

# **Electrical Circuit (2)**

## **Power Factor Correction(week7 class1)**

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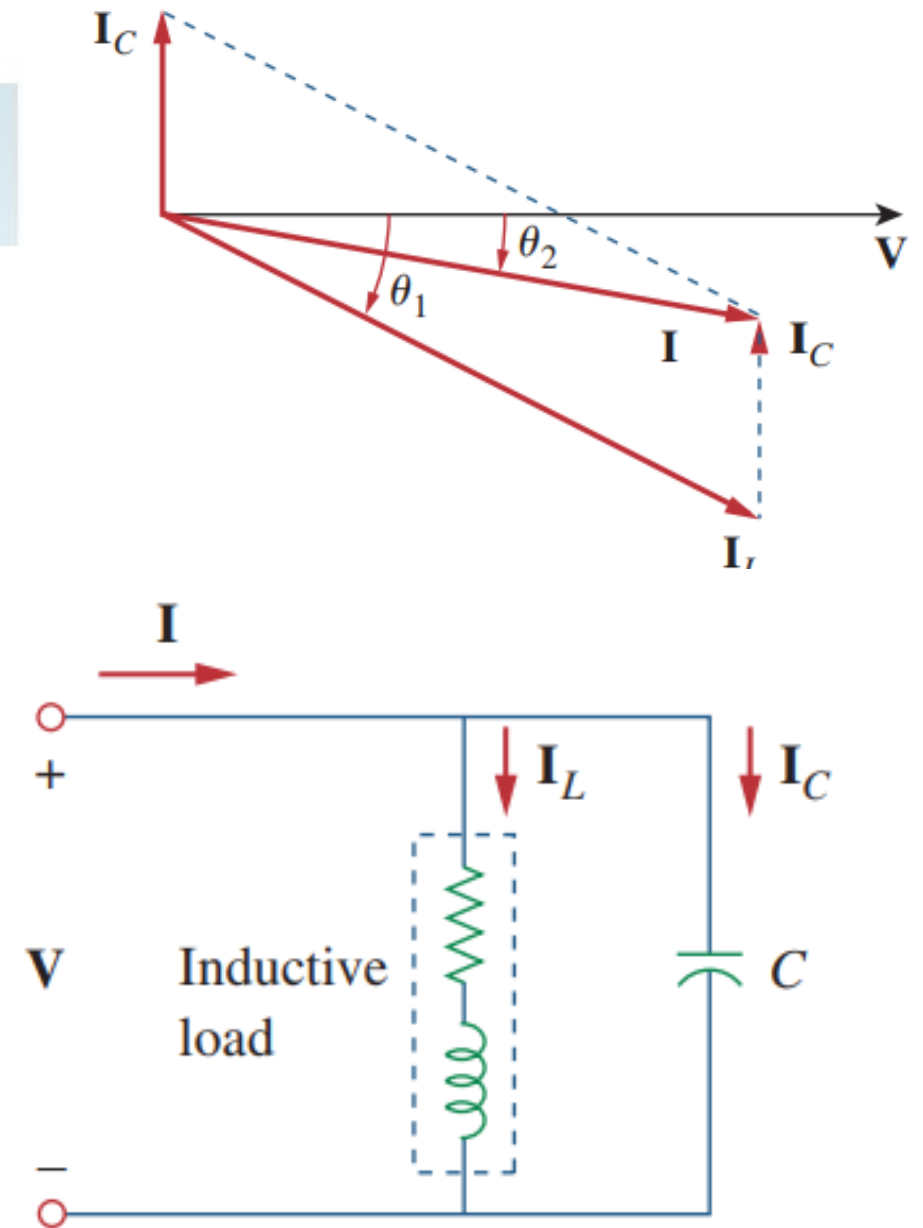
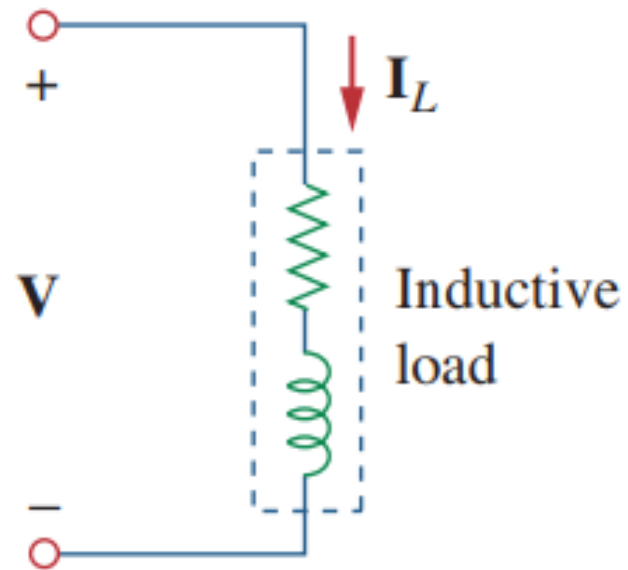
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## 11.8

## Power Factor Correction

The process of increasing the power factor without altering the voltage or current to the original load is known as **power factor correction**.



## 11.8

## Power Factor Correction

$$P = S_1 \cos \theta_1, \quad Q_1 = S_1 \sin \theta_1 = P \tan \theta_1$$

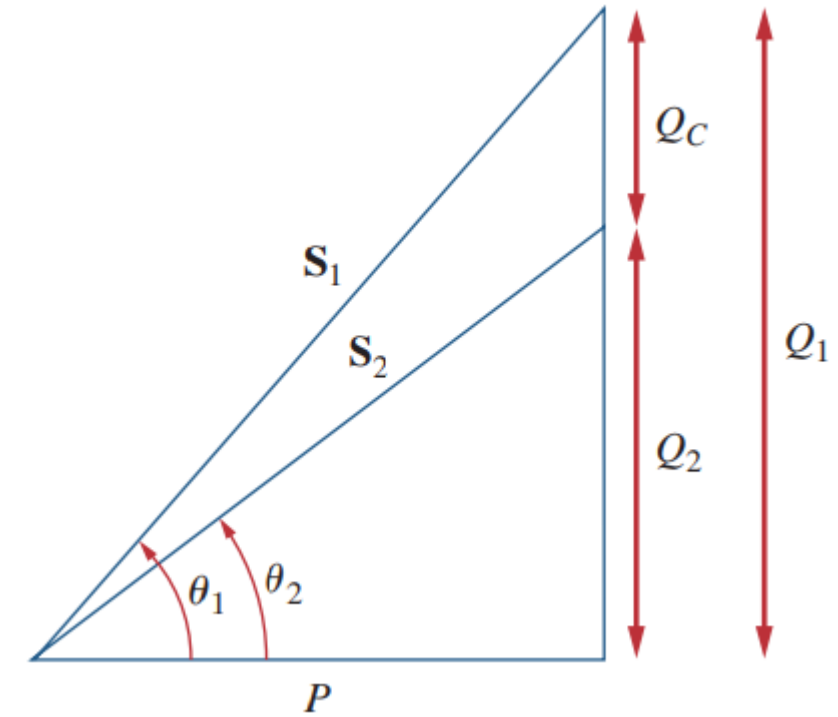
$$Q_2 = P \tan \theta_2$$

$$Q_C = Q_1 - Q_2 = P(\tan \theta_1 - \tan \theta_2)$$

$$Q_L = \frac{V_{\text{rms}}^2}{X_L} = \frac{V_{\text{rms}}^2}{\omega L} \Rightarrow L = \frac{V_{\text{rms}}^2}{\omega Q_L}$$

$$Q_C = \frac{V_{\text{rms}}^2}{X_C} = V_{\text{rms}}^2 * \omega * C$$

$$C = \frac{Q_C}{\omega V_{\text{rms}}^2} = \frac{P(\tan \theta_1 - \tan \theta_2)}{\omega V_{\text{rms}}^2}$$



## 11.8

## Power Factor Correction

When connected to a 120-V (rms), 60-Hz power line, a load absorbs 4 kW at a lagging power factor of 0.8. Find the value of capacitance necessary to raise the pf to 0.95.

## 11.8

## Power Factor Correction

When connected to a 120-V (rms), 60-Hz power line, a load absorbs 4 kW at a lagging power factor of 0.8. Find the value of capacitance necessary to raise the pf to 0.95.

$$S_1 = \frac{P}{\cos \theta_1} = \frac{4000}{0.8} = 5000 \text{ VA}$$

$$Q_1 = S_1 \sin \theta = 5000 \sin 36.87 = 3000 \text{ VAR}$$

$$\cos \theta_2 = 0.95 \quad \Rightarrow \quad \theta_2 = 18.19^\circ$$

$$S_2 = \frac{P}{\cos \theta_2} = \frac{4000}{0.95} = 4210.5 \text{ VA}$$

$$Q_2 = S_2 \sin \theta_2 = 1314.4 \text{ VAR}$$

$$Q_C = Q_1 - Q_2 = 3000 - 1314.4 = 1685.6 \text{ VAR}$$

$$C = \frac{Q_C}{\omega V_{\text{rms}}^2} = \frac{1685.6}{2\pi \times 60 \times 120^2} = 310.5 \mu\text{F}$$

## 11.8 Power Factor Correction

Find the value of parallel capacitance needed to correct a load of 140 kVAR at 0.85 lagging pf to unity pf. Assume that the load is supplied by a 110-V (rms), 60-Hz line.

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## Power Factor Correction

Find the value of parallel capacitance needed to correct a load of 140 kVAR at 0.85 lagging pf to unity pf. Assume that the load is supplied by a 110-V (rms), 60-Hz line.

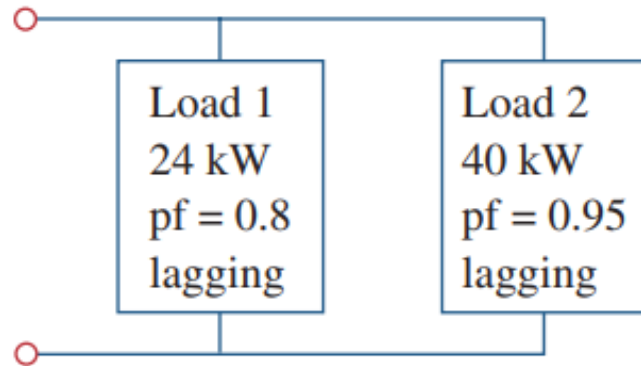
$$C = \frac{Q_c}{V^2 * 2 * \pi * f} = \frac{140000}{110^2 * 2 * \pi * 60} = 30.69 \text{ mF}$$

## 11.8

## Power Factor Correction

**11.74** A 120-V rms 60-Hz source supplies two loads connected in parallel, as shown in Fig. 11.89.

- (a) Find the power factor of the parallel combination.
- (b) Calculate the value of the capacitance connected in parallel that will raise the power factor to unity.

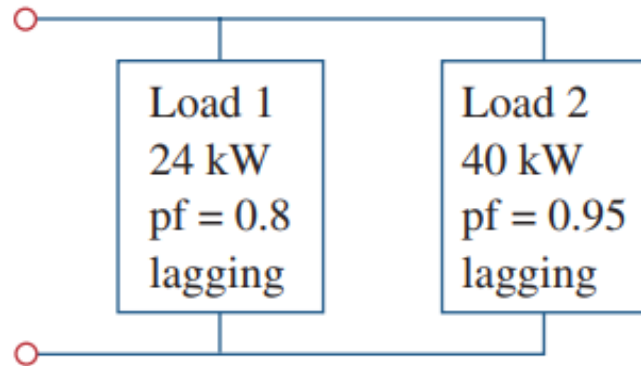


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## Power Factor Correction

**11.74** A 120-V rms 60-Hz source supplies two loads connected in parallel, as shown in Fig. 11.89.

- (a) Find the power factor of the parallel combination.
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$$Q_1 = P_1 \tan(\cos^{-1}(\theta_1)) = 24 \tan(\cos^{-1}(0.8)) = 18 \text{ KVAR}$$

$$Q_2 = P_2 \tan(\cos^{-1}(\theta_2)) = 40 \tan(\cos^{-1}(0.95)) = 13.147 \text{ KVAR}$$

$$S_{1,2} = S_1 + S_2 = P_1 + jQ_1 + P_2 + jQ_2 = 24 + j18 + 40 + j13.147$$

$$S_{1,2} = 64 + j31.147$$

$$I_{1,2} = \frac{S_{1,2}}{V_{rms}} = \frac{64 + j31.147}{120} = 0.533 + j0.26 = 0.6 \angle 25.95 \text{ kA}$$

$$C = \frac{Q_{1,2}}{V_{rms}^2 * 2 * \pi * f} = \frac{31.147}{120^2 * 2 * \pi * 60} = 5.737 \text{ mF}$$

$$I_{1,2,3} = \frac{S_{1,2,3}}{V_{rms}} = \frac{64}{120} = 0.533 \text{ kA}$$

