

# SOLUTIONS

## ECE222

### Quiz 4

To get full credit, show all your work. If you need extra space write on the back and clearly indicate the question number.

- 1) Given the following voltage and current:

$$i(t) = 5 \sin(377t - 20^\circ) \text{ A}$$

$$v(t) = 10 \cos(377t + 30^\circ) \text{ V}$$

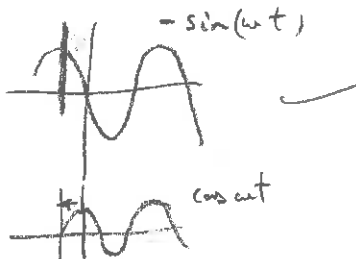
Determine the phase relationship between  $i(t)$  and  $v(t)$ , i.e. which leads which and by how much?

$$5 \sin(377t - 20^\circ) = 5 \cos(377t - 20^\circ - 90^\circ) = 5 \cos(377t - 110^\circ)$$

$$\phi_v = 30^\circ, \phi_i = -110^\circ \Rightarrow \phi_v - \phi_i = 30^\circ - (-110^\circ) = 140^\circ$$

$\Rightarrow v$  leads  $i$  by  $140^\circ$

- 2) Give the phasor representation of  $v_0 = -4 \sin(10t + 10^\circ)$


$$-\sin(\omega t) = \cos(\omega t + 90^\circ)$$
$$\Rightarrow -4 \sin(10t + 10^\circ) = 4 \cos(10t + 10^\circ + 90^\circ)$$
$$= 4 \cos(10t + 100^\circ) \Rightarrow \underline{\underline{\vec{V}_0 = 4 \angle 100^\circ \text{ V}}}$$

- 3) Find the sinusoid represented by the phasor:  $\underline{I} = -3 + j4$

$$\underline{I} = -3 + j4 = 5 \angle 126.87^\circ \rightarrow \underline{\underline{i(t) = 5 \cos(\omega t + 126.87^\circ)}}$$

$$|I| = \sqrt{3^2 + 4^2} = 5$$

$$\angle I = \arctan\left(\frac{4}{-3}\right) = 126.87^\circ$$

(POINT IS IN THE SECOND QUADRANT OF COMPLEX PLANE)

- 4) Using phasors derive the phase relationship between voltage and current for a capacitor, i.e. which leads which and by how much.

$$V = IZ \quad \text{CAPACITANCE } Z = \frac{1}{j\omega C} = \frac{-j}{\omega C} = \frac{1}{\omega C} e^{-j90^\circ}$$

$$\text{Let } I = I_m e^{j0^\circ}$$

$$\Rightarrow V = (I_m e^{j0^\circ}) \left(\frac{1}{\omega C}\right) e^{-j90^\circ} = \underline{\underline{\frac{I_m}{\omega C} e^{-j90^\circ}}}$$

$\Rightarrow$  VOLTAGE LAGS CURRENT BY  $90^\circ$   
OR CURRENT LEADS VOLTAGE BY  $90^\circ$