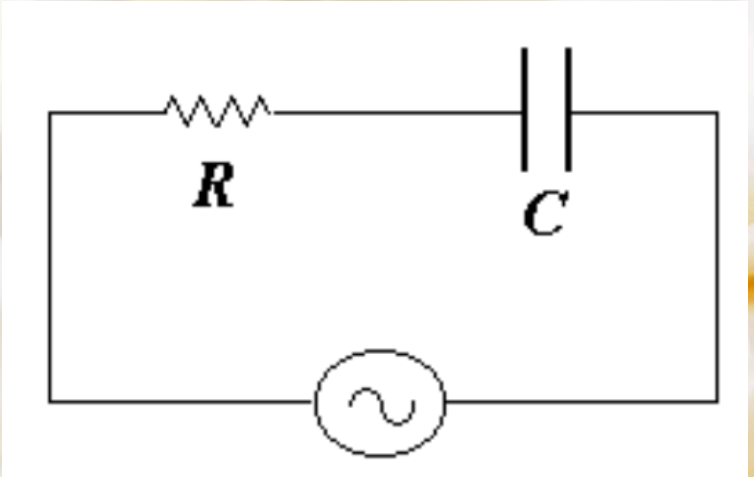
مدارهای RC و RL



مدار RC

$$V = V_R + V_C$$

$$i = i_m \sin \omega t$$

$$V = V_m \sin(\omega t + \varphi)$$

$$V_R = iR = i_m R \sin \omega t$$

$$V_C = \frac{q}{C} = \frac{\int i dt}{C} = \frac{i_m \int \sin \omega t \, dt}{C}$$

$$V_C = -\frac{i_m \cos \omega t}{C\omega}$$

$$V_C = i_m \frac{1}{C\omega} \sin\left(\omega t - \frac{\pi}{2}\right)$$

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

مقاومت ظاهری خازن

$$V = V_m \sin(\omega t + \varphi) = V_R + V_C$$
$$= i_m R \sin \omega t - i_m \frac{1}{C\omega} \cos \omega t$$

$$V_m \cos(\varphi) \sin(\omega t) + V_m \sin(\varphi) \cos(\omega t)$$
$$= i_m R \sin \omega t - i_m X_C \cos \omega t$$

$$V_m \cos(\varphi) = i_m R$$

$$V_m \sin(\varphi) = -i_m X_C$$

$$\frac{V_m \sin(\varphi)}{V_m \cos(\varphi)} = -\frac{i_m X_C}{i_m R}$$

$$\tan(\varphi) = -\frac{X_C}{R} = -\frac{1}{RC\omega}$$

$$V_m^2 \cos^2(\varphi) = i_m^2 R^2$$

$$V_m^2 \sin^2(\varphi) = i_m^2 X_C^2$$

$$V_m^2(\cos^2(\varphi) + \sin^2(\varphi))$$
$$= i_m^2(R^2 + X_C^2)$$

$$V_m^2 = i_m^2(R^2 + X_C^2)$$

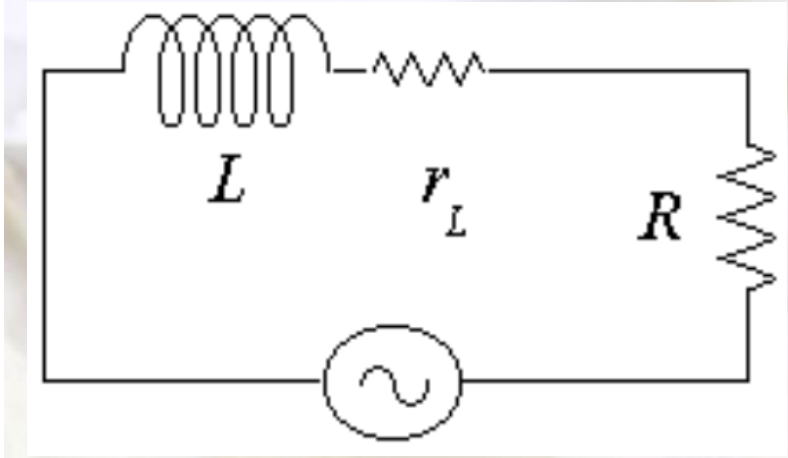
$$V_m = i_m \sqrt{R^2 + X_C^2}$$

$$V_m = i_m\sqrt{R^2 + X_C^2} = i_m Z$$

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

مقاومت ظاهری مدار RC

$$Z = \sqrt{R^2 + \frac{1}{\omega^2 C^2}}$$



مدار RL

$$V = V_R + V_L$$

$$i = i_m \sin \omega t$$

$$V = V_m \sin(\omega t + \varphi)$$

$$R_0 = r + R_L$$

$$V_{R_0} = iR_0 = i_m R_0 \sin \omega t$$

$$V_L = L\frac{di}{dt} = i_m L\omega \cos \omega t$$

$$V_L = i_m L\omega \sin\left(\omega t + \frac{\pi}{2}\right)$$

$$X_L = L\omega$$

مقاومت ظاهری سلف

$$V = V_m \sin(\omega t + \varphi) = V_R + V_L$$
$$= i_m R_0 \sin \omega t + i_m L\omega \cos \omega t$$

$$V_m \cos(\varphi) \sin(\omega t) + V_m \sin(\varphi) \cos(\omega t)$$
$$= i_m R_0 \sin \omega t + i_m X_L \cos \omega t$$

$$V_m \cos(\varphi) = i_m R_0$$

$$V_m \sin(\varphi) = i_m X_L$$

$$\frac{V_m \sin(\varphi)}{V_m \cos(\varphi)} = \frac{i_m X_L}{i_m R_0}$$

$$\tan(\varphi) = \frac{X_L}{R_0} = \frac{L\omega}{R_0}$$

$$V_m^2 \cos^2(\varphi) = i_m^2 R_0^2$$

$$V_m^2 \sin^2(\varphi) = i_m^2 X_L^2$$

$$V_m^2(\cos^2(\varphi) + \sin^2(\varphi))$$
$$= i_m^2(R_0^2 + X_L^2)$$

$$V_m^2 = i_m^2(R_o^2 + X_L^2)$$

$$V_m = i_m \sqrt{R^2 + X_L^2}$$

$$V_m = i_m\sqrt{R_0^2 + X_L^2} = i_m Z$$

$$Z = \sqrt{R_0^2 + X_L^2}$$

مقاومت ظاهری
مدار RL

$$Z = \sqrt{R_0^2 + \omega^2 L^2}$$