ELEMENTS OF ELECTRICAL ENGINEERING
Course Code : UE25EE141A/B

PES UNIVERSITY

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ELEMENTS OF ELECTRICAL ENGINEERING (UE25EE141A/B)

Numerical Examples on Series-Parallel AC Circuits

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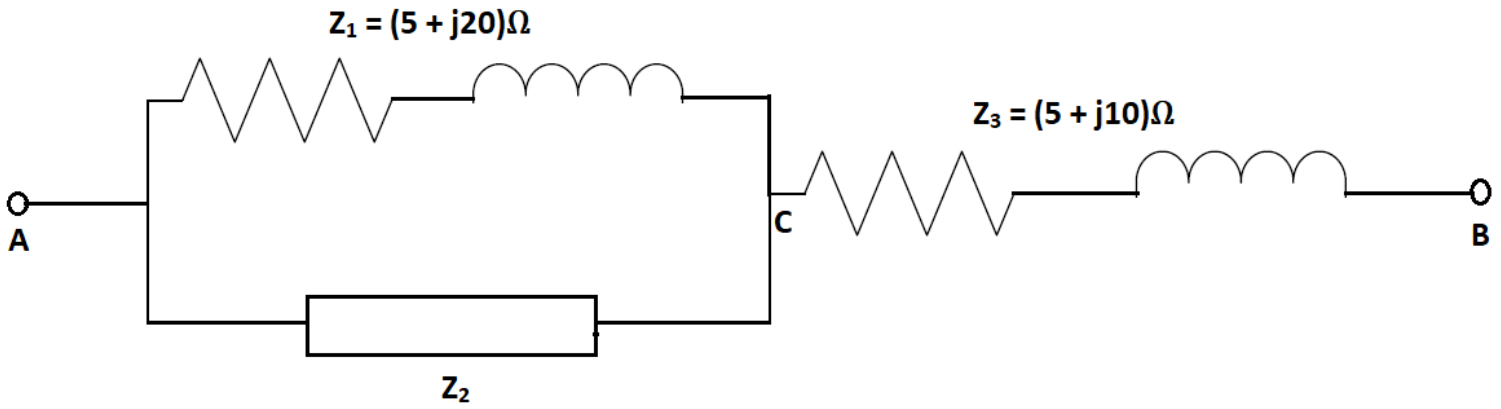
Numerical Example 1

Question:



When a 220V AC supply is applied across terminals A & B of the circuit shown, the total power input is 3.25kW and the total current is 20A, lag. Find the complex expressions for currents through Z_1 and Z_2, taking V_{AC} as reference phasor.

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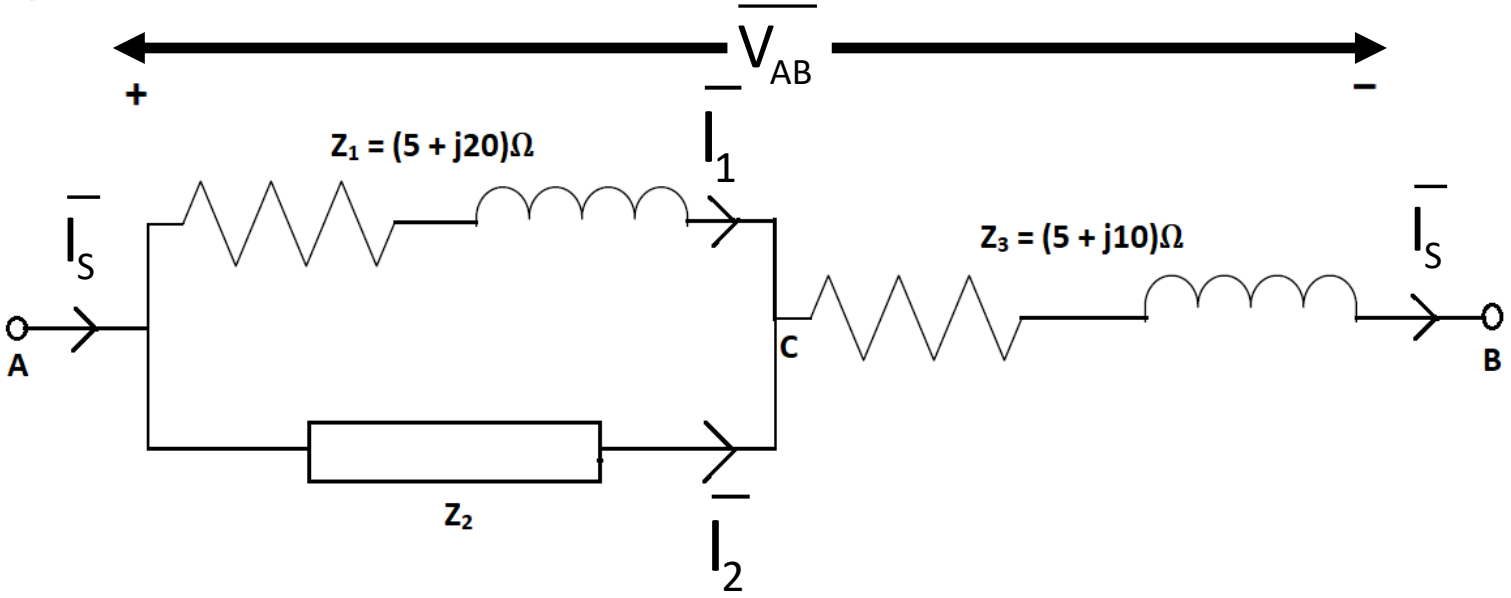
Numerical Example 1

Solution:



Considering supply voltage as reference, $\overline{V_{AB}} = 220\angle 0°$ V

Given, total power input = 3.25KW

i.e., $V_{AB} * I_s * \cos\phi = 3.25KW = 220*20*\cos\phi$

$\Rightarrow \phi = 42.38°$

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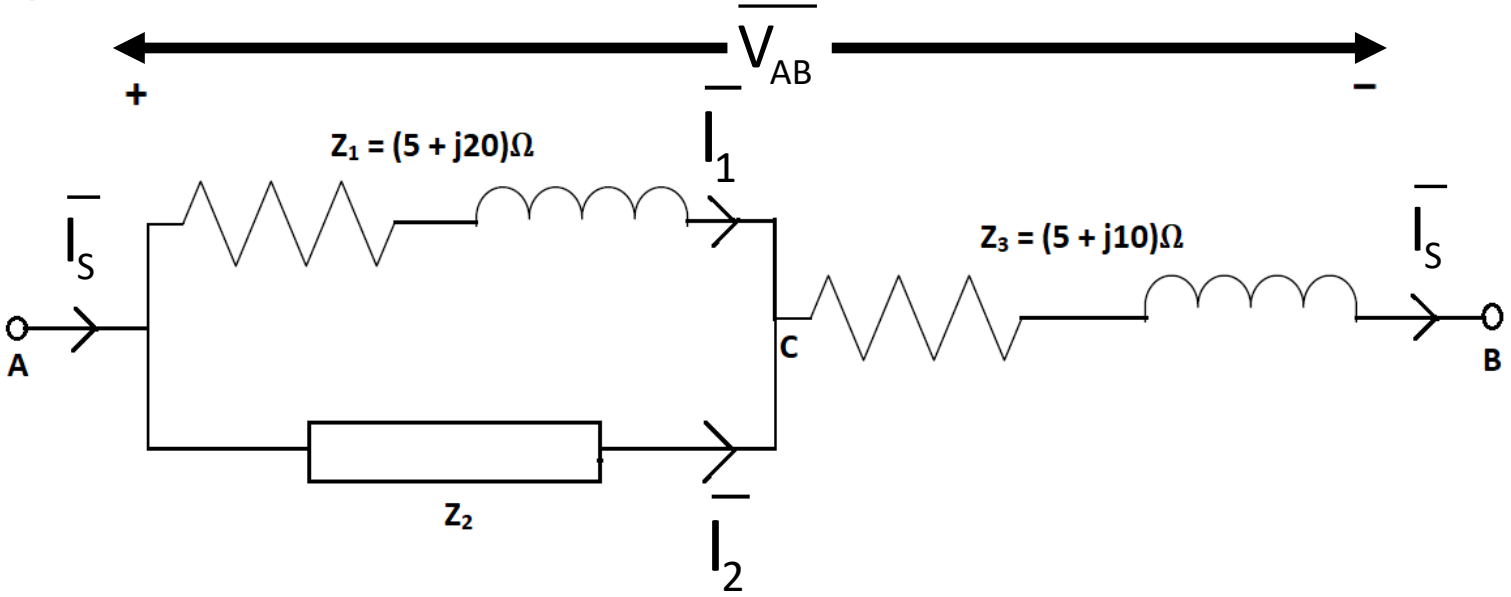
Numerical Example 1

Solution:



Since supply current is given as lag, $\bar{I}_S = 20\angle -42.38°$ A

$$\overline{V_{CB}} = \bar{I}_S * Z_3 = 223.61\angle 21.05°\text{V}$$

$$\overline{V_{AC}} = \overline{V_{AB}} - \overline{V_{CB}} = 81.11\angle -81.98°\text{V}$$

$$\bar{I}_1 = \frac{\overline{V_{AC}}}{Z_1} = 3.93\angle -157.95°\text{A}$$

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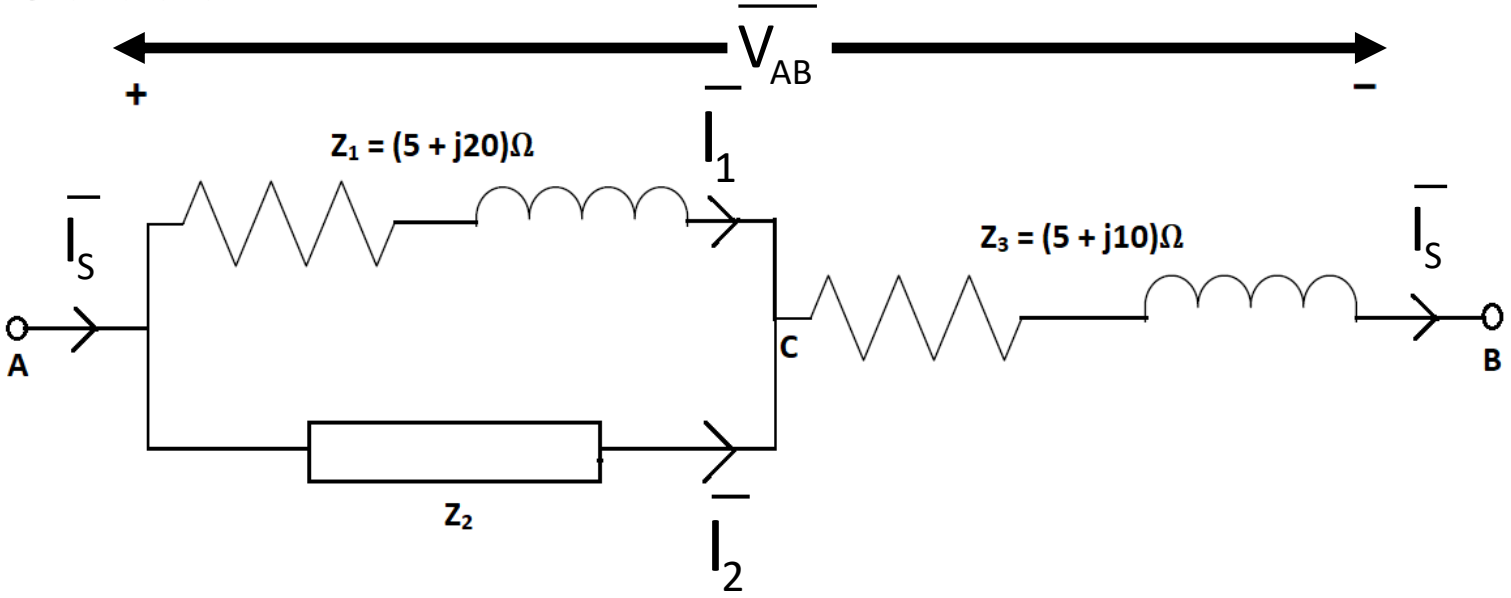
Numerical Example 1

Solution:



$\overline{I}_2 = \overline{I}_s - \overline{I}_1 = 21.98\angle -33.1°\text{A}$

We found that $\overline{V}_{AC} = 81.11\angle -81.98°$ V

To make $\overline{V}_{AC}$ as reference, add 81.98° to its phase angle.

Also, Add the same angle to all other phasors.

Thus, $\overline{I}_1 = 3.93\angle -75.97°\text{A}$; $\overline{I}_2 = 21.98\angle 48.88°\text{A}$

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Numerical Example 2

Question:

A voltage of 200 V is applied to a pure resistor (R), a pure capacitor, C and a lossy inductor coil with resistance of 100 Ω, all of them connected in parallel. The total current is 2.45 A, while the component currents are 1.5, 2.0 and 1.2 A respectively. Find the total power factor and also the power factor of the coil. Also find the total active and reactive power.

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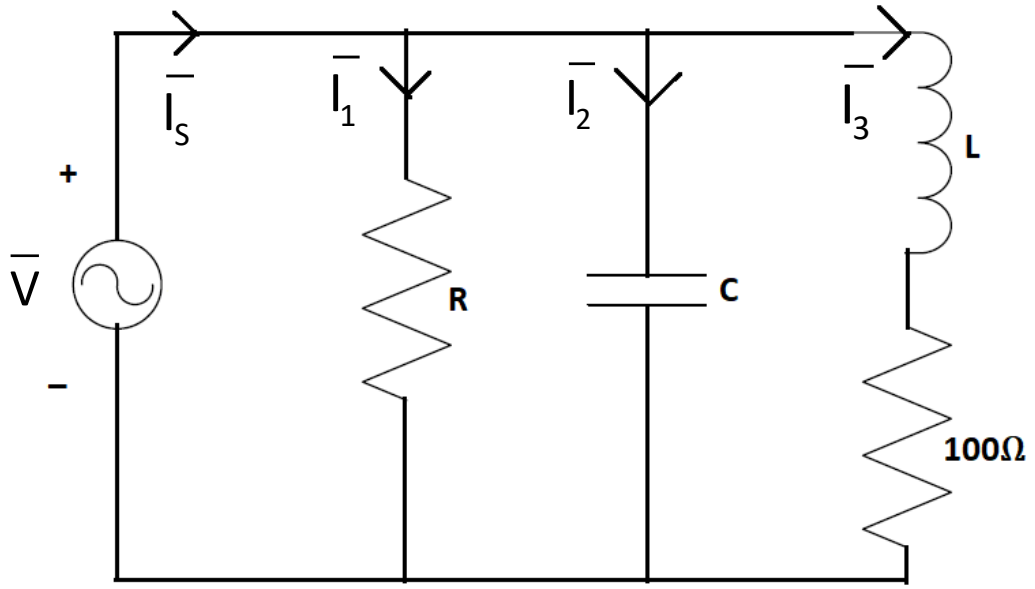
Numerical Example 2

Solution:



Let us consider supply voltage as reference

$$\Rightarrow \bar{V} = 200\angle 0° \text{ V}$$

Therefore $\bar{I}_1 = 1.5\angle 0° \text{ A} ; \bar{I}_2 = 2\angle 90° \text{ A}$

In branch 3, $|Z_3| = \frac{200}{1.2} = 166.66\Omega$

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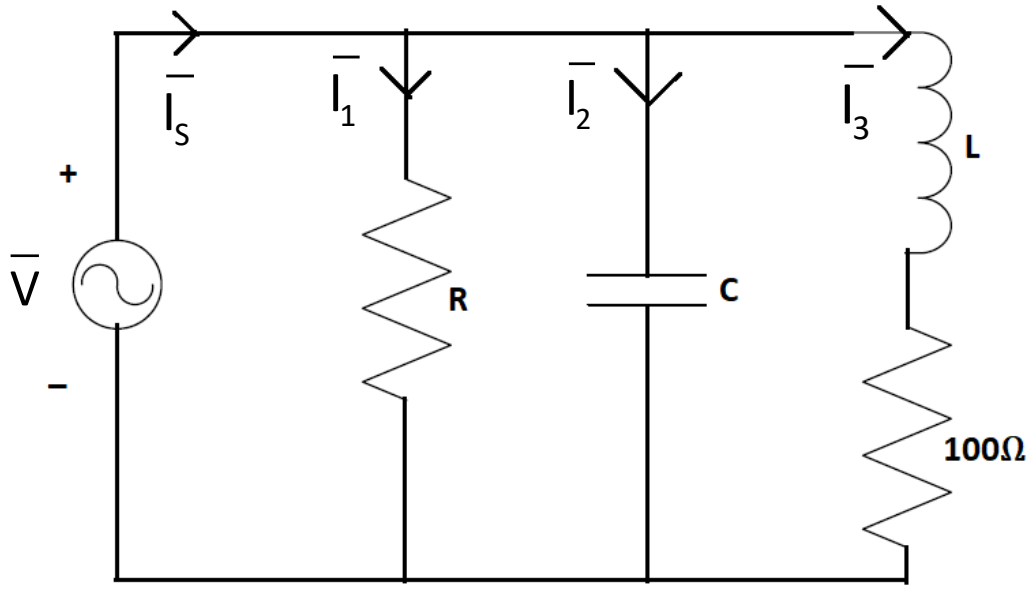
Numerical Example 2

Solution:



Therefore, $\phi_3 = \cos^{-1}\left(\frac{r_3}{|Z_3|}\right) = 53.13° \Rightarrow \bar{I}_3 = 1.2\angle -53.13°$ A

Hence, $\bar{I}_S = \bar{I}_1 + \bar{I}_2 + \bar{I}_3 = 2.45\angle 25.1°$ A

Phase Angle of the network = $\phi = \angle\bar{V} - \angle\bar{I}_s = -25.1°$

Overall Power factor = $\cos\phi = 0.905$ Lead

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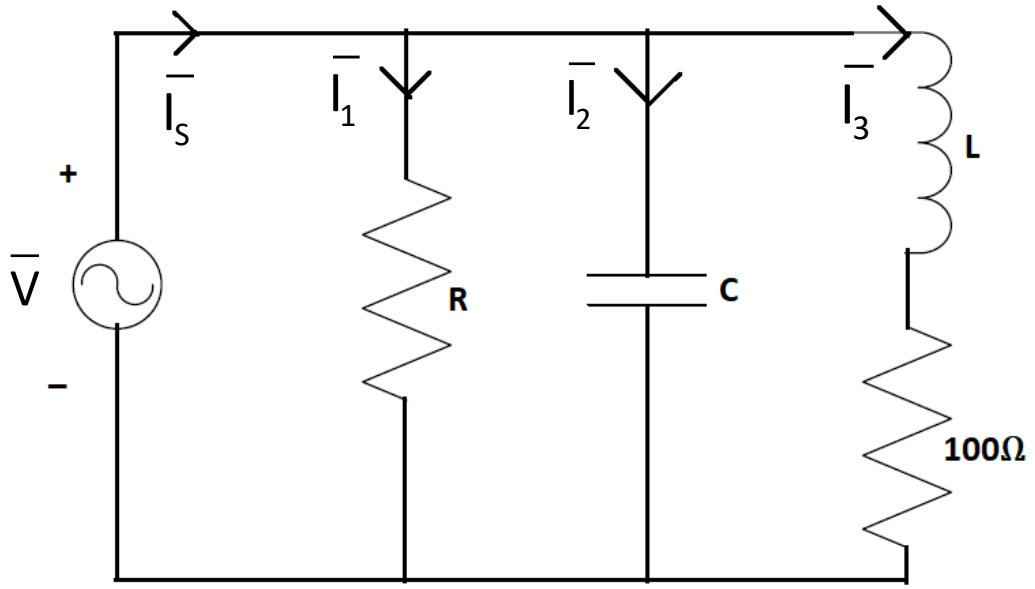
Numerical Example 2

Solution:



Power factor of the coil = $\cos\phi_3$ = 0.6 Lag

Total Active Power, $P_T = V*I_S*\cos\phi$ = 443.45W

Total Reactive Power, $Q_T = V*I_S*\sin\phi$ = -207.85 VAR

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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