

# task\_jti0uzudcmg4u22t\_with\_calculation

## Student Group

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complex impedance, exam ee1 WS2022

**Exercise E4 Analyzing complex Impedances**  
 (written test, approx. 14 % of a 60-minute written test, WS2022)

2. Calculate the phasor voltage  $\underline{U}$  and the current  $\underline{I}$  in the circuit shown in the figure. The components ( $R$  and  $X_L$ ) shall be given.

After analysis, the full bridge dimensioned circuit diagram shall be extracted and built (figure) in phase (calculated) left ( $Z$ )  $\underline{U} = \underline{U} \cdot \underline{I} = (20 \angle 0^\circ + j4 \text{ Ohm}) \cdot (5 \angle 90^\circ) = 100 \angle 90^\circ \text{ V}$

Solution  
 .. Calculation of physical values of the components.  
 Solution  $R = 20 \text{ Ohm}$ ,  $X_L = j4 \text{ Ohm}$

Solution

$\underline{I} = \frac{\underline{U}}{Z} = \frac{100 \angle 90^\circ}{20 + j4} = \frac{100 \angle 90^\circ}{20.4 \angle 11.3^\circ} = 4.9 \angle 78.7^\circ \text{ A}$   
 $\underline{U} = \underline{I} \cdot Z = 4.9 \angle 78.7^\circ \cdot (20 + j4) = 98 \angle 78.7^\circ + j19.6 \angle 78.7^\circ = 98 \cos(78.7^\circ) - j19.6 \sin(78.7^\circ) = 20.4 - j19.6 \text{ V}$   
 The current and voltage across phase on the circuit are  $\underline{I} = 4.9 \angle 78.7^\circ \text{ A}$  and  $\underline{U} = 20.4 - j19.6 \text{ V}$  resulting in a power  $P = \text{Re}\{\underline{U} \cdot \underline{I}^*\} = 20.4 \cdot 4.9 = 100 \text{ W}$ .  
 The power factor  $\cos(\phi) = \frac{\text{Re}\{Z\}}{|Z|} = \frac{20}{20.4} = 0.98$ .  
 Impedance  $Z = 20 + j4 \text{ Ohm}$ .  
 $\underline{U} = \underline{I} \cdot Z = (4.9 \angle 78.7^\circ) \cdot (20 + j4) = 98 \angle 78.7^\circ + j19.6 \angle 78.7^\circ = 98 \cos(78.7^\circ) - j19.6 \sin(78.7^\circ) = 20.4 - j19.6 \text{ V}$   
 $\underline{I} = \frac{\underline{U}}{Z} = \frac{100 \angle 90^\circ}{20 + j4} = 4.9 \angle 78.7^\circ \text{ A}$   
 With the complex part comes the complex value  $\underline{U} = 20.4 - j19.6 \text{ V}$  and  $\underline{I} = 4.9 \angle 78.7^\circ \text{ A}$ .  
 $\phi = \arctan\left(\frac{\text{Im}\{Z\}}{\text{Re}\{Z\}}\right) = \arctan\left(\frac{4}{20}\right) = 11.3^\circ$   
 The phase  $\phi$  can be calculated as  $\phi = \arctan\left(\frac{-4.68}{0.24}\right) = -10.8^\circ$

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