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Section-A

Q1.

(i) Ans:- Active element :→ Elements which can perform the operation of circuit independently.
e.g.- diodes, transistors.

passive element :→ which are not able to perform the operation of circuit independently.
eg.- R,L,C.

(ii) Ans:- It states that the electric current flowing through a conductor is directly proportional to the potential difference applied across its two terminale when the temperature and other atomospheric condition remains unchanged.

$$V \propto I$$
$$V = IR$$

where R is constant of proportionality called Resistance.

Limitations:-
(i) It is applicable only for DC circuits.
(ii) Not valid if the atmospheric conditions are change
(iii) not applicable for semiconductor devices.

(iii) Ans:-

RMS value :→ effective value or virtual value is the rms value of an alternating current is the value of that direct current which produces the same amount of heat flowing through a Conductor for a give time as produced by the ~~current~~ alternating current when flowing through the same Conductor for a same time.

Average value :→ It is the value of that direct current which tranfors across any circuit the same amount of charge as is transfered by the alternating current where the two half Cycles are exactly similar the average value over a Complete cycle is zero.

Form factor :→ The ratio of rms value or average value is called form factor. It is denoted by K_f.

$$K_f = \frac{\text{Rms value}}{\text{avg value}}$$

$$K_f = \frac{I_{rms}}{I_{av}} = \frac{I_{max}/\sqrt{2}}{2I_{max}/\pi}$$

$$K_f = 1.11$$

Amplitude factor :- The ratio of maximum value to r.m.s. value of an alternating quantity is called Amplitude factor or peak factor.

$$\text{peak factor} = \frac{I_{max}}{I_{r.m.s}} \quad \text{or,} \quad \frac{E_{max}}{E_{r.m.s}}$$

$$\text{peak factor} = \frac{\cancel{I_{max}}}{\cancel{I_{max}}/\sqrt{2}} = \sqrt{2} = 1.414$$

(iv) soln:-

$$\text{loop I} - 12 = 12I_1 + 10(I_1 - I_2) \quad \text{— (I)}$$
$$\text{loop II} - 10 = 6I_2 + 10(I_1 + I_2) \quad \text{— (II)}$$

Now
from eqn (I),

$$12 = 12I_1 + 10I_1 - 10I_2$$
$$12 = 22I_1 - 10I_2 \quad \text{— (III)}$$

from eqn (II),

$$10 = 6I_2 + 10I_1 + 10I_2$$
$$10 = 10I_1 + 16I_2 \quad \text{— (IV)}$$

from eqn (III) & (IV),

$$12 = 22I_1 - 10I_2$$
$$10 = 16I_2 + 10I_1$$

$$32 = 38I_2$$

$$I_2 = \frac{32}{38} = 0.842\,A$$

eqn (3)

$$12 = 22I_1 - 10I_2$$
$$12 = 22I_1 - 10 \times 0.842$$
$$12 = 22I_1 - 8.42$$
$$12 + 8.42 = 22I_1$$

$20.42 = 22I_1$

$I_1 = \frac{20.42}{22} = 0.928\ A$

$\therefore$ current in $10\Omega = I_1 + I_2$

$= 0.928 + 0.842$

$= 1 + 1 = 2A$ Ans

(V) Ans :- Electrical Energy :→ It is the total amount of work done in an Electrical circuit. Its unit watt hour.

$W = VQ$

$= VIt$

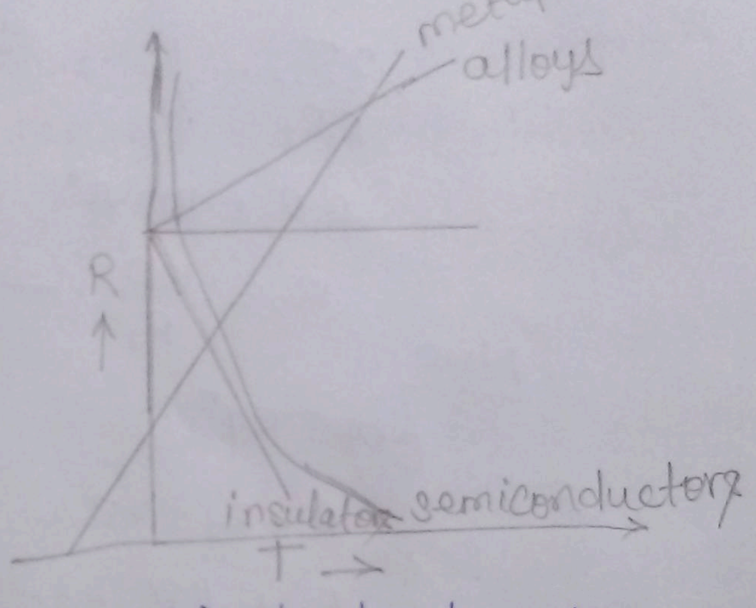
Mechanical Energy :→ when a body to which force is applied moves in or opposite direction of the applied force, work is said to be done by or against the body. The units of work is Newton metre or Joule.

$W = F \times S$

one unit $= 3.6 \times 10^6$ watt.sec

Section-B

Q2. (i) Ans:→



(a) for pure metals:→ As the temperature increases resistance also increases and α is positive.

(b) For insulature semiconductors and electrolytes:→ As temperature increases, resistance decreases and α is -ve.

(c) For alloys:→ As temperature increases, there is small increases in resistance and α has very small positive value.

Q2. Given that

(ii) Ans:- $R_1 + R_2 = 25\Omega$ — (i)

$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{4}\Omega$$

then

$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{4}\Omega$$

$$\frac{R_2 + R_1}{R_1 R_2} = \frac{1}{4}$$

$$\frac{25}{R_1 R_2} = \frac{1}{4}$$

$$R_1 R_2 = 100\,\Omega$$

$$R_2 = \frac{100}{R_1} \quad \text{— (ii)}$$

Now

from eq^n (i)

$$R_1 + R_2 = 25\Omega$$

$$R_1 + \frac{100}{R_1} = 25 \quad \left[\because R_2 = \frac{100}{R_1}\right]$$

$$R_1^2 + 100 = 25R_1$$

$$R_1^2 - 25R_1 + 100 = 0$$

$$R_1^2 - 20R_1 - 5R_1 + 100 = 0$$

$$R_1(R_1 - 20) - 5(R_1 - 20) = 0$$

$$(R_1 - 5)(R_1 - 20) = 0$$

$$R_1 = 5\Omega,\ 20\Omega$$

then from eq^n (ii)

$$R_2 = \frac{100}{R_1} = \frac{\cancel{100}}{\cancel{5}} = 20\Omega$$

$$R_2 = \frac{100}{R_1} = \frac{\cancel{100}\,5}{\cancel{20}} = 5\Omega$$

Q3. Sol^n:- Let $R_0 \rightarrow$ is the resistance of any material at 0°C and $R_t \rightarrow$ resistance at t°C then ~~change~~

at 0°C, $R = R_0$, $\alpha = \alpha_0$

at t_1°C, $R = R_1$, $\alpha = \alpha_1$

According to definition

$$R_1 - R_0 = \alpha_0 R_0 (t_1 - 0)$$

$$R_1 - R_0 = \alpha_0 R_0 t \quad \text{--- (1)}$$

$$R_1 = R_0 (1 + \alpha_0 t_1)$$

Let the resistance R_1 at t_1°C be now cooled to 0°C and gives value R_0

$$R_0 = R_1 [1 + \alpha_1 (0 - t_1)]$$

$$R_0 = R_1 [1 - \alpha_1 t_1] \quad \text{--- (2)}$$

$$R_0 = R_1 - R_1 \alpha_1 t_1$$

$$\alpha_1 = \frac{R_1 - R_0}{R_1 t_1} \quad \text{--- (3)}$$

Put (1) in (3)

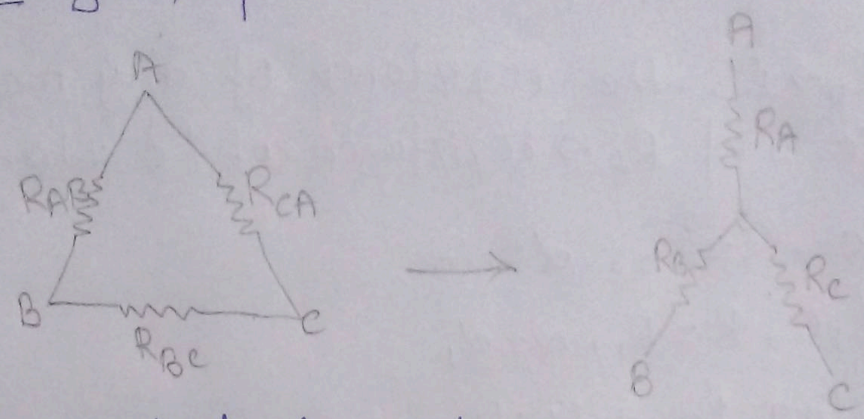
$$\alpha_1 = \frac{\alpha_0 R_0 \cancel{t_1}}{R_1 \cancel{t_1}}$$

$$\alpha_1 = \alpha_0 \frac{\cancel{R_0}}{\cancel{R_0}(1 + \alpha_0 t_1)}$$

$$\boxed{\alpha_1 = \frac{\alpha_0}{(1 + \alpha_0 t_1)}}$$

Hence, Required Eq^n.

Q4. sol^n:- $\Delta \rightarrow Y$



The equivalent resistance across terminals A and B, R_{AB} of star = R_{AB} of Delta.

$$R_A + R_B = \frac{R_{AB}(R_{BC}+R_{CA})}{R_{AB}+(R_{BC}+R_{CA})} \quad \text{—} (1)$$

|||ly $$R_B + R_C = \frac{R_{BC}(R_{AB}+R_{CA})}{R_{AB}+R_{BC}+R_{CA}} \quad \text{—} (2)$$

|||ly $$R_C + R_A = \frac{R_{CA}(R_{AB}+R_{BC})}{R_{AB}+R_{BC}+R_{CA}} \quad \text{—} (3)$$

Subtract (2) from (1) and add the result to (3)

(1)-(2) $$R_A + \cancel{R_B} - \cancel{R_B} - R_C = \frac{R_{AB}(R_{BC}+R_{CA}) - R_{BC}(R_{AB}+R_{CA})}{R_{AB}+R_{BC}+R_{CA}}$$

$$R_A - R_C = \frac{(R_{AB}-R_{BC})R_{CA}}{R_{AB}+R_{BC}+R_{CA}}$$

$$R_A - R_C = \frac{R_{AB}R_{CA} - R_{BC}R_{CA}}{R_{AB}+R_{BC}+R_{CA}} \quad \text{—} (4)$$

(4)+(3),
$$R_A \cancel{-} R_C + R_C + R_A = \frac{R_{AB}R_{CA} - R_{BC}R_{CA}}{R_{AB}+R_{BC}+R_{CA}} + \frac{R_{BC}R_{AB} + R_{CA}R_{BC}}{R_{AB}+R_{BC}+R_{CA}}$$

$$R_A = \frac{\cancel{R_{BC}} \cdot \frac{R_A^2}{R_C R_B} \cdot R_{BC}}{\cancel{R_{BC}}\left(\frac{R_A}{R_C} + 1 + \frac{R_A}{R_B}\right)}$$

$$\Rightarrow \cancel{R_A}\left(\frac{R_A}{R_C} + 1 + \frac{R_A}{R_B}\right) = \frac{R_A^{\cancel{2}}}{R_C R_B} \cdot R_{BC}$$

$$\Rightarrow \frac{R_A R_B + R_C R_B + R_A R_C}{\cancel{R_C R_B}} = \frac{R_A}{\cancel{R_C R_B}} \cdot R_{BC}$$

$$\boxed{\frac{R_A R_B + R_C R_B + R_A R_C}{R_A} = R_{BC}}$$

Similarly,

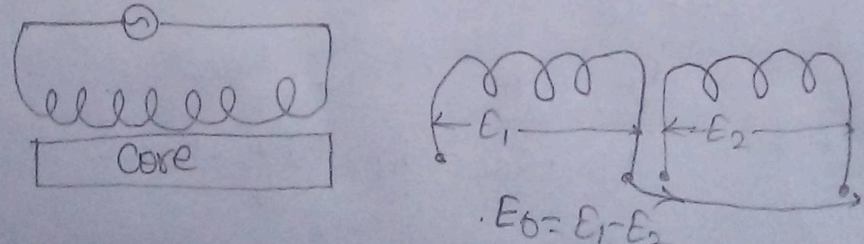
$$\boxed{R_{AB} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_C}}$$

Similarly,

$$\boxed{R_{CA} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_B}}$$

Q.5. Ans :- Transducers :-> It is a device with converts any physical quantity like temperature, pressure, displacement, flow, vibrations, huminity, force etc into an equivalent electrical signal in the from of voltage or current.

LVDT - (Linear variable Differential Transducer) :->



$E_0 = E_1 - E_2$

$$2R_A = \frac{2R_{AB}R_{CA}}{R_{AB}+R_{BC}+R_{CA}}$$

$$\boxed{R_A = \frac{R_{AB}R_{CA}}{R_{AB}+R_{BC}+R_{CA}}} \quad \text{—} (5)$$

Similarly, $$\boxed{R_B = \frac{R_{BC}R_{AB}}{R_{AB}+R_{BC}+R_{CA}}} \quad \text{—} (6)$$

Similarly, $$\boxed{R_C = \frac{R_{BC}R_{CA}}{R_{AB}+R_{BC}+R_{CA}}} \quad \text{—} (7)$$

(2) from $Y \rightarrow \Delta$

Divide (5) by (6)

$$\frac{R_A}{R_B} = \frac{\cancel{R_{AB}}R_{CA}}{R_{BC}\cancel{R_{AB}}} = \frac{R_{CA}}{R_{BC}}$$

$$R_{CA} = \frac{R_A}{R_B} \cdot R_{BC} \quad \text{—} (8)$$

Divide (5) by (7)

$$\frac{R_A}{R_C} = \frac{R_{AB}}{R_{BC}}$$

$$R_{AB} = \frac{R_A}{R_C} \cdot R_{BC} \quad \text{—} (9)$$

put (8) & (9) in (5)

$$R_A = \frac{\left(\frac{R_A}{R_C} \cdot R_{BC}\right) \cdot \left(\frac{R_A}{R_B} \cdot R_{BC}\right)}{\frac{R_A}{R_C} \cdot R_{BC} + R_{BC} + \frac{R_A}{R_B} \cdot R_{BC}}$$

Construction :-

(i) It Consists of one primary.

(ii) secondary windings around as a cylinderical Coil with rod shaped core positioned inside the Coil. The rod shaped core provides low reluctance path for the flux linking with Coil.

(iii) Displacement of moving Core is to be measured.

working :-

(i) connect primary winding to AC Supply Source.

(ii) Assume the core is at centre of the coils. Therefore the flux linking with both secondaries will be equal. Hence due to equal flux linkage. $E_1 = E_2$ and $E_0 = E_1 - E_2 = 0$. This position of core is Called as null position.

(iii) Now If the Core is displaced towards Secondary one then the flux linking with Secondary one increases and secondary two decreases. $E_1 > E_2$ and E_0 = positive.

(iv) similarly If the core is displaced towards secondary two then the flux linking with secondary two increase and secondary ~~one~~ ~~increase~~ two decrease $E_1 < E_2$ and E_0 is negative.