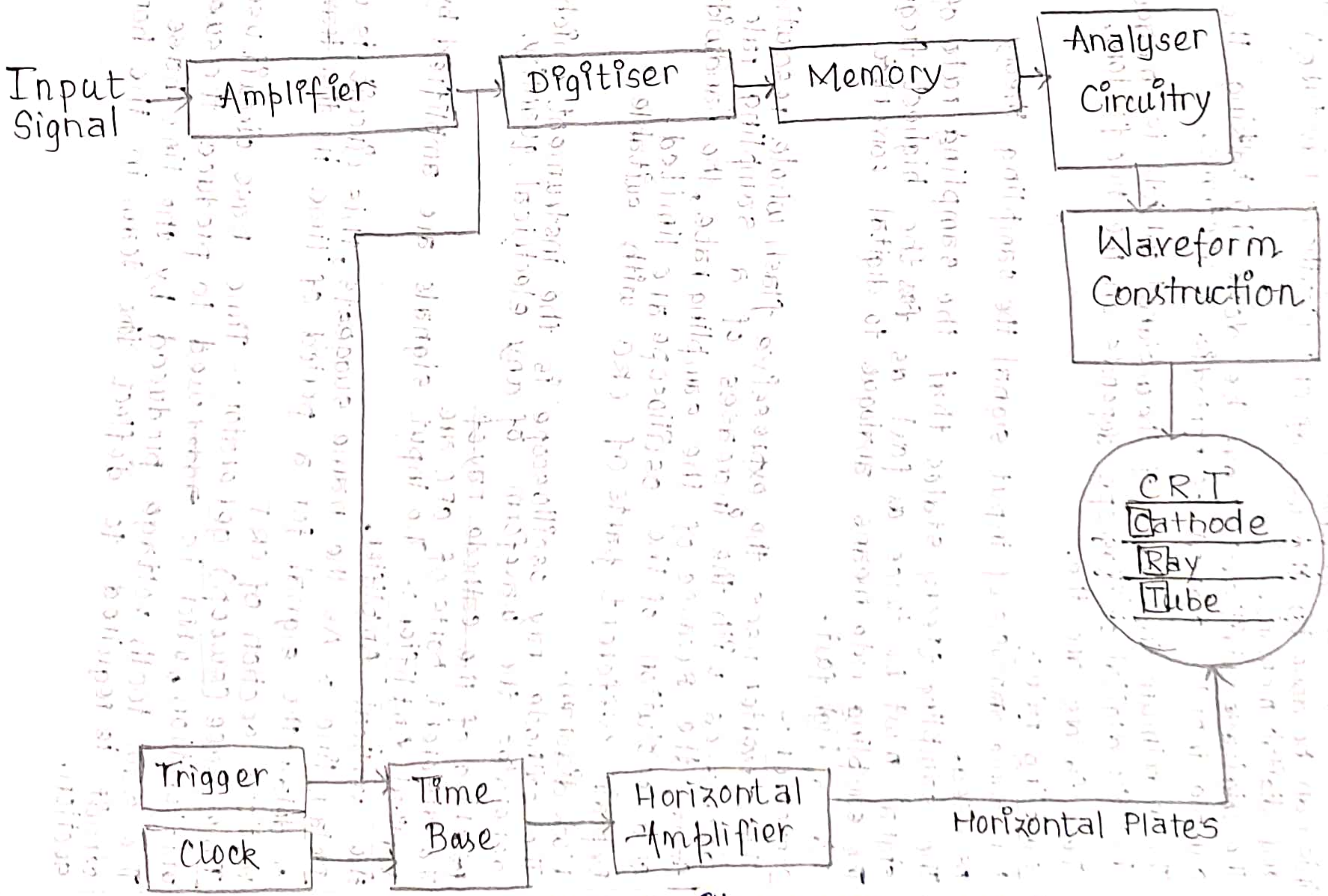
$3 \times 8^3 + 7 \times 8^2 + 4 \times 8^1 + 5 \times 8^0 =$

1536 + 448 + 32 + 5 = ~~20201~~ 2021

Octal	
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

Hexadecimal	
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
(A)10	1010
(B)11	1011
(C)12	1100
(D)13	1101
(E)14	1110
(F)15	1111

9. Explain the working of a digital oscilloscope with suitable block diagram.



Digital Oscilloscope Block Diagram.

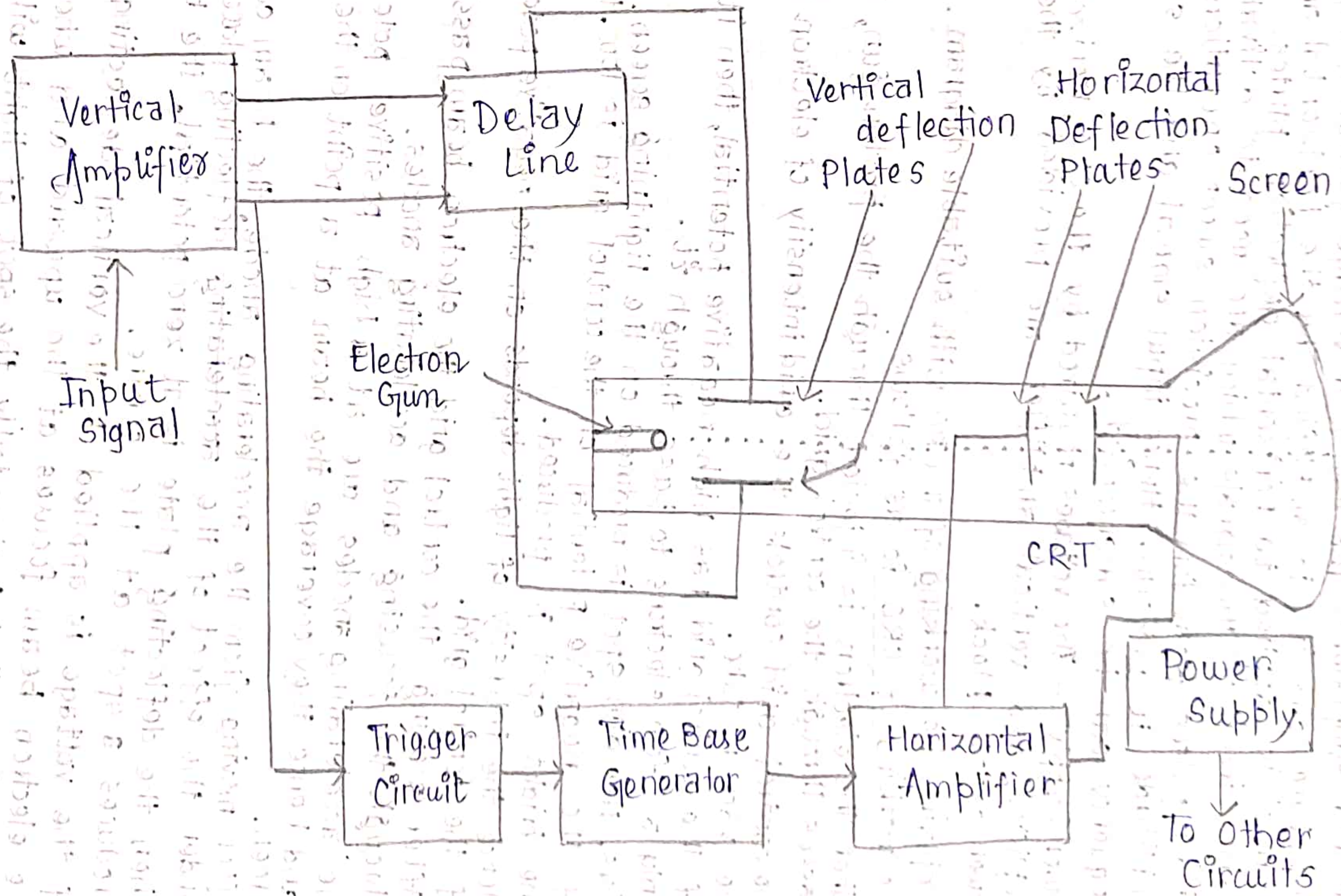
The working principle of Daigital Storage Oscilloscope is.
→ The digital oscilloscope digitises and stores the input signal.
This can be done by the use of CRT (cathode ray tube) and digital memory.
→ The ~~digitalis~~ digitisation can be done by talking the sample input signal of periodic wavefroms.
→ The maximum frequency of the ~~a~~ signal which is meacured by the digital oscilloscope depends on the two factors. These factors are the.

1) <u>Sampling rate</u> :-
For same analysis of input signal the sampling theory is used.
The sampling theory states that the sampling rate of the signal must be twice as fast as ~~fas~~ the highest frequency
The sampling rate means analogue to digital converter has a high fast.

<u>Converter</u> :-
The converter uses the expressive flash whole resolution decreases with the increases of a sampling rate.
~~from the~~ Because of the sampling rate, the bandwidth and resolution of the oscillosope are limited.

10. Explain Different parts of CRO with suitable block diagram.
The cathode ray oscilloscope is the instrument which generates the waveform of any electrical quantity.
~~Working of the cathode ray of~~
The different parts of CRO are

- <u>Vertical Amplifier</u> :- The input signals are amplified by the vertical Amplifier.
- <u>Delay line</u> :- As the name suggests, this circuit is used to delay the signal for a period of time in the ~~traversal~~ vertical section of CRT
- <u>Time Base (sweep) generator</u> :- Time base circuit uses a uni-junction, which is ~~added~~ used to produce the sweep.
The saw tooth voltage produced by the time base circuit is required to deflect the team in the horizontal section.


Vertical Amplifier
Input Signal
Delay Line
Electron Gun
Vertical deflection Plates
Horizontal Deflection Plates
Screen
CRT
Power Supply
To Other Circuits
Trigger Circuit
Time Base Generator
Horizontal Amplifier

Horizontal Amplifier :- The saw tooth voltage produced by the time base circuit is amplified by the horizontal amplifier before it is applied to horizontal deflection plates.

Trigger Circuit :- The signals which are used to activate the trigger pulses ~~from~~ for the precision sweep operation whose amplitude is uniform. Hence input signal and the sweep frequency can be synchronised.

Power Supply :- The voltages required by the CRT, horizontal amplifier, and vertical amplifier are provided by the power supply block.

11. Explain the working of a CRO with suitable diagram.

Soln The working of CRO is as follows.

→ When the electron is injected through the proton gun, it passes through the control grid.

→ The control grid controls the ~~grid~~ intensity of electron in the vacuum tube.

→ If the control grid has high negative potential, then it allows only a few electrons to pass through it.

→ Thus, the dim spot is produced on the lightning screen.

→ If the negative potential on the control grid is low, then he bright spot is produced.

→ Hence the intensity of light depends on the negative potential of the control grid.

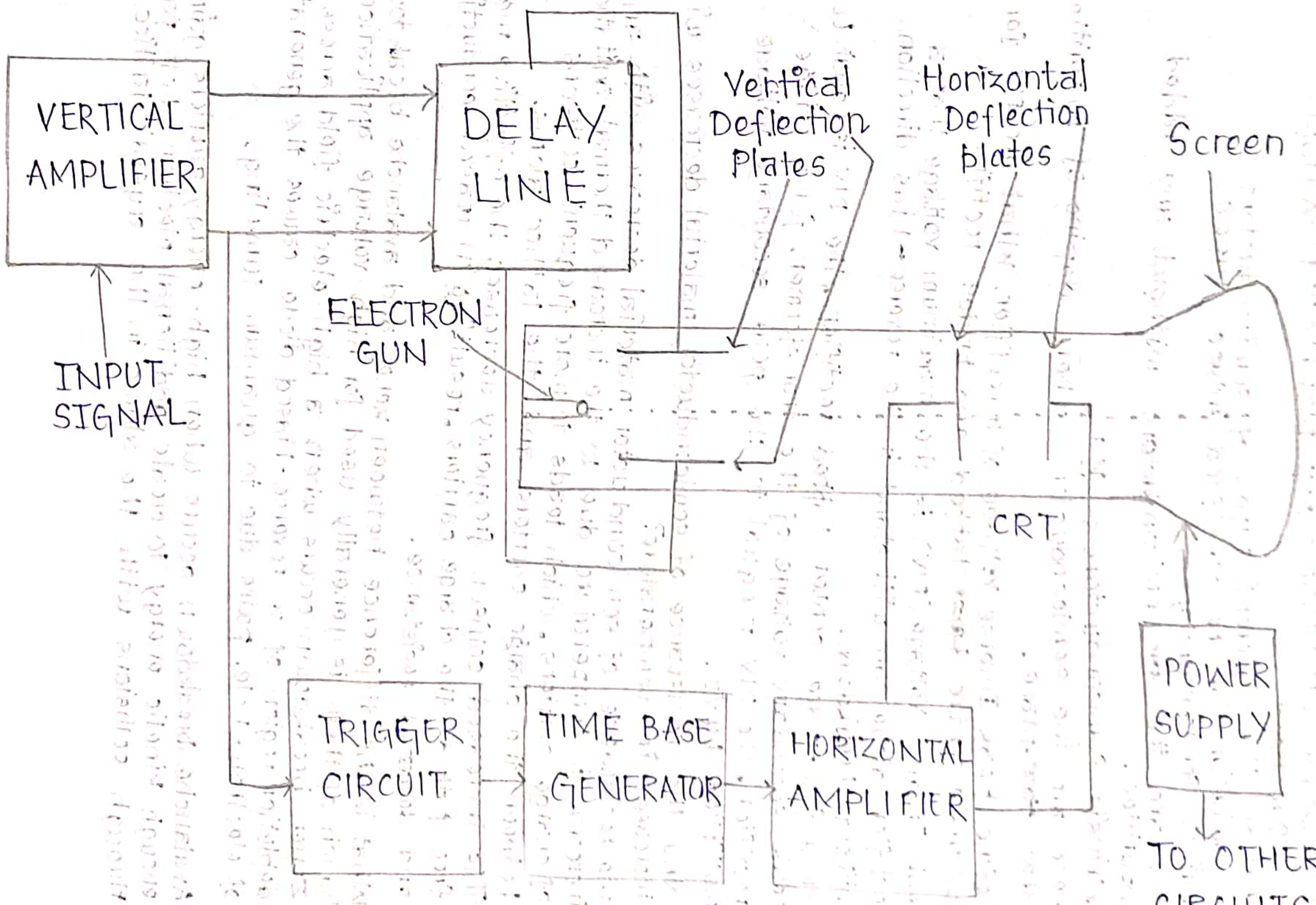
→ After moving the control grid the electron beam passing through the focusing and accelerating anodes.

→ The accelerating anodes are at a high positive potential and hence they coverage the beam at a point on the ~~beam~~ screen.

→ After moving from the accelerating anode, the beam comes under the effect of the ~~accelerating~~ deflecting plates.

→ When the deflecting plate is at zero potential, the beam produces a spot at the centre.

→ If the voltage is applied to the vertical deflecting plate, the electron beam focuses at the upward and when the voltage is applied horizontally the spot of light will be deflected horizontally.



BLOCK DIAGRAM FOR CATHODE RAY OSCILLOSCOPE

Dt:- 09.04.2024. **ASSIGNMENT - 04**

UNIT-03

SEMICONDUCTOR DIODES AND DIODE APPLICATIONS.

Short Questions

Q1. What are the different types of semiconductors.

Sol^n Semiconductor can be classified into two types.

a) Intrinsic Semiconductors :-
These are the ~~pu~~ semiconductors without any added impurities.

b) Extrinsic Semiconductors :-
These are the semiconductors where doping of impurities takes ~~place~~ place.

02. Define peak Inverse Voltage of a rectifier. What are PIV for full wave centre ~~tapp~~ tapped and bridge rectifier?

Sol^n:- Peak Inverse Voltage (PIV) is the maximum voltage that a rectifier diode can withstand in the reverse-bias direction without breakdown.
For a full-wave center-tapped rectifier, the PIV is equal to the peak secondary voltage of the transformer. for a bridge rectifier, the PIV is equal to the peak secondary voltage multiplied by $\sqrt{2}$.

03. Why the resistance of semiconductor material decreases with increases in temperature?

Sol^n:- the resistance of semiconductor material decreases with an increase in temperature due to the increased thermal agitation of charge carriers, which leads to more frequent collisons between the charge carriers and the lattice atoms.
This increased collison frequency decreases the effective mean free path of the charge carriers, resulting increased conductivity and decresed resistance.

04. What is the difference between zener and avalanche breakdown? Which of them is generally used for high voltage application?

Sol^n:- Zener breakdown occurs when a high electric field across the depletion region of a reverse-biased diode causes the generation of electron-hole pairs due to quantum tunneling.

Avalanche breakdown occurs when high-energy carriers gain enough kinetic energy to create additional electron-hole pairs through collisions with the atoms in the crystal lattice.

05. What are the majority charge carriers in p-type and n-type semiconductors?

Sol^n: In p-type semiconductors, the majority charge ~~entities~~ carriers are "holes" (electron deficiencies created by doping with acceptor impurities), while in n type semiconductors, the majority charge carriers are electrons.

06. What is a ideal diode?

Sol^n An Ideal diode is a theoritical concept representing a diode that conducts current perfectly in one direction (forward bias) and blocks it completely in the reverse direction (reverse bias), with no voltage drop across it.

07. What is the basic difference between p-type and n-type semiconductor?

Sol^n:- The basic difference between p-type and n-type is

	P-type Semiconductor	n-type Semiconductor
i)	In p-type semiconductors the majority charge carriers are "holes" positive created by doping.	In n-type semiconductors the majority charge carriers are negative "electrons" created by doping.
ii)	In p-type semiconductors we add trivalent impurities to the crystal Ex :- Boron	ii) In-n-type semiconductors we add penta-valent impurities. Ex:- Germanium

08. Define biasing and justify its necessity.

Sol^n:- Biasing refers to the application of external voltage to a semiconductor device (such as a diode or translator) to establish the desired operating conditions. It's neccesary to ensure that the device operates in the desired mode (forward or reverse bias) and within its specialised operating range.

09. What is Breakdown Voltage?

Sol^n Breakdown voltage is the voltage at which a semiconductor device, such as a diode or transistor, undergoes a transition from its normal operating ~~system~~ mode to a high conductivity.

10. Mention difference between clipper and Claamper?

11 What is biased clipper?

Sol^n A biased clipper is a clipper circuit where a DC biased voltage is added to the input signal before clipping. This bias voltage shifts the input signal up or down altering the clipping level accordingly.

12 What is knee voltage?

Sol^n Knee Voltage is the voltage at which a diode starts to conduct significantly in the forward direction. It's the voltage where the diode current begins to rise sharply with increasing forward voltage.

13 What is a zener diode?

Sol^n Zener diode is a special type of diode designed to operate in the reverse breakdown region. It is designed to have a well-defined breakdown voltage (the zener voltage) and ~~exibits~~ exibits a relatively constant voltage drop across its terminals when reverse-biased.

14. Define static and dynamic resistance?

Sol^n:- Static Resistance

This is the ~~the~~ static resistance offered by a component to direct current (DC). It's measured using a DC voltage source and current meter, and is a constant value for a specific voltage across the component.

Dynamic Resistance :- This refers to the resistance offered by a component to alternating current (AC). It can vary depending on the frequency of the AC signal and is often measured using impedance analyzers.

15. Differentiate between P-type and N-type semiconductors. Also name the doping materials used for their formation.

Sol^n P-type Semiconductor:- Doped with elements having three valence electrons (e.g Boron, Alluminium). These elements create "holes" where an electron could be, allowing for movement of positive charge carriers (holes).

N-type Semiconductor :- Doped with elements having five valence electrons become free to move, creating negative charge carriers.

16 Why silicon is mostly prefered as a semiconductor material. Explain by giving at least five reasons?

Sol^n:- Silicon is widely used as semiconductor material due to the following reasons.

Abundant :- Silicon is the second most abundant element in the ~~Wor~~ ~~ld World~~ Earth's crust, making it readily available and affordable.

Stable Dioxide(SiO_2): Silicon dioxide (silicon dioxide) forms a stable, insulating layer on silicon's surface crucial for creating MOSFETs (Metal-Oxide-Semiconductor Field-Effect Transistor) the building blocks of integrated circuits.

Mature Processing Techniques:- fabrication processes for silicon devices are well-established, realible, and cost-effective.

Wide Bandgaps :- Silicon's bandsgap (energy difference between valence and conduction bands) is suitable for a variety of electronic applications, offering a good balance between conductivity.

Relatively High Thermal Conductivity :- Silicon conducts heat reasonably well, which is important for dissipating heat generated in electronic devices.

17. State cut in voltage value of diode for silicon and germanium -

Sol^n Silicon diode

The cut in voltage in silicon diode is typically around 0.7 volts (V). This is the forward voltage required for significant current to flow through the diode in the forward bias direction.

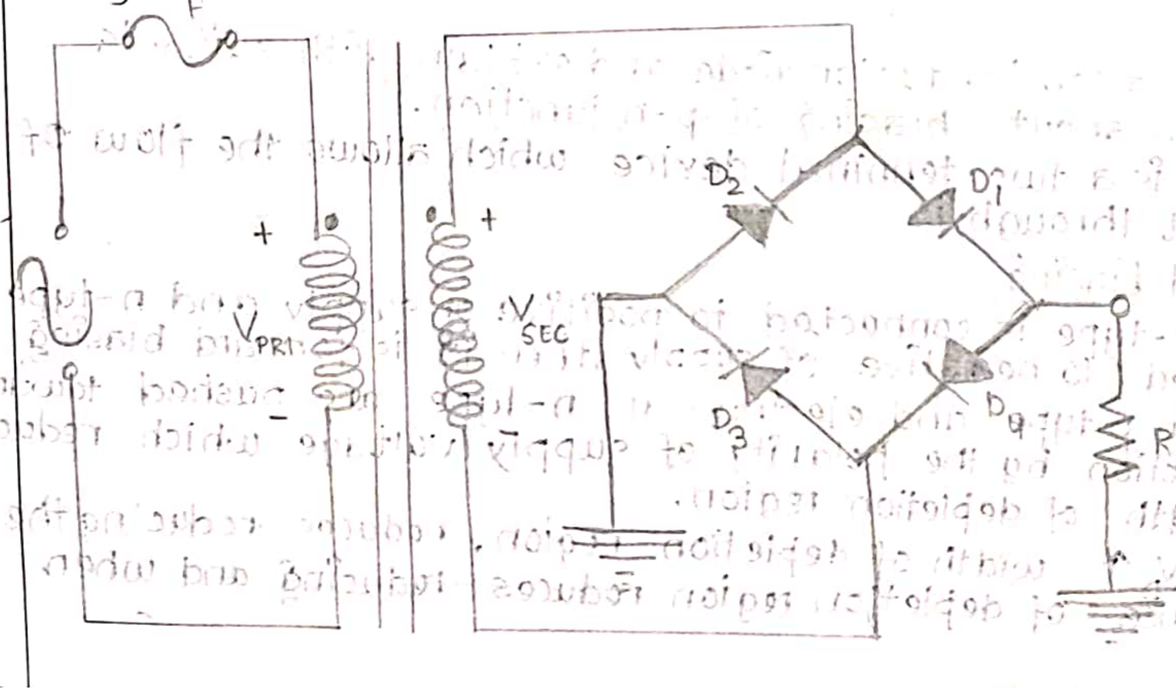
Germanium Diode

Germanium diodes have a lower cut in voltage, around 0.3 V. Howeves due to higher leakage currents and temperature sensitivity, they are less common in modern electronics.

LONG QUESTIONS

18. Draw the circuit diagram of a full wave bridge type rectifier using diode and explain its operation with suitable waveform.

Sol^n



Operation +ve half cycle

→ During the +ve half cycle, Diodes D_2 & D_3 will be shunt.

→ At this time diodes D_1 & D_2 will be opened.

$$S_1 \rightarrow a \rightarrow c \rightarrow b \rightarrow d \rightarrow S_2$$

Applying KVL in loop

$$V_m - V_{D_2} - V_D - V_{D_3} = 0$$

$$V_m - V_o = 0$$

$$\boxed{V_m = V_o}$$

operation of -ve half cycle.

During the negative half cycle, diodes D_1 & D_2 will be shunt & D_2 and D_3 will be opened.

The directions of current will be

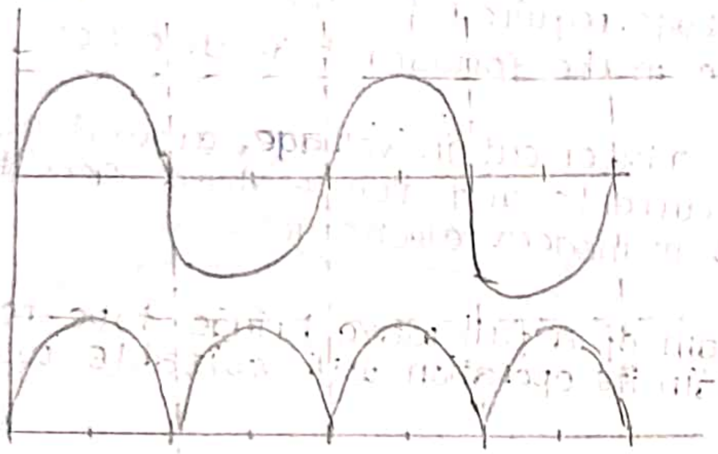
$$S_2 \rightarrow d \rightarrow c \rightarrow b \rightarrow a \rightarrow S_1$$

Applying KVL in the loop

$$V_m - V_{D4} - V_o - V_{D1} = 0.$$

$$\boxed{V_o = V_m}$$

The output DC voltage will be as shown.



Q9. What is a semiconductor diode and explain with suitable diagram about biasing of p-n junction.

→ A diode is a two terminal device which allows the flow of current through it.

:- Forward biasing

→ When p-type is connected to positive of supply and n-type is connected to negative of supply, then it is forward biasing.

→ Holes in p-type and electrons in n-type are pushed towards the junction by the polarity of supply voltage which reduces the width of depletion region.

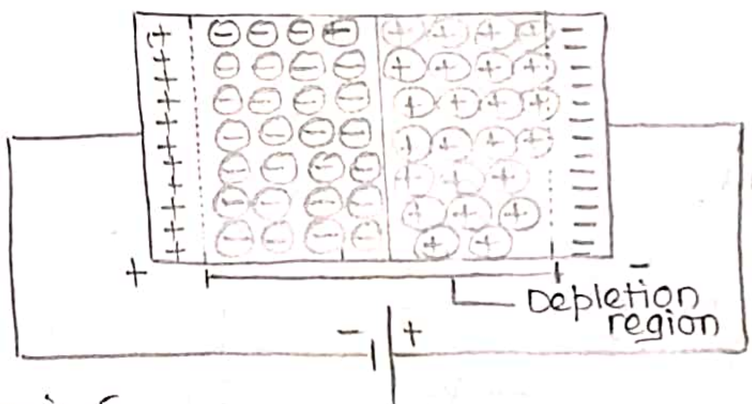
→ When $V_D \uparrow$ width of depletion region, reduces reducing the resistance of depletion region ~~reduces reducing~~ and when the resistance of depletion region becomes negligible.

Reverse biasing :-

→ When p-type is connected to negative of supply and n-type is connected to positive of supply; then it is reverse biasing.

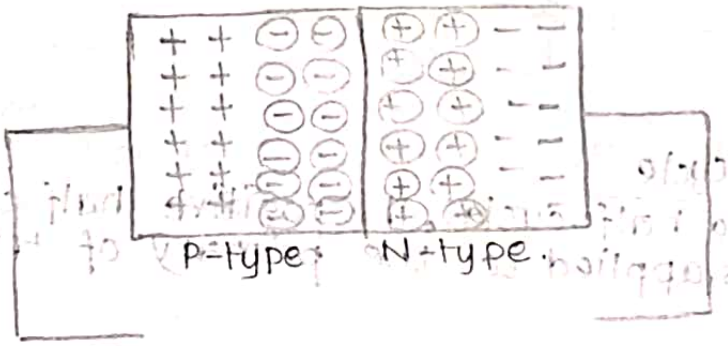
→ Holes in p-type and electrons in n-type are attracted towards the polarity of supply thereby increasing the width of depletion region.

→ When V_D increases, the width of depletion region increasing offering more resistance to the flow of majority carriers. Hence there is no current flow due to majority carriers.



no/zero biasing

When no external supply is given, it is called as zero baising



Under no biasing condition, the flow of majority and minority carriers cancel out. so, the overall current flow is zero.

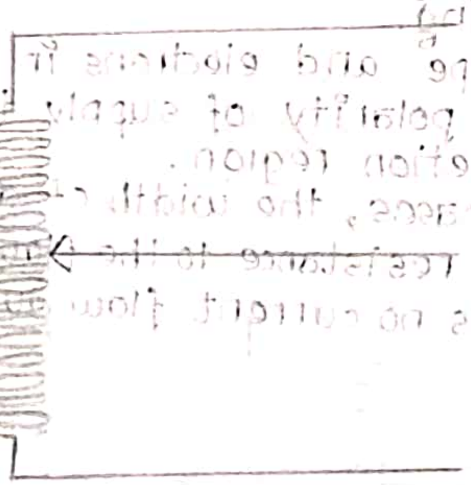
20 With a neat daigram of circuit diagram and waveforms, explain the working of centre tapped full wave rectifier. Also discuss about the merits & demerits of it.

Sol^n In a centre taped rectifier, ~~the~~ consists of a) center tapped transformer

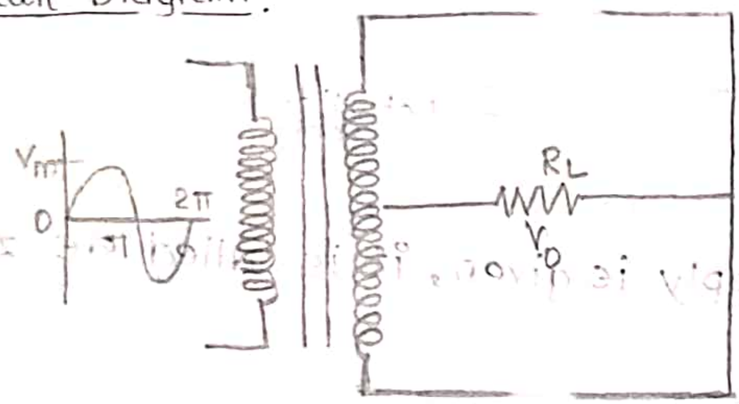
b) two diodes

c) load resistor (R_L).

The secondary winding is divided equally in two parts. The middle point is coincident as tapping point. The turn ratio. $\frac{N_2}{N_1} = \frac{2}{1}$.

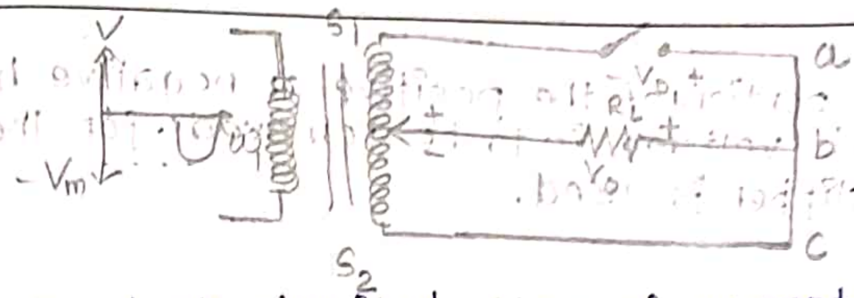


Circuit Diagram.



During Half cycle

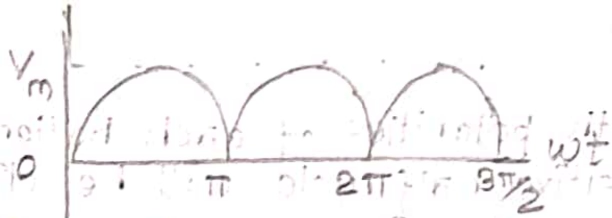
→ During the +ve half cycle, the positive half cycle on portion of i/p signal is applied tot the primary of transformer,



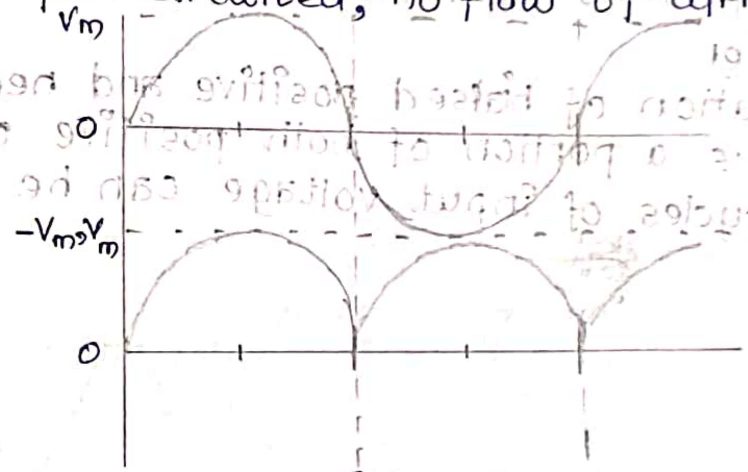
as D_2 short circuited, flow of current is as :-
$S_2 \to C \to b \to S_1$

→ Applying KVL.
$-V_{D_2} - V_0 + V_m = 0$

$\boxed{V_0 = V_m}$



→ As D_1 is open circuited, no flow of current.



21 Write short notes on clipper.

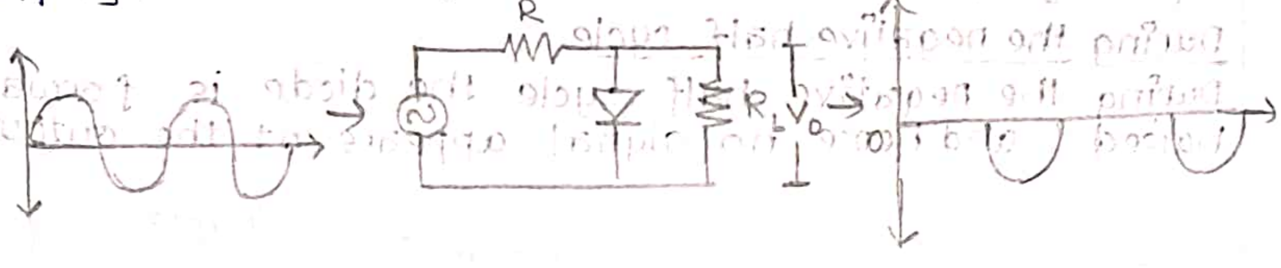
→ The circuit with which the waveform is shaped by removing (or clipping) a portion of the applied wave is known as a clipping circuit.

→ Clippers find extensive use in radar, digital and other electronic device.

→ The types of diode clippers are.
a) Positive clipper
b) Baised clipper
c) combination clipper.

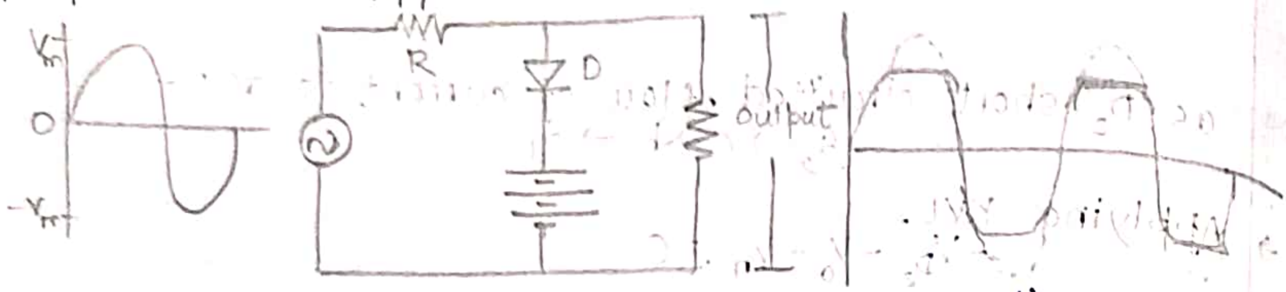
Positive clipper:

A positive clipper is that which removes the positive half cycle of the input voltage.



Baised Clipper.

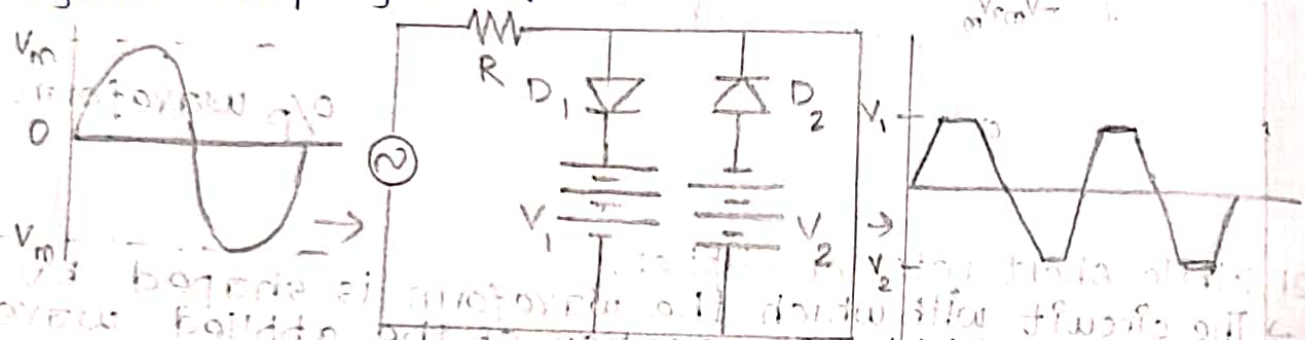
Sometimes a small portion of the positive or negative half cycle of the input voltage is to be removed. for their purpose baised clipper is used.



With polarities of each battery as shown, a portion of each positive half cycle will be clipped. However the negative half cycle will appear as such across the load.

Combination clipper

It is the combination of biased positive and negative clippers. with this a portion of both positive and negative half cycles of input voltage can be removed.



22. Explain the Working of positive clampping circuits.

Sol^n:- Positive clamper

If the circuit pushes the signal upwards then the circuit is said to be a positive clamper. When the signal is pushed upwards, the negative peak of the signal meets the zero level.

The positive clamper passes the input signal to the output load when the diode is reverse biased and blocks the input signal when the diode is forward biased.

During the negative half cycle.

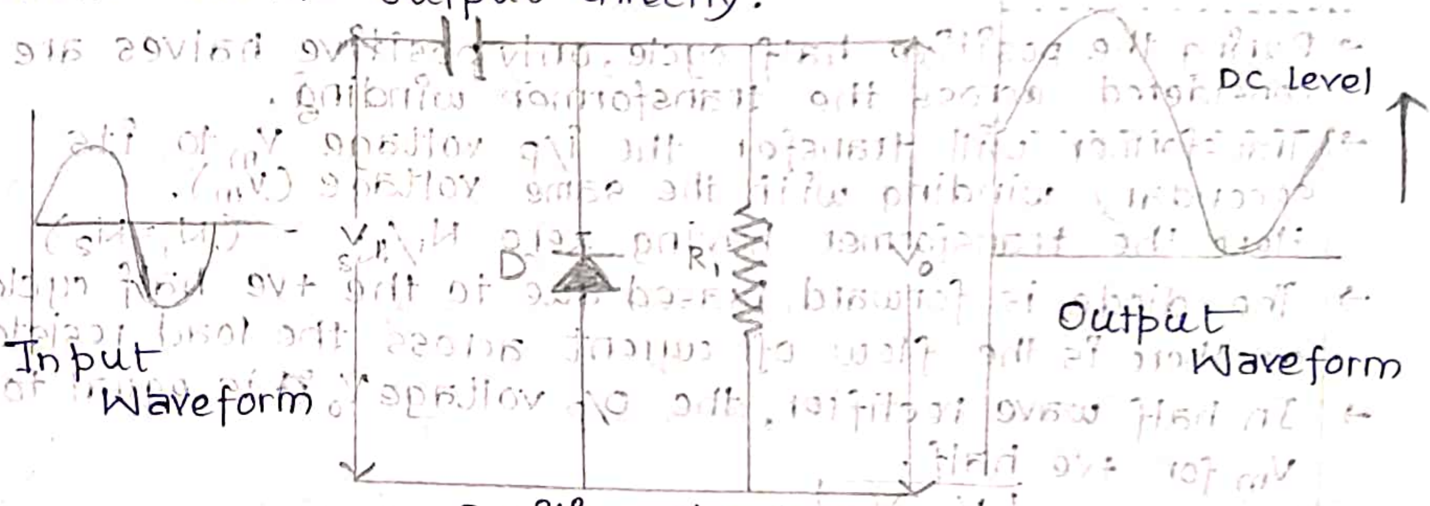
During the negative half cycle the diode is forward baised and hence no signal appears at the output.

→ In forward baised condition, the diode allows electric current through it.

→ This current flows through the capacitor and charges it to the peak value of the input voltage V_m. The capacitor charged in inverse polarity (positive) with the input voltage.

During positive half cycle.

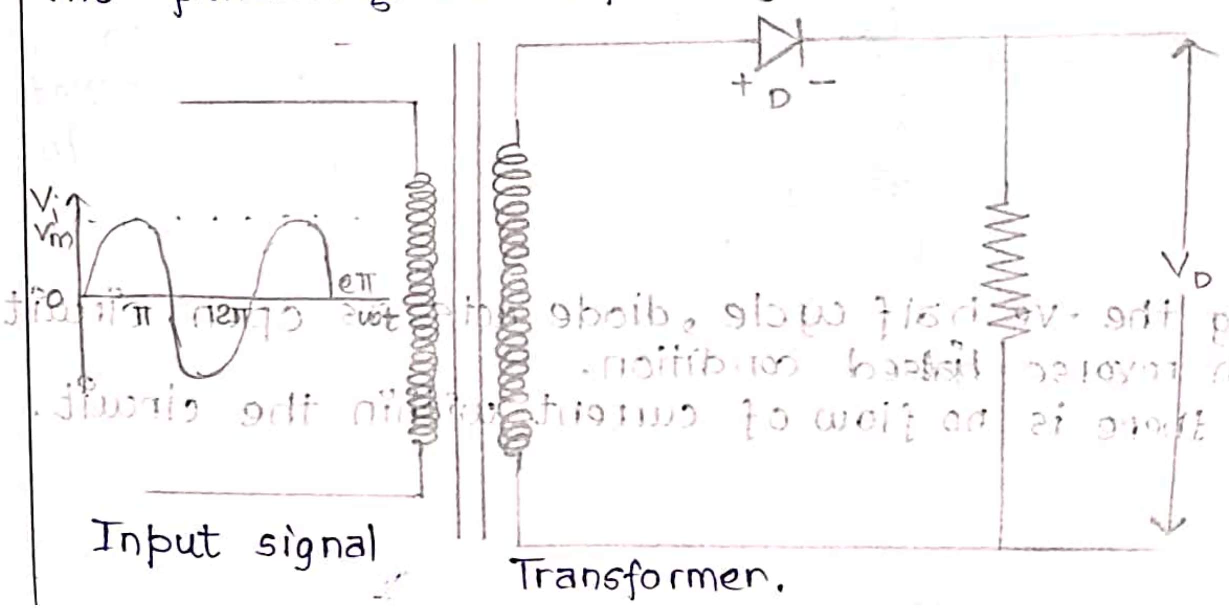
During the positive half cycle of the input AC signal, the diode is reverse biased and hence the signal appears at the output. In reverse baised condition, the diode doesn't allow electric current through it. So the input current towards output directly.



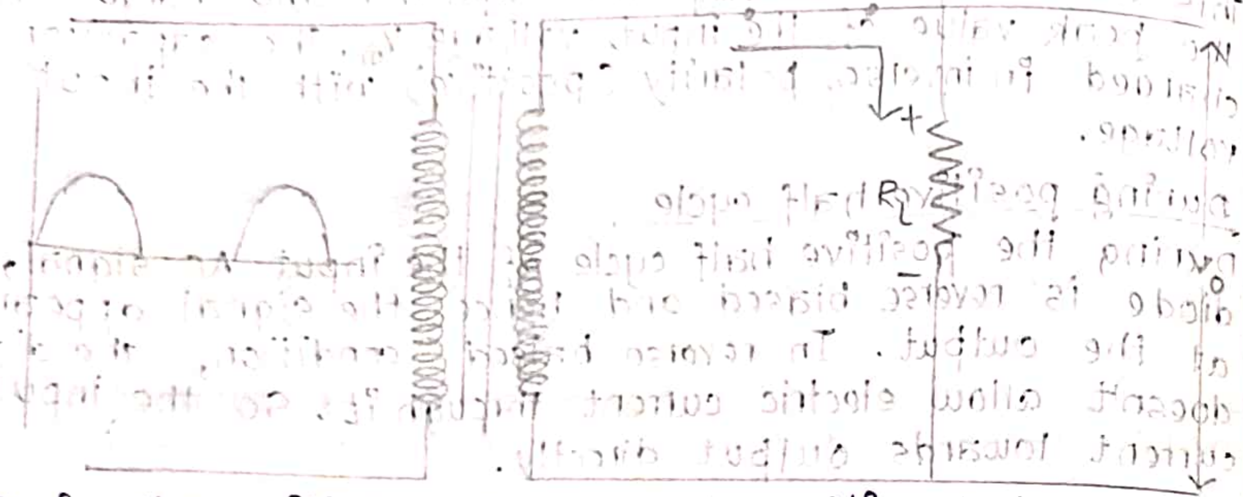
Positive clamper.

23. With a neat diagram, explain the working of a half wave rectifier, along with relevent waveforms.

Sol^n:- Half-wave rectifier is defined as the electronic device which converts only one half of the i/p AC signal to the pulsating DC depending upon the diode connection.



N_1 = no. of turns in primary winding
N_2 = no. of turns in secondary winding



→ During the positive half cycle, only positive halves are considered across the transformer winding.

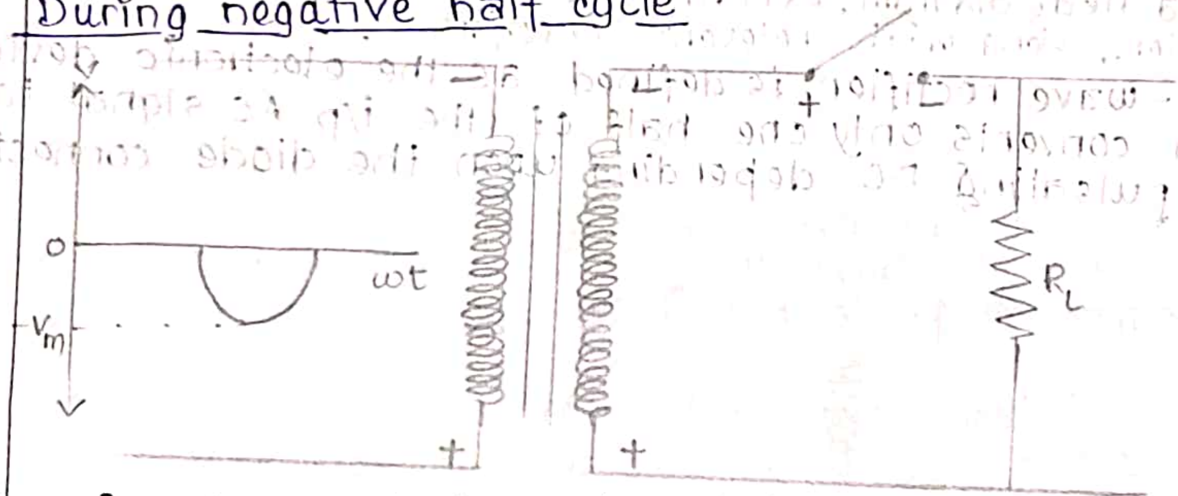
→ Transformer will transfer the i/p voltage V_m to its secondary winding with the same voltage (V_m).
Here the transformer having zero N_1/N_2 = ($N_1 = N_2$)

→ The diode is forward biased due to the +ve half cycle. so there is the flow of current across the load resistor R_L.

→ In half wave rectifier, the o/p voltage V_0 is equal to V_m for +ve half.

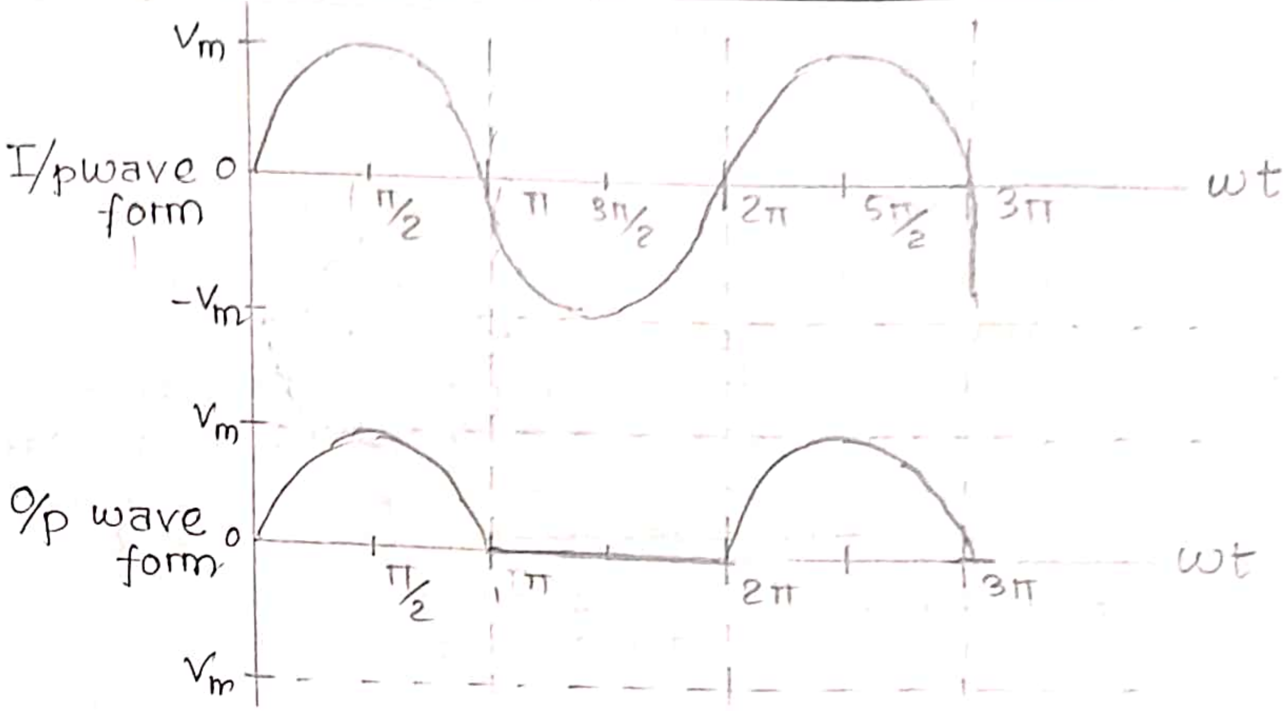
$$\boxed{V_0 = V_m}$$

<u>During negative half cycle</u>



→ During the -ve half cycle, diode acts as open circuit on reverse biased condition.

→ Hence there is no flow of current within the circuit.



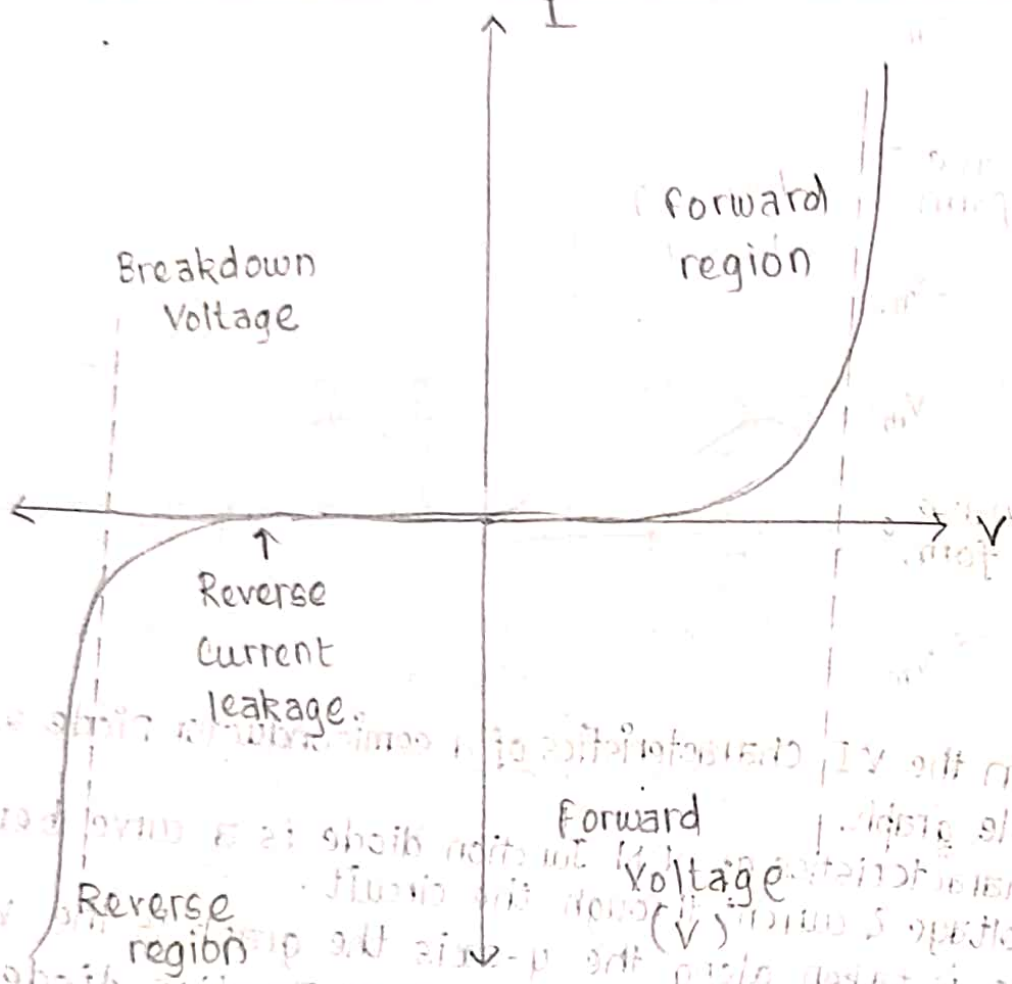
24. Explain the VI Characteristics of a semiconductor Diode with suitable graph.

Solⁿ:- VI characteristics of PN Junction diode is a curve between the voltage & current through the circuit. the graph is the V-I Voltage is taken along the y-axis the graph is the V-I characteristic of curve of the P-N Junction diode.

With the help of the curve we can understand that there are 3 regions 'n' which the diode work & they are.

i) zero bias
ii) Forward bias.
iii) Reverse bias.

When the p-n junction diode is n zero bias condition, there is no external voltage applied ~~to~~ & this means that the potential barrier at the junction doesn't allow the flow of current.



I
V
Forward region
Breakdown Voltage
Reverse current leakage.
Forward Voltage (V)
Reverse region

Dt:- 18.04.2024

ASSIGNMENT-06.

Introduction to Sensors, Introduction to Power system & Domestic ~~warning~~. wiring.

Short Question.

1. What is a sensor?

Sol:- An sensor is an electrical sensor is a device that detects a physical parameter of interest (e.g heat, light, sound)

2. What are the function of a sensor?

Soln:- It converts electrical signal that can be measured and used by an electrical or electronic system.

3. Write any two applications of temperature sensor?

Soln:- The two applications of temperature sensor.

→ Temperature sensors are aused to detect and measure coldness and heat and convert it into an electrical signal.

→ Temperature sensors are also used in our daily life in water heaters, thermometers, refrigerators etc.

4. Explain different type of light sensors.

The different type of light sensors are

i) Photodiodes - converts light energy to electrical energy

ii) Photoresistors - detect the wheather a light is on or off

iii) Phototransistors - detect and amplify light signals.

iv) Photovoltaic light sensors - converts light energy into DC electrical energy in voltage or current.

5. What is a force sensor?

Soln:- A force sensor or sensing resistor is a material whose resistance changes when a force, pressure or mechanical stress is applied.

6. Mention sensors that used for security purpose?

Soln:- Sensors used for security purpose are

i) Displacement sensors.

ii) Motion sensors.

iii) Sound sensors.

7. Which sensor is used in printer

Soln:- Piezoelectric sensors are used in printer

8. What is the function of a fuse.

Soln:- A fuse is a device used in an electrical circuit for protecting electrical devices against overloads and short circuits.

9. Mention the difference between fuse and MCB.

Soln-

Fuse	MCB
→ Fuse is a device used in an electrical circuit for protecting devices against overloads and short circuits.	→ A Minature circuit breaker (MCB) MCBs are automatic switches that automatically turn off the power supply when it detects a power surge.
→ Fuses can't be reused	→ Miniature Circuit Breakers are reusable
→ Fuses only provides thermal protection	→ MCB provides both thermal as well as magnetic protection

10. Write short note on i) Temperature sensor ii) Displacement sensor iii) Piezoelectric Sensors.

i) Temperature Sensor

A temperature sensor is a device that detects and measures the degree of hotness or coldness and converts it into an electrical signal.

Working :- The working of a temperature meter depends upon the voltage across the diode. The temperature changes is directly proportional to the diode's resistance. The cooler the temperature, the lesser will be in resistance, and vice-versa.

Application :- It is widely used in displayed in numeric form over readout units. of temperature sensors.

→ Domestic water heaters

→ Refrigerators.

ii) Displacement Sensors

A Displacement sensors is a device that measures ~~that~~ the distance between the sensor and an object by detecting the amount of displacement through a variety of elements and converting it into an distance. Displacement sensors are widely used.

Working :-

They measure displacement by converting movement into electromagnetic, electrostatic or magneto electric signals and can be converted into a readable format for the users.

Application :- It is used in Automotive and Motorsport.

→ Used in factory Automation.

iii) Piezoelectric sensors

A piezoelectric sensors is a device that can convert various physical forces, including pressure, vibration and temperature, into electrical charges that can be measured.

Working.

A piezoelectric sensor converts mechanical or thermal input into an electrical signal, The sensor sends a signal when it sustains physical force. such as pressure, pushing, or changing temperature.

Applications.

→ They are used to measure dynamic pressure. Dynamic pressure measurements include turbulence, engine combination.

→ Piezoelectric ~~use~~ sensors are applied in Diezel fuel injectors. optical adjustment, Ultrasonic cleaning and welding.

→ sensor is used in electrical appliances like dot matrix printer

11. Explain the working of a hydro power plant with a block diagram.

Working of Hydro power plant

Dam and Reservoir

The dam is constructed on a large river in hilly areas to ensure sufficient water storage at height. The dam forms a large reserviour behind it. The height of water level (called as water ~~level~~ head) in the reserviour determines how much potential energy is stored in it.

control gate

Water from the reserviour is allowed to flow through the penstock to the turbine. The amount of water which is to be released can be controlled by a control gate.

Penstock

A penstock is a huge steel pipe which carriers water from the reservoir to the turbine. PE is converted KE as it flows down through the penstock due to gravity.

Water turbine:-

Water from the penstock is taken into the water turbine. The turbine is automatically mechanically coupled to the turbine shaft.

Generator

A generator is mounted in the powerhouse, and it is mechanically coupled to the turbine shaft. When the turbine blades are rotated, it drives the generator and electricity is generated which is then stepped up with the help of transformer.

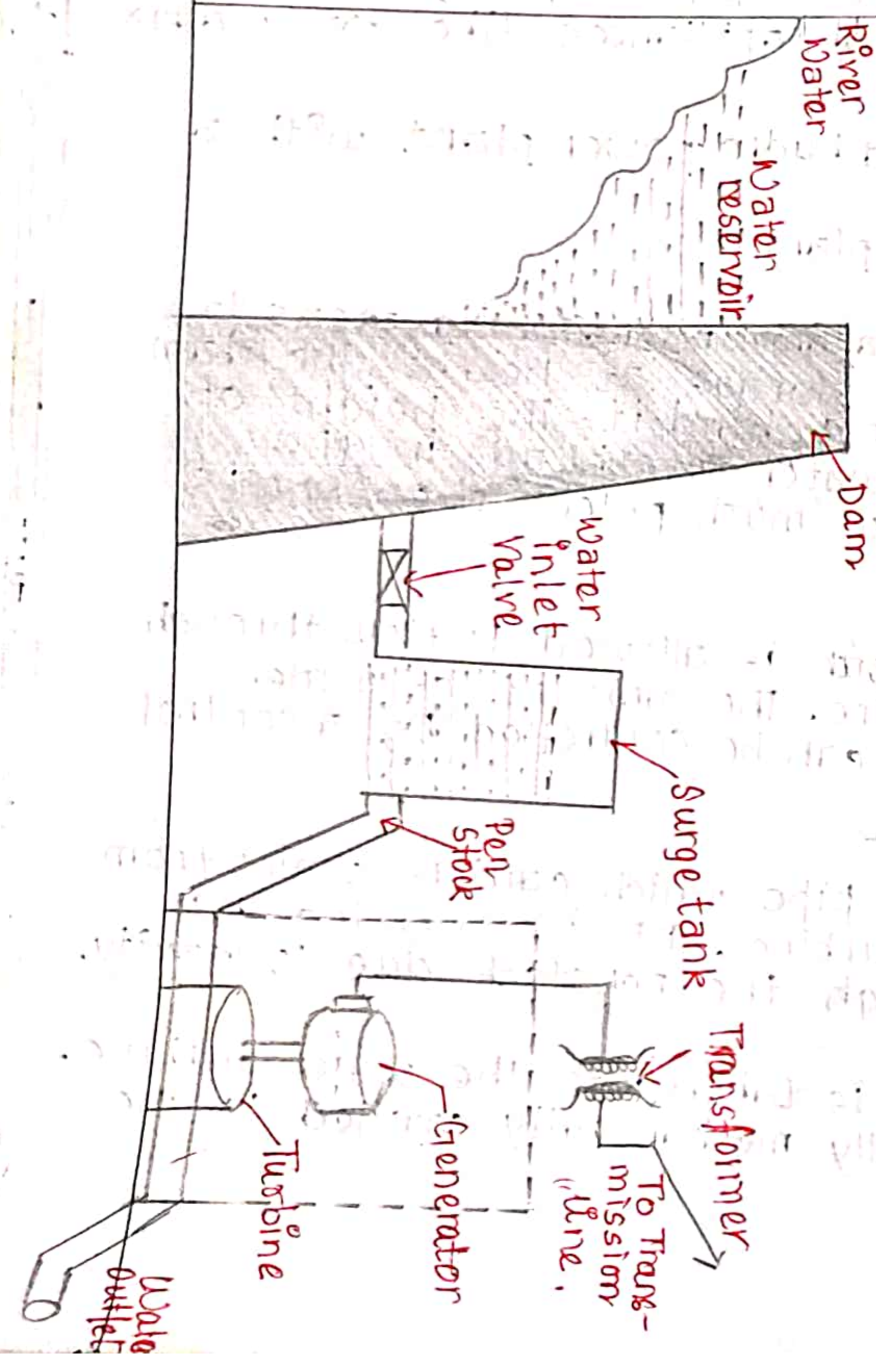
Surge tank

Surge tank are usually provided in high or medium head power plants when considerably long penstock is required.

→ It is a small reservoir or tant which is open at the top.

Transformer

The transformer inside the power-house takes the AC and converts it to higher voltage current.



12. Explain the working of a thermal plant with a block diagram.

Ans: Thermal power generation plants are the most conventional source of electric power.
It consists of alternator runs with help of steam turbine.

Working

→ The coal thermal power plants, steam is produced at high pressure in the steam boiler

→ The steam is further supper heated in a super heater. This super-heated steam then enters into the turbine and rotates the turbine blades that means here in the turbine. the stored potential energy of the high pressured steam is converted into mechanical energy.

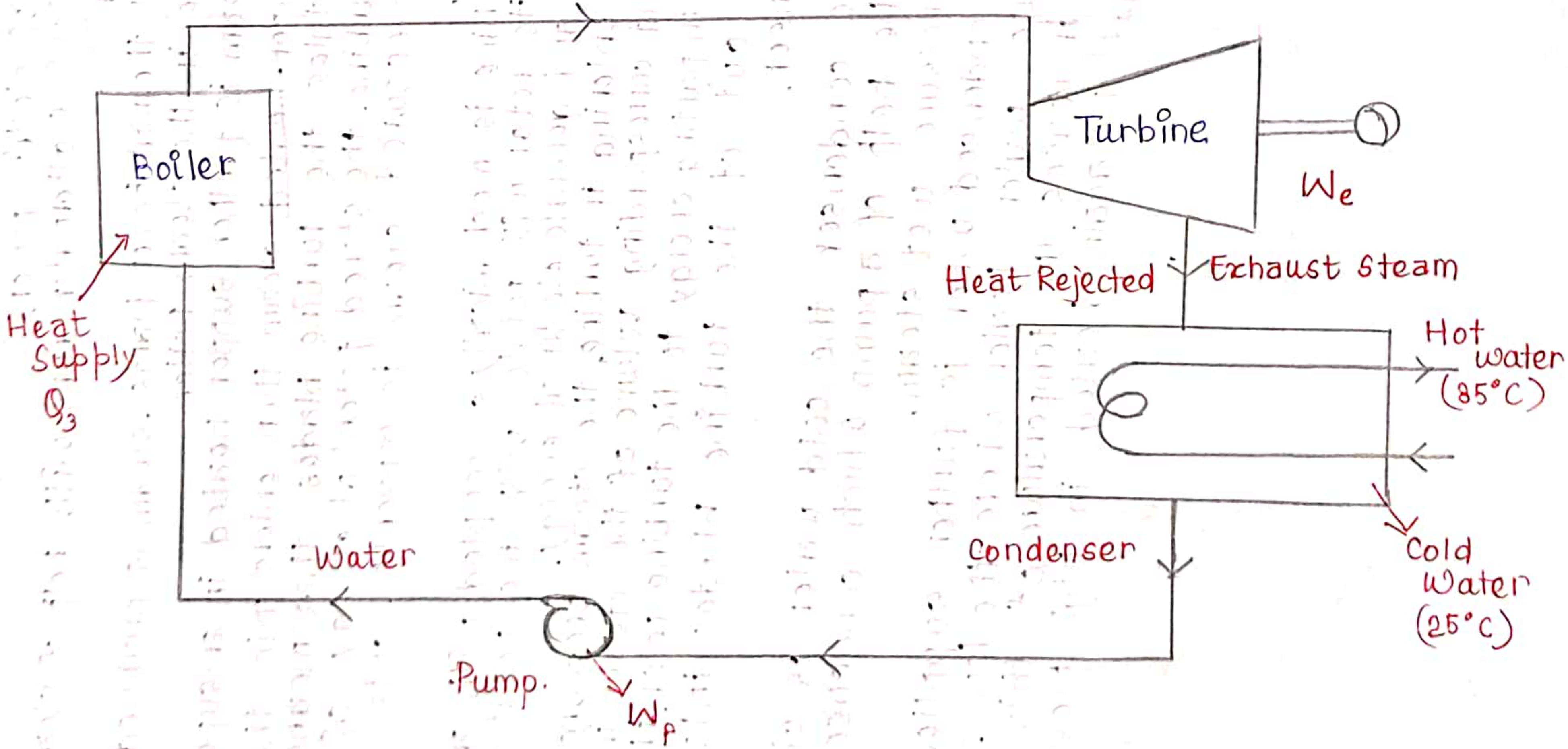
→ The turbine is mechanically so coupled with alternator that its rotor will rotate with the rotation of turbine blades and generate electrical energy.

→ After entering in turbine, the steam pressure suddenly falls and corresponding volume of the steam increases.

→ After imparting energy to the turbine rotor, the steam passes out of the turbine blades into the condenser.

→ In the condenser the cold water is circulated with the help of a pump which condenses the low-pressure wet steam.

→ This condensed water is further supplied to low pressure water heater where the low-pressure steam increases the temperature of this feed water, it is again heated in high pressure.



BLOCK DIAGRAM FOR THERMAL POWER PLANT.

13 ~~Explain the function of a power.~~

13. Explain the working of a nucleur power plant with a block diagram.

Sol^n:- A nucleur power stations electrical power is generated By nucleur fission. reaction.

Working.

Heavy elements such as uranium (U^{235}) or Thorium (Th^{232}) are subjected to nuclear fission reaction in a nucleur ~~fission~~.reactor.

→ Due to fission, a large amount of heat energy is produced which is transferred to the reactor coolant. The coolant may be water, gas or a liquid metal.

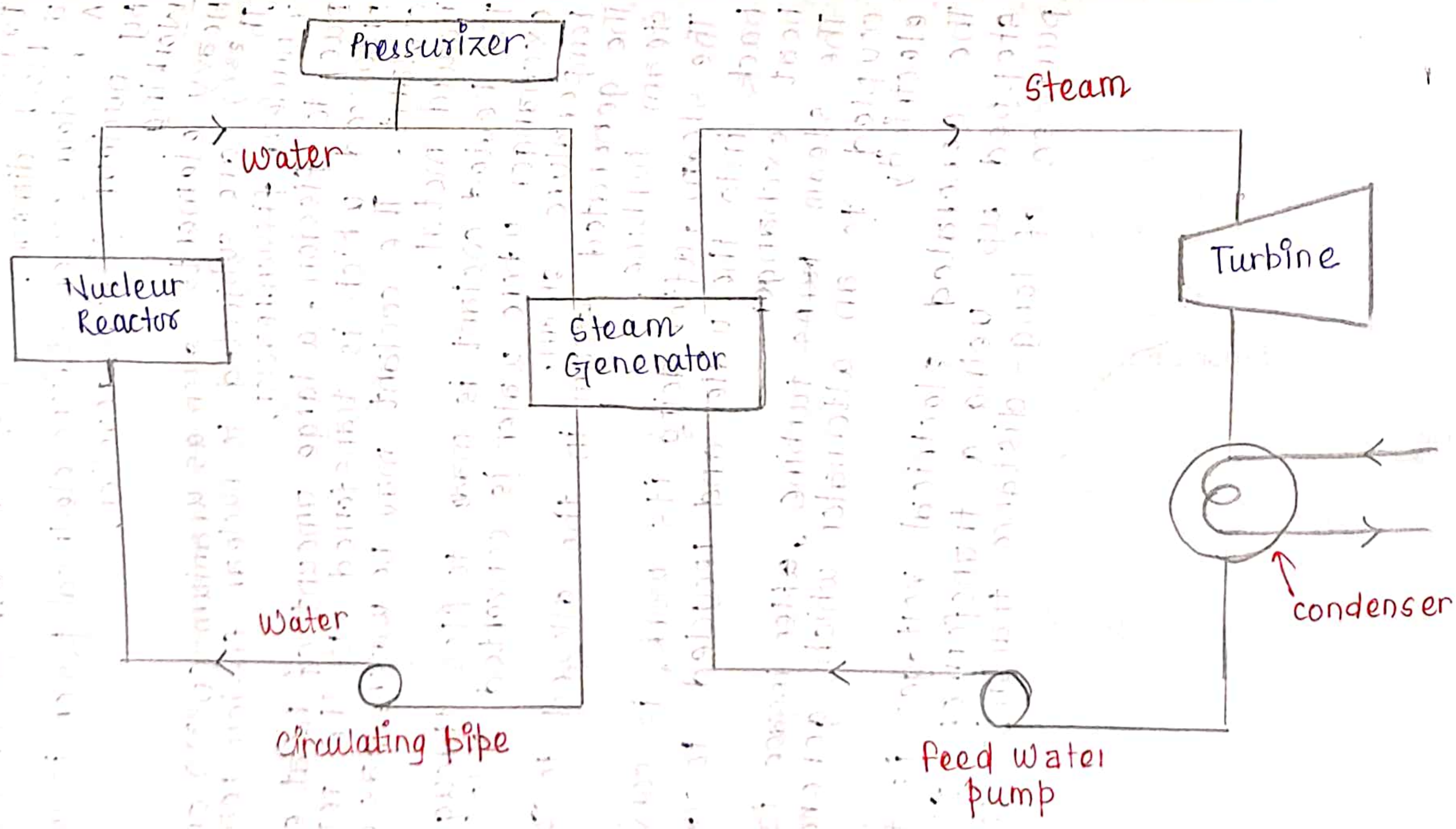
→ The heated coolant is made to flow through a heat exchanger where water is converted into high-temperature steam.

→ The generated steam in the allowed to drive the steam turbine.

→ The steam, after doing its work, is converted back into the water and recycled to ~~the~~ the heat exchanger

→ The steam ~~turns~~ turbine, ~~after incase~~ is coupled to an alternator which generates electricity.

→ The generated electrical voltage is then stepped up using a transformer for the purpose of long-distance transmission.



BLOCK DIAGRAM FOR NUCLEAR POWER PLANT

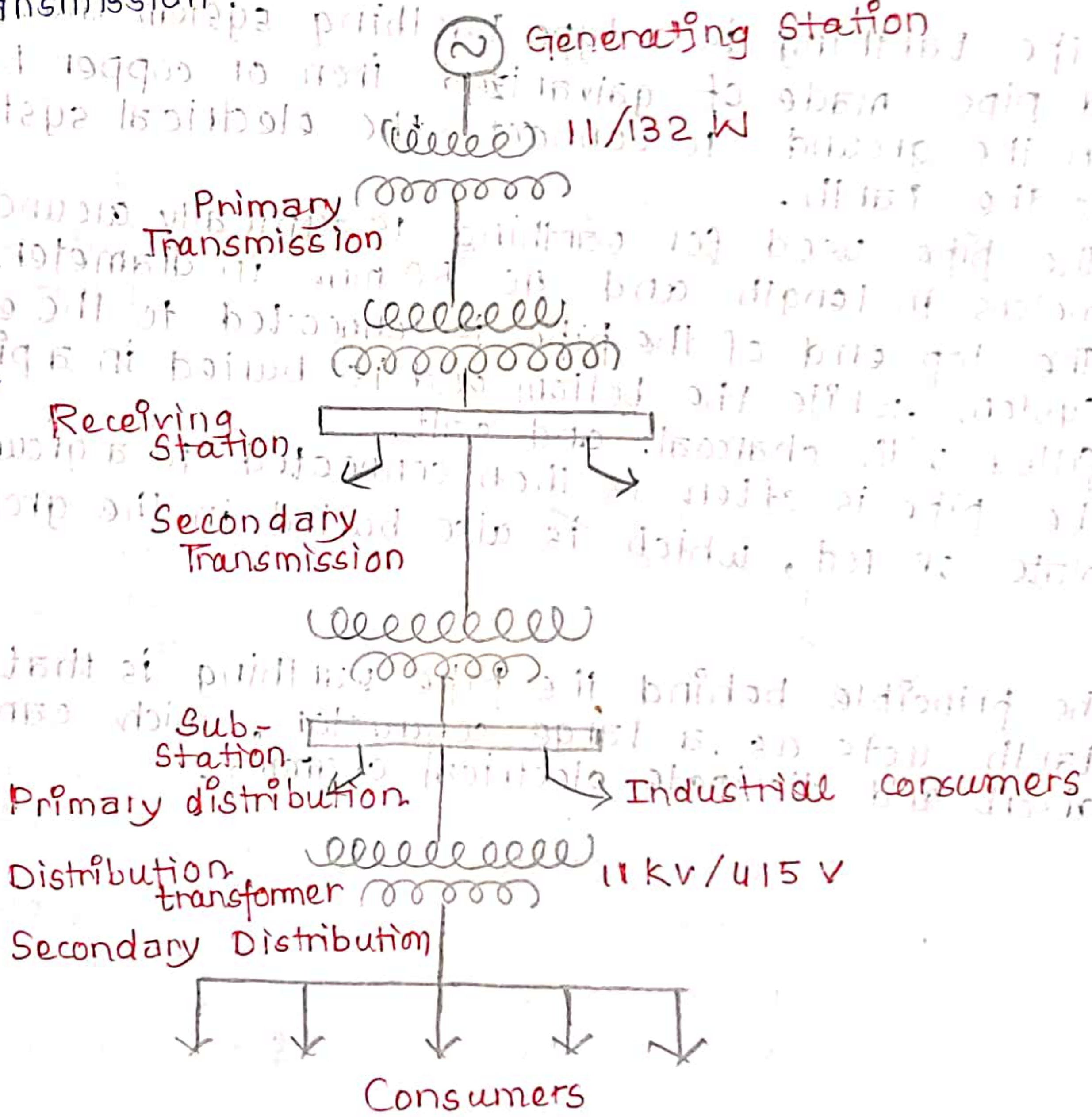
14. Explain the function of a power system with the help of a general layout.

→ The power system is a network which consists of generation distribution and transmission system.

→ It uses the form of energy (like coal and diesel) and converts it into electrical energy.

→ The power plant, transformer, transmission line, substations, distribution line, and distribution transformer are the six main components of the power system.

→ The power plant generates the power which is step-up or step down through the transformer for transmission.



15. Write a short ~~ned~~ note on pipe & plate earthing.

Sol^n Earthing is ~~a~~ the process of connecting an electrical system to the Earth

→ The process of transfering the ~~inte~~ immodiate dischar of the electrical energy directly to the Earth by th help of the low resistance wire is known as the electrical Earthing.

Pipe Earthing.

→ Pipe Earthing is the most widely used in the industry and is also very highly affordable with efficient.

→ A galvanised steel pipe is 38 mm in diameter and em inside the soil.

* Pipe Earthing is a type Earthing system that uses a pipe made of galvanized iron or copper buried in the ground to connect the electrical system to the Earth.
* The pipe used for earthing is typically around 2-3 meters in length and 40-50 mm in diameter.
* The top end of the pipe is connected to the electric system, while the bottom end is buried in a pit filled with charcoal. and salt.
* The pipe is often is then connected to a grounding plate or rod, which is also buried in the ground.

+ The principle behind the pipe earthing is that the Earth acts as a large conductor, which can absorb and dissipate electrical charges.

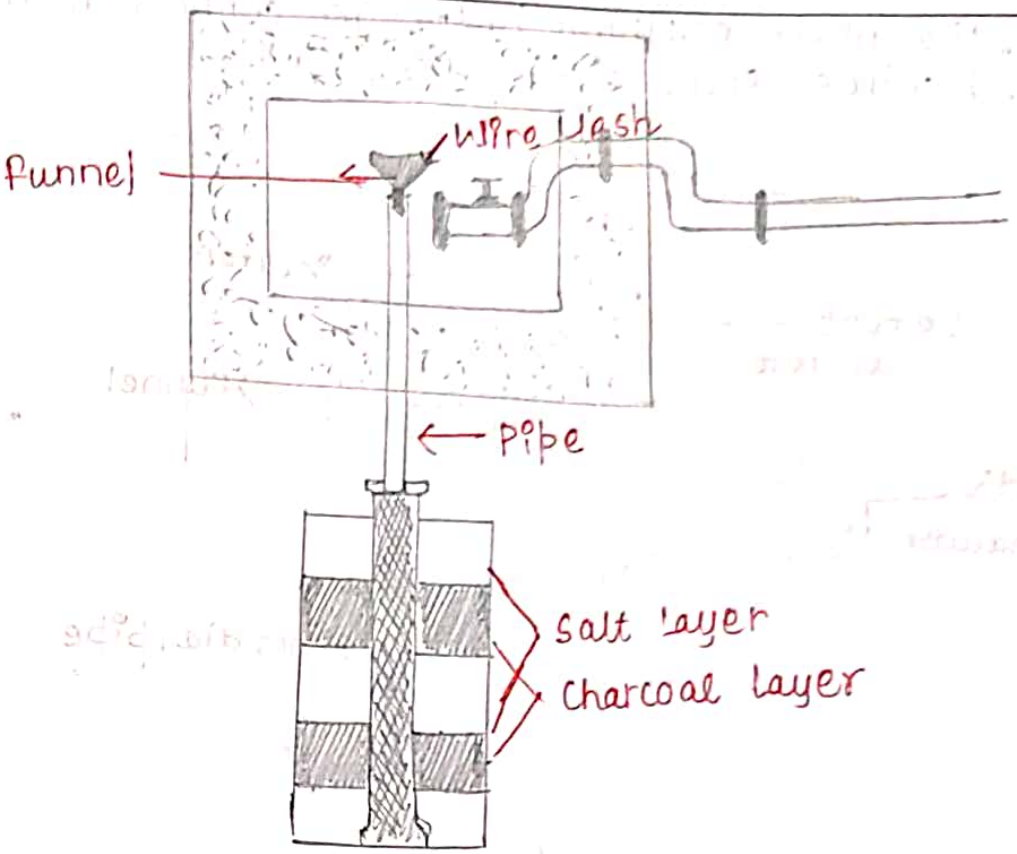


Plate Earthing

→ The most efficient way of Earthing is plate earthing, which involves installing a galvanized copper plate 3m deep in the Earth and connecting it to all the conductors.

* The salt soaks the ~~salt~~ alkali of the ground and the coal makes the soil to hold the moisture.
* So using these salt and coal helps to increase the overall conductivity of the Earthing system.
* When the conductivity increases, the leakage current easily flows to the ground. It increases the efficiency of the overall earthing system.

+ Plate Earthing is used in power stations, transmission lines, large electrical panels, high voltage transformers, where the amount of earth fault current is very high.

+ Also, the plate earthing helps to connect more no of ground wires from different loads.

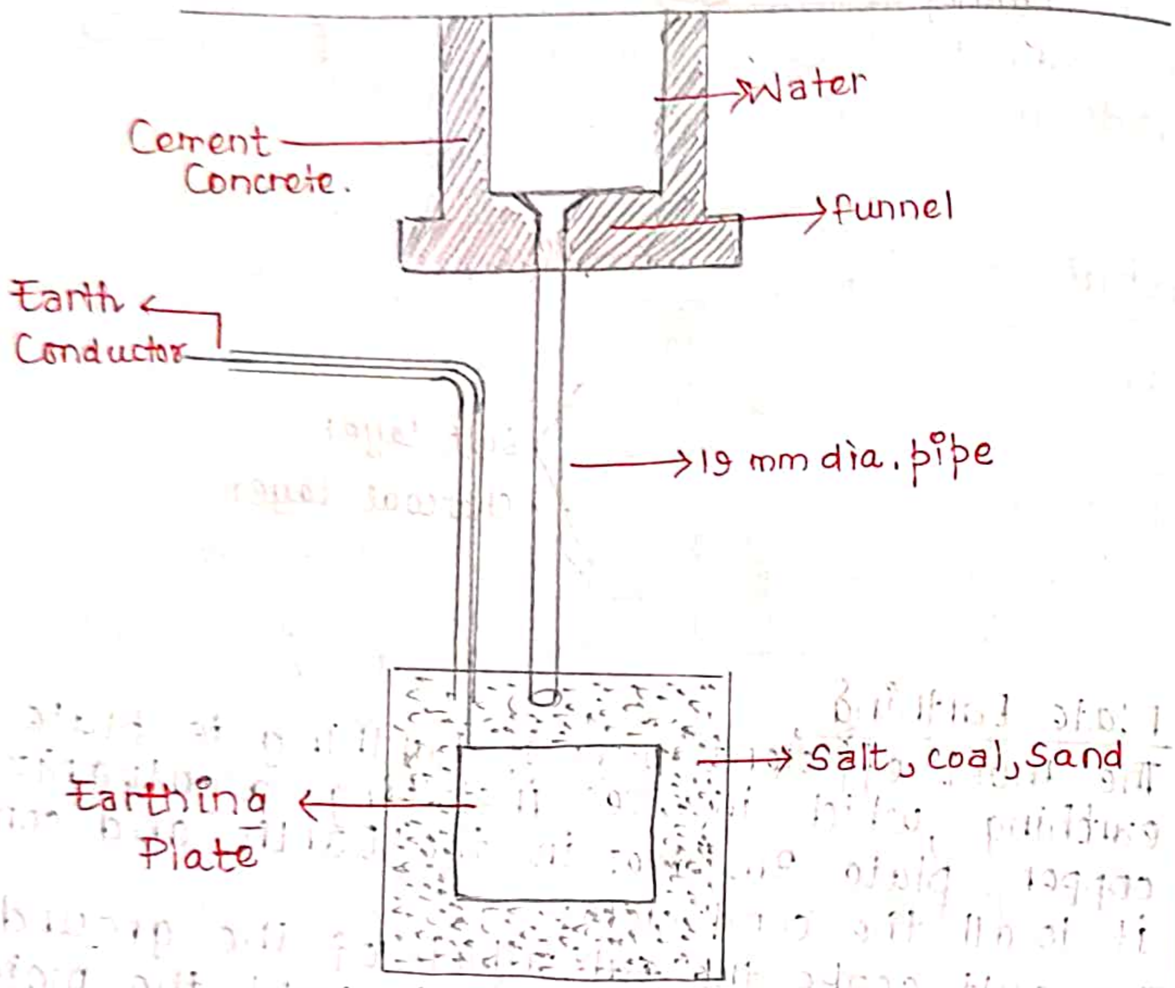


Plate Earthing System

16. How a person gets an electric shock? What are the precautions should be taken to avoid electric shock;

Sol^n An Electric occurs when a person meets an electric energy source and current through his/her body.

Precautions should be followed

→ Always shut off the power to a circuit or device that you will be working on

→ Never touch/try repairing any electrical equipment with wet hands.

→ Always use insulated tools, rubber gloves and goggles while working on any electric circuits.

→ Never try to repair any energized equipment

- Never use alluminium or steel ladder for repairing electric circuits at heights.
- Always use circuit breakers or fuse with appropriate current rating.

— x —