B. Sc. Part II

Paper IV

Current electricity

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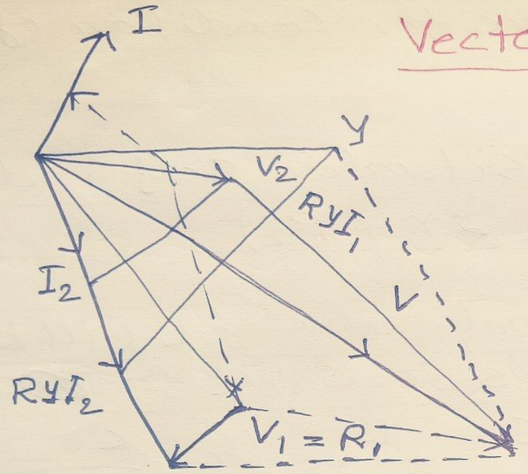
Vector Diagram



$R_1 I_2 = \frac{I}{W_c} = V_1$

Since the Potential at Points E and D of the bridge are equal. Therefore the Same Current I flows through the Capacitor C and resistance r. Hence a Voltage Ir is developed on the resistance r. Since the Current I Through capacitor C leads The voltage V_3 by Phase angle $\pi/2$. The voltage V_I is equal to The vector Sum of $V_3 = \frac{1}{WC}$ and I_r.

Due to equal Potential at E and D The voltage $V_3 = R_3 I_2$ and $1/WC$ are equal.

The voltage $I_2 R_3$ and current I_2 are is same Phase. Also The voltage $R_4 I_2$ and I_2 are in same Phase. The voltage LWI_2 across L lags The current I_2 by Phase angle $\pi/2$. The voltage V_4 is equal to the vector sum of LWI_2 and $R_4 I_2$. I_3 is equal to vector ~~Som~~ Sum of I and I_1.

voltage V_1 is equal to vector sum of V_1 and V_2 and V_4 also.

Now from the geometry of figure.

$$V_1 = V_{AB} = R_1 I_1 = rI - \frac{I}{jwc} I$$

or

$$I = \frac{r + \frac{I}{jwc}}{R} I \quad \text{——} \quad (1)$$

which is equation I

$$I_1 = \frac{\left(r + \frac{I}{jwc}\right) I}{R_1} = 0$$

Again $V_3 = R_3 I_2 = -j \frac{1}{wC} I$

or $I_3 = \frac{I}{jwCR_3}$ —— (2)

which is equation

$$I_2 = \frac{I}{jwCR_3}$$

and $V_2 + V_4 = R_2 I_3 + [-(R_4 + jwL) I_2]$.

$$= V_3 E = (-rI)$$

Keeping in view that $V_E > V_B > V_C$ and $V_D = V_E$ from which $V_D = V_C$ we see that

$$V_B - V_C = V_2 = R_2 I_3$$

and

$$V_C - V_D = -(V_D - V_C) = -V_4 = -(r_4 + jwL) I_2$$

$$\therefore V_B - V_D = (V_B - V_C) + (V_C - V_D)$$

$$= R_2 I_3 - (R_4 + jwL) I_2$$

Again,

$$V_B - V_D = V_B - V_E = (V_E - V_B) = I_r$$

$$\therefore \quad R_2 I_3 - (R_4 + j\omega L) I_2 = -I_r$$

or $\quad R_2 I_3 - (R_4 + j\omega L) I_2 = 0 \quad \text{—— (3)}$

which is equation

$$R_2 (I_1 + I) - (j\omega L + R_4) I_2 + I_r = 0$$

we have seen That from equation (1) (2) and (3) The Condition of balance is

$$L = CR_3 \left[r \left(1 + \frac{R_2}{R_1} \right) + R_2 \right] \text{ and}$$

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$