ELEMENTS OF ELECTRICAL ENGINEERING
Course Code : UE25EE141A/B

PES UNIVERSITY

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ELEMENTS OF ELECTRICAL ENGINEERING (UE25EE141A/B)

NUMERICAL EXAMPLES ON POWER FACTOR IMPROVEMENT

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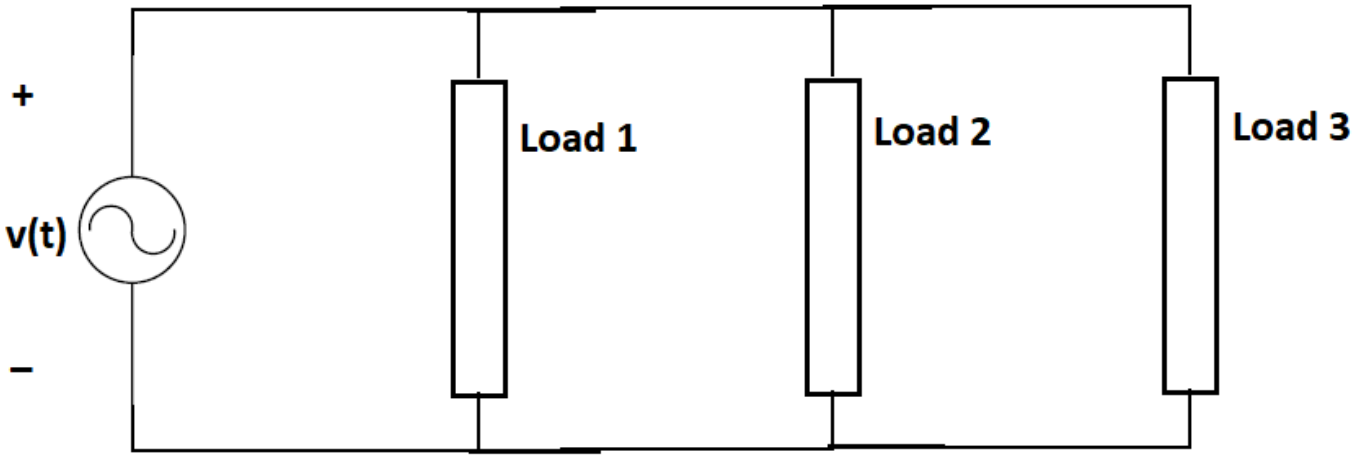
Numerical Example 1

Question:

The load connected across an AC supply consists of a heating load of 15KW, a motor load of 40KVA at 0.6 lag and a load of 20KW at 0.8 lag. Calculate the total power drawn from the supply in (KW and KVA) and its power factor. What would be the KVAR rating of a capacitor to bring the power factor to unity and how must the capacitor be connected?

Numerical Example 1

Solution:



Load 1 : Heating Load $\Rightarrow$ Resistive $\Rightarrow$ $\cos\phi_1 = 1$

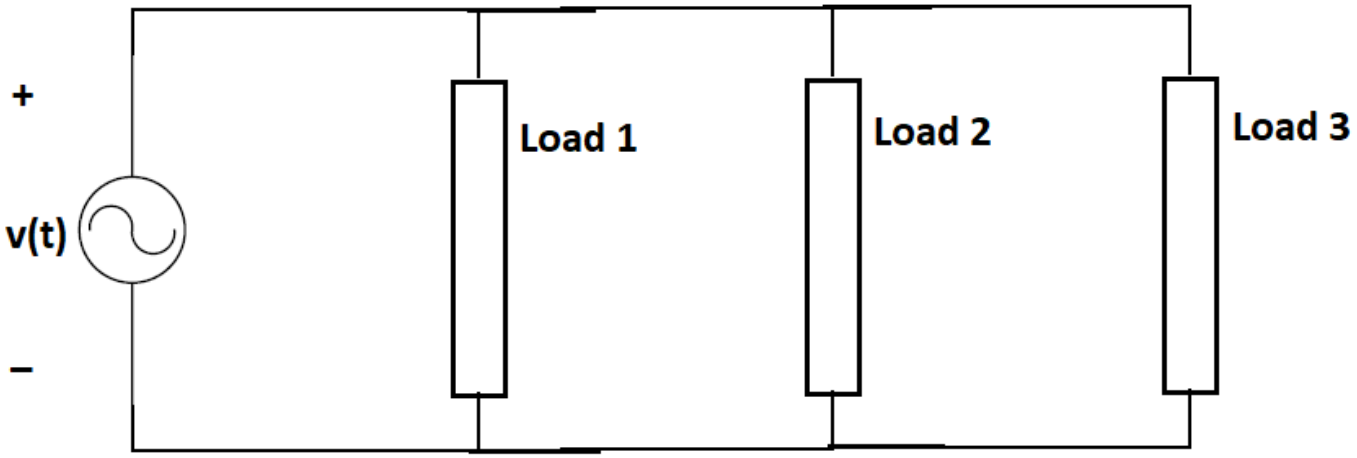
$P_1 = 15\text{KW}$ (given)

$Q_1 = 0$

$S_1 = \sqrt{P_1^2 + Q_1^2} = 15\text{KVA}$

Numerical Example 1

Solution:



Load 2 : Motor Load $\Rightarrow$ Inductive

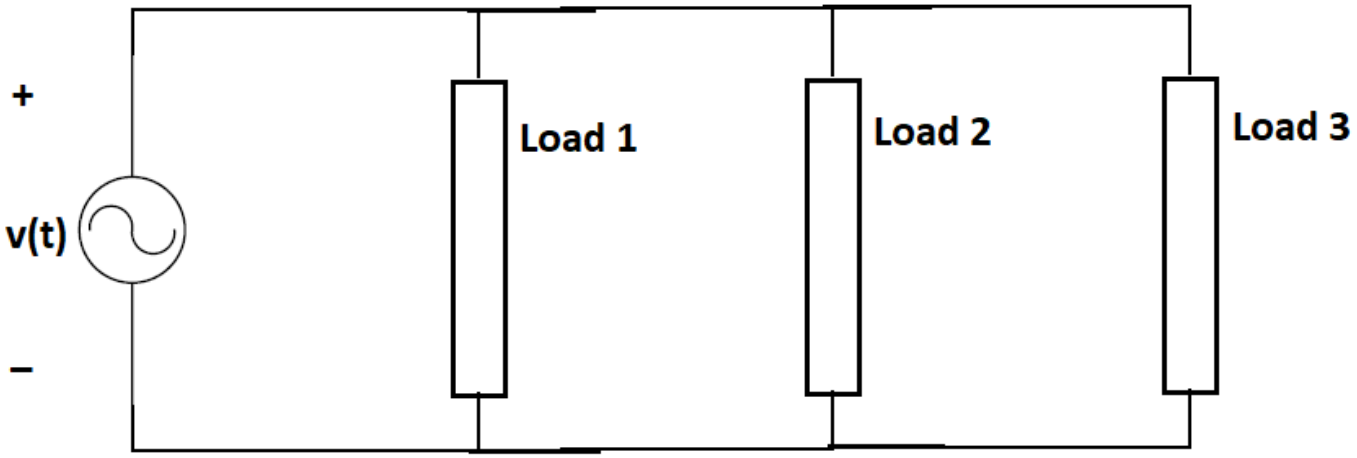
S_2 = 40KVA & $\cos\phi_2$ = 0.6 Lag (given)

$P_2 = S_2\cos\phi_2$ = 24KW

$Q_2 = \sqrt{S_2^2 - P_2^2}$ = 32KVAR

Numerical Example 1

Solution:



Load 3 : Inductive Load

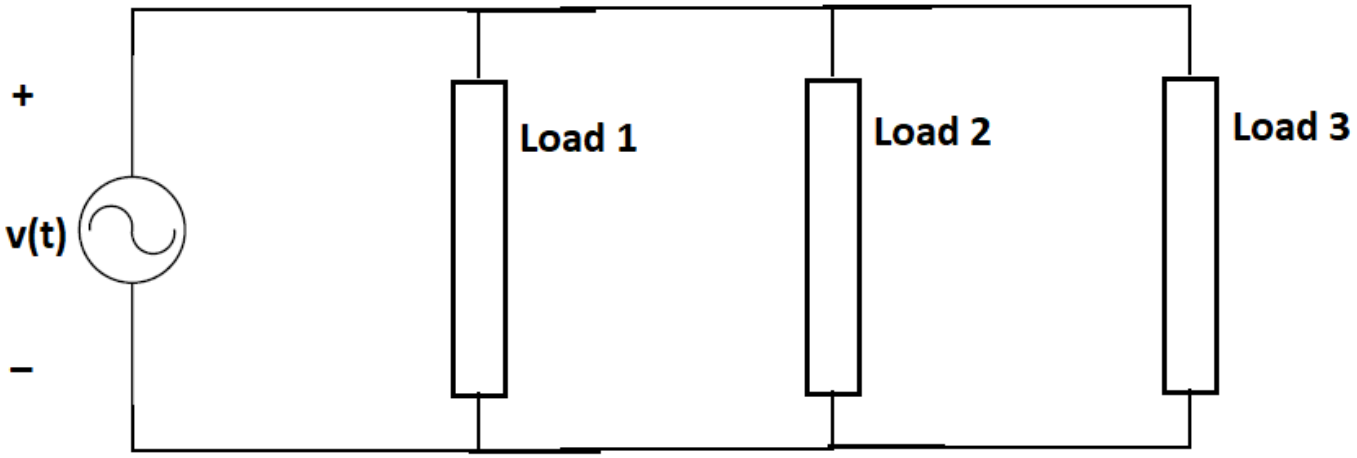
P_3 = 20KW & $\cos\phi_3$ = 0.8 Lag (given)

$$S_3 = \frac{P_3}{\cos\phi_3} = 25\text{KVA}$$

$$Q_3 = \sqrt{S_3^2 - P_3^2} = 15\text{KVAR}$$

Numerical Example 1

Solution:



Net Active Power, $P_T = P_1 + P_2 + P_3 = 59KW$

Net Reactive Power, $Q_T = Q_1 + Q_2 + Q_3 = 47KVAR$

Net Apparent Power, $S_T = \sqrt{P_T^2 + Q_T^2} = 75.43KVA$

To make overall power factor unity, net reactive power must be zero. Hence, connect a capacitor of rating 47KVAR in parallel to achieve this.

Numerical Example 2

Question:

The power consumed in the inductive load is 2.5 kW at 0.71 lagging power factor. The input voltage is 230 V, 50 Hz. Find the value of the capacitor C which must be placed in parallel, such that the resultant power factor of the input current is 0.866 lagging.

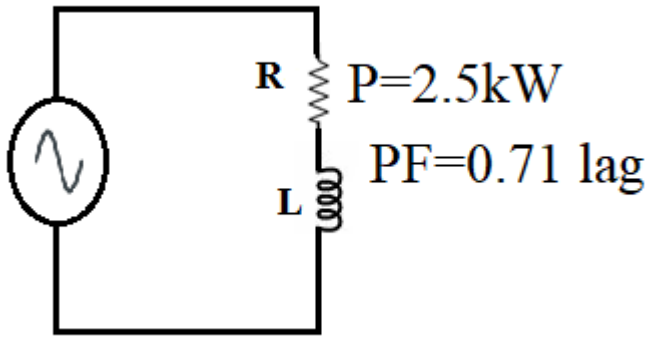
Solution:

$$P = VI\cos\phi$$

$$I = 15.309\ A$$

$$\phi = \cos^{-1}0.71 = 44.76$$

$$\therefore I = 15.309\angle -44.76°\ A$$



Numerical Example 2

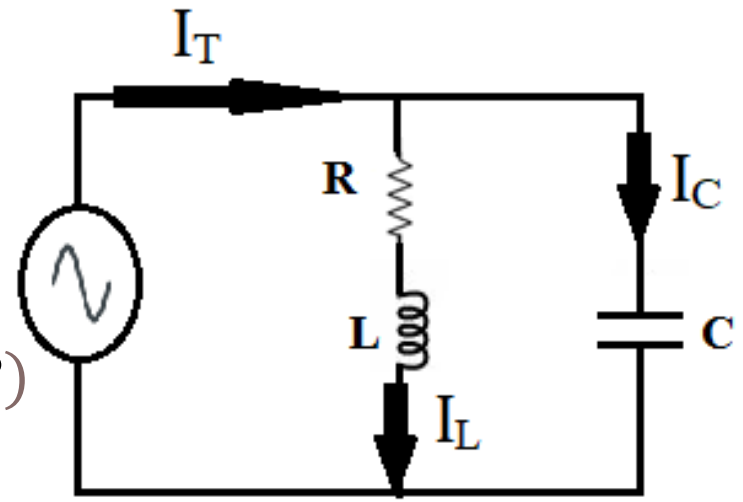
$By\ KCL$

$$I_T\angle -30° = (15.309\angle -44.76°) + (I_C\angle 90°)$$

By equating real parts.

$$I_T cos30° = (15.309\ cos44.76°) + (I_C\ cos90°)$$

$$I_T = 12.55A$$



$$I_C = I_T - I_L \quad (phasor\ sum\ )$$

$$I_C = (12.55\angle -30°) - (15.309\angle -44.76°)$$

$$\therefore \quad I_C = 4.504\angle 90°$$

$$\therefore X_C = \frac{V_C}{I_C} = \frac{230}{4.504} = 51.065\Omega \qquad C = \frac{1}{2\pi f X_c} = 62.33\mu f$$

ELEMENTS OF ELECTRICAL ENGINEERING

Text Book & References

Text Book:

1. "Basic Electrical Engineering" S.K Bhattacharya, 1st Edition Pearson India Education Services Pvt. Ltd., 2017
2. "Basic Electrical Engineering", D. C. Kulshreshta, 2nd Edition, McGraw-Hill. 2019
3. "Special Electrical Machines" E G Janardanan, PHI Learning Pvt. Ltd., 2014

Reference Books:

1. "Engineering Circuit Analysis" William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023

2. "Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.

THANK YOU

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