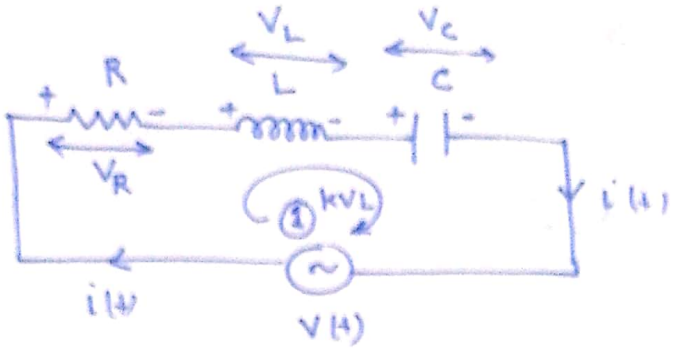
RLC Circuit



1 KVL

$$V(t) - V_R - V_L - V_c = 0$$

$$V(t) = V_R + V_L + V_c \quad \rightarrow (1)$$

$$V_R = IR$$

$$I_c = C \frac{dV_c}{dt}$$

Replace $\frac{d}{dt} \longrightarrow j\omega$

$$I_c = I = C j\omega V_c$$

$$V_c = \frac{I}{j\omega C}$$

$$V_c = -j\frac{I}{\omega C}$$

$$V_c = -jIX_c \quad \because X_c = \frac{1}{\omega C} \rightarrow (2)$$

$$V_L = L \frac{dI}{dt}$$

$$V_L = Lj\omega I$$

$$V_L = j\omega L I$$

$$V_L = jX_L I \quad \because X_L = \omega L \rightarrow (3)$$

From (1) (2) (3)

$$V(t) = IR + jX_L I - jX_c I$$

$$\therefore V(t) = IZ$$

↳ total impedance

$$IZ = IR + jX_L I - jX_c I$$

$$Z = R + jX_L - jX_c$$

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

$$\therefore Z = a + jb$$

$$|z| = \sqrt{a^2 + b^2}$$