Homework 16

1. a) Find the real part of $z = e^{j\pi/4}$.

   b) Find the rectangular form of $e^{j\pi/3}$.

   c) Find the rectangular form of $5\angle 25° \cdot 8\angle 35°$

   d) Find the magnitude of $\left(\dfrac{j^{-1}}{3+j4}\right)\left(\dfrac{10e^{-j15°}}{(1+j)^2}\right)$.

   e) Find the polar (magnitude and angle) form of $\sqrt{2+\sqrt{3}} - j\sqrt{2-\sqrt{3}}$

2. Given ω = 10k rad/s, for each of the following impedances, determine which of the following the impedance is from: a capacitor, an inductor, or a resistor. Also, find the value of that capacitor, inductor, or resistor. Recall that $z_R = R$, $z_L = j\omega L$, and $z_C = 1/j\omega C$.

   a) $j40\ \Omega$

   b) $-j1\ \text{k}\Omega$

   c) $2\ \text{k}\Omega$

   d) $j8\ \text{k}\Omega$

   e) $-j100\ \Omega$

3. Derive a symbolic expression for the impedance of $R + j\omega L$ in parallel with $\dfrac{1}{j\omega C}$ at frequency $\omega^2 = \dfrac{1}{LC}$. Express the value in form $a + jb$.

4. Write phasors (in both $Ae^{j\phi}$ and $A\angle\phi$ notations) for each of the following signals:

   a) $v(t) = 4\cos(100t + 30°)$ V

   b) $i(t) = 7\sin(\omega t - 45°)$ mA

   c) $i(t) = 50\ \text{nF} \cdot \dfrac{d}{dt} 4\cos(100t + 30°)$ V

   d) $v(t) = 17\ \mu\text{H} \cdot \dfrac{d}{dt} 7\sin(60t - 45°)$ mA

   e) $v(t) = 4\cos(100t + 30°)\ \text{V} + 3\sin(100t - 150°)$ V

5. Given ω = 1 M rad/sec, write inverse phasors for each of the following signals:

a) $\mathbf{I} = 6e^{j45°}$ A

b) $\mathbf{V} = j9$ V

c) $\mathbf{I} = -2$ A

d) $\mathbf{V} = 6(1+j)e^{j45°}$ V

e) $\mathbf{I} = e^{3+j45°}\ \mathrm{A} = e^{3}\angle 45°$ A

Answers:

1.a) $\text{Re}[z] = \frac{1}{\sqrt{2}}$ b) $z = \frac{1}{2} + j\frac{\sqrt{3}}{2}$ c) $20 + 20\sqrt{3}$ d) 1 e) $2\angle -15°$

2.a) $L = 4$ mH b) $C = 0.1$ μF c) $R = 2$ kΩ d) $L = 0.8$ H e) $C = 1$ μF

3. $z = \frac{L}{RC} - j\sqrt{\frac{L}{C}}$

4.a) $4e^{j30°}$ V b) $7\angle -135°$ mA c) $20e^{j120°}\mu A$ d) $7.14e^{-j45°}\mu$V e) $5\angle 66.9°$V

5.a) $6\cos(1\text{M}t + 45°)$ A b) $9\cos(1\text{M}t + 90°)$ V c) $2\cos(1\text{M}t + 180°)$ A

d) $6\sqrt{2}\cos(1\text{M}t + 90°)$ V e) $e^{3}\cos(1\text{M}t + 45°)$ A