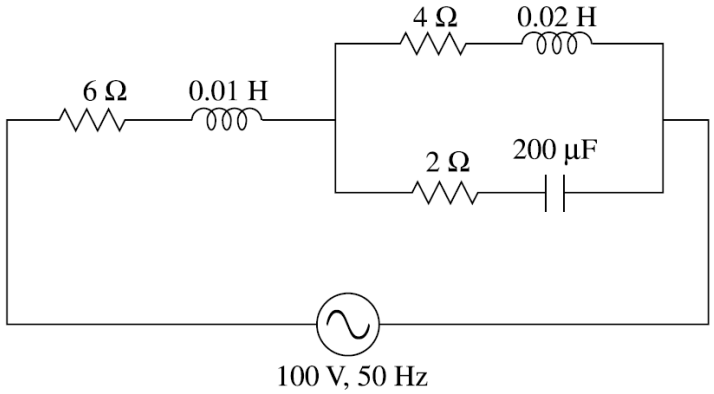
NOTES -Class 33

Numericals on Series – Parallel AC Circuits

1. Determine the current in the circuit shown. Find the power consumed and powerfactor.



Solution

$$X_{L_1} = 2\pi \times 50 \times 0.01 = 3.14\ \Omega$$

$$X_{L_2} = 2\pi \times 50 \times 0.02 = 6.28\ \Omega$$

$$X_C = \frac{1}{2\pi \times 50 \times 200 \times 10^{-6}} = 15.92\ \Omega$$

$$\overline{Z_1} = 6 + j3.14\ \Omega$$

$$\overline{Z_2} = 4 + j6.28\ \Omega$$

$$\overline{Z_3} = 2 - j15.92\ \Omega$$

$$\overline{Z} = \overline{Z_1} + \frac{\overline{Z_2}.\overline{Z_3}}{\overline{Z_2} + \overline{Z_3}}$$

$$= (6 + j3.14) + \frac{(4 + j6.28)(2 - j15.92)}{(4 + j6.28) + (2 - j15.92)} = 17.27\ \angle 30.75^\circ\ \Omega$$

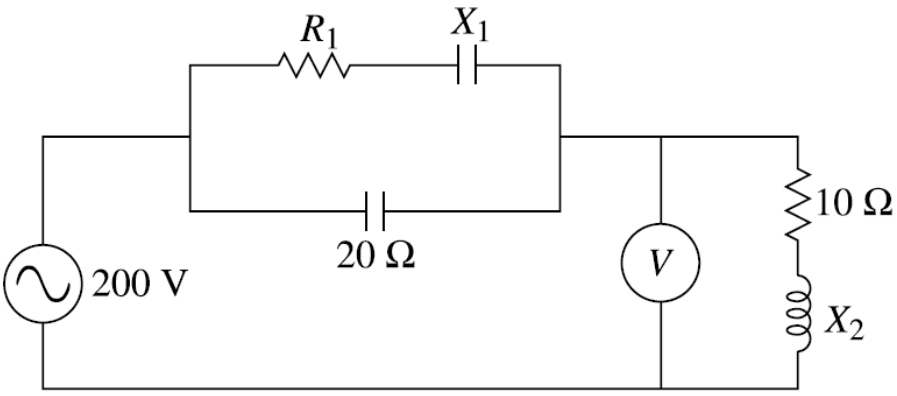
$$\overline{I} = \frac{\overline{V}}{\overline{Z}} = \frac{100\angle 0^\circ}{17.27\angle 30.75^\circ} = 5.79\ \angle -30.75^\circ\ \text{A}$$

$$P = VI\cos\phi = 100 \times 5.79 \times \cos(30.75^\circ)$$

$$= 497.94\ \text{W}$$

$$\text{pf} = \cos\phi = \cos(30.75^\circ) = 0.86\ \text{(lagging)}$$

2.The circuit of Fig. takes 12 A at a lagging power factor and dissipates 1800 W. The reading of the voltmeter is 200 V. Find R1, X1 and X2.



Solution

$$I = 12 \text{ A}$$
$$P = 1800 \text{ W}$$

Let

$$\bar{I} = 12 \angle 0^\circ \text{ A}$$
$$Z_2 = \frac{200}{12} = 16.667 \ \Omega$$
$$Z_2 = \sqrt{R_2^2 + X_2^2}$$
$$16.67 = \sqrt{(10)^2 + X_2^2}$$
$$(16.67)^2 = 10^2 + X_2^2$$
$$277.88 = 100 + X_2^2$$
$$X_2 = 13.33 \ \Omega$$
$$\bar{V}_2 = (12 \angle 0^\circ)\,(10 + j13.33)$$
$$= (12 \angle 0^\circ)\,(16.666 \angle 53.13^\circ) = 200 \angle 53.13^\circ \text{ V}$$
$$P = VI \cos \phi$$
$$1800 = 200 \times 12 \times \cos \phi$$
$$\cos \phi = 0.75$$
$$\phi = 41.41^\circ$$

Applied voltage $\overline{V_{eq}} = 200 \angle 41.41^\circ$ V

Voltage across parallel branches = $200 \angle 41.41^\circ - 200 \angle 53.13^\circ = 40.84 \angle -42.73^\circ$ V

$$\text{Current through capacitor} = \frac{40.84\angle -42.73^\circ}{20\angle -90^\circ} = 2.04 \angle 47.27^\circ \text{ A}$$

$$\text{Current through } R_1 \text{ and } X_1 = 12 \angle 0^\circ - 2.04\angle 47.27^\circ = 10.72\angle -8.03^\circ \text{ A}$$

$$\overline{Z_1} = \frac{40.84\angle -42.73^\circ}{10.72\angle -8.03^\circ}$$

$$= 3.81 \angle -34.7^\circ\ \Omega = 3.13 - j2.17\ \Omega$$

$$R_1 = 3.13\ \Omega$$

$$X_1 = 2.17\ \Omega$$