ECE 3510 homework # 6 Review of Steady-State AC

1. Convert the following complex numbers to polar form ($m\angle\theta$ or $me^{j\theta}$). a) $2.6 + 8.7j$ b) $3 + 4j$ c) $-3 - 4j$

2. Convert the following complex numbers to rectangular form (a + bj). a) $10\cdot e^{j\cdot 60\cdot deg}$ b) $10\cdot e^{-j\cdot 45\cdot deg}$ c) $20\cdot e^{j\cdot 120\cdot deg}$

3. Add or subtract the complex numbers. a) $(3 + 2j) + (6 + 9j)$ b) $(9 - 10j) - (9 + 10j)$

4. Multiply the complex numbers. a) $\left(20\cdot e^{j\cdot 40\cdot deg}\right)\cdot\left(10\cdot e^{j\cdot 60\cdot deg}\right)$ b) $(-2 - j)\cdot(-6 - 9j)$

5. Divide the complex numbers. a) $\dfrac{20\cdot e^{j\cdot 40\cdot deg}}{10\cdot e^{j\cdot 60\cdot deg}}$ b) $\dfrac{12 + 10j}{6 + 9j}$

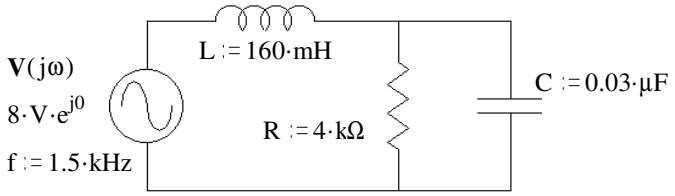
6. Add and subtract the sinusoidal voltages using phasors. Draw a phasor diagram which shows all 4 phasors, and give your final answer in time domain form.

$v_1(t) = 1.5\cdot V\cdot\cos(\omega\cdot t + 10\cdot deg)$ $v_2(t) = 3.2\cdot V\cdot\cos(\omega\cdot t + 25\cdot deg)$

a) Find $v_3(t) = v_1(t) + v_2(t)$ b) Find $v_4(t) = v_1(t) - v_2(t)$

7. a) Find $\mathbf{Z_{eq}}$.

b) Find the current $\mathbf{I_L}(j\omega)$.



8. Find the steady-state magnitude and phase of each of the following transfer functions. $|H(j\cdot\omega)|$ = ? $\angle H(j\omega)$ = ?

a) $\omega := 10\cdot\dfrac{rad}{sec}$ $H(s) = \dfrac{\frac{40}{sec}\cdot s}{s^2 + \frac{10}{sec}\cdot s + \frac{200}{sec^2}}$

b) $f := 50\cdot Hz$ $H(s) = \dfrac{s^2 + \frac{1000}{sec}\cdot s}{s^2 + \frac{300}{sec}\cdot s + \frac{10000}{sec^2}}$

9. Express the following signals in the time domain, first as a cosine with a phase angle and then as a sum of cosine and sine with no phase angles: $s = j\cdot\omega$

a) $\omega := 20\cdot\dfrac{rad}{sec}$ $Y(s) = \dfrac{\frac{20}{sec}\cdot s + \frac{300}{sec^2}}{s^2 + \frac{10}{sec}\cdot s + \frac{800}{sec^2}}$

b) $\omega := 40\cdot\dfrac{rad}{sec}$ $Y(s) = \dfrac{2\cdot s^2 + \frac{300}{sec}\cdot s}{s^2 + \frac{10}{sec}\cdot s + \frac{800}{sec^2}}$

Answers

1. a) $9.08\cdot e^{j\cdot 73.4\cdot deg}$ b) $5\cdot e^{j\cdot 53.1\cdot deg}$ c) $5\cdot e^{-j\cdot 126.9\cdot deg}$

2. a) $5 + 8.66\cdot j$ b) $7.071 - 7.071\cdot j$ c) $-10 + 17.321\cdot j$ 3. a) $9 + 11\cdot j$ b) $-20\cdot j$

4. a) $200\cdot e^{j\cdot 100\cdot deg}$ b) $24.2\cdot e^{j\cdot 82.9\cdot deg}$ 5. a) $2\cdot e^{-j\cdot 20\cdot deg}$ b) $1.385 - 0.41\cdot j$

6. a) $v_1(t) + v_2(t) = 4.67\cdot\cos(\omega\cdot t + 20.2\cdot deg)\cdot V$ b) $v_1(t) - v_2(t) = 1.794\cdot\cos(\omega\cdot t - 142.5\cdot deg)\cdot V$

7. a) $1.82\cdot k\Omega$ $-15.2\cdot deg$ b) $4.4\cdot mA$ $15.2\cdot deg$

8. a) M = 2.828 $45\cdot deg$ b) M = 2.544 $-25.8\cdot deg$

9. a) $1.118\cdot\cos\left(20\cdot\frac{rad}{sec}\cdot t + 26.6\cdot deg\right)$ $\cos\left(20\cdot\frac{rad}{sec}\cdot t\right) - 0.5\cdot\sin\left(20\cdot\frac{rad}{sec}\cdot t\right)$ b) $13.89\cdot\cos\left(40\cdot\frac{rad}{sec}\cdot t - 48.5\cdot deg\right)$ $9.2\cdot\cos\left(40\cdot\frac{rad}{sec}\cdot t\right) + 10.4\cdot\sin\left(40\cdot\frac{rad}{sec}\cdot t\right)$