EE 213 Honors – Spring 2020
Quiz 4 - 20 points

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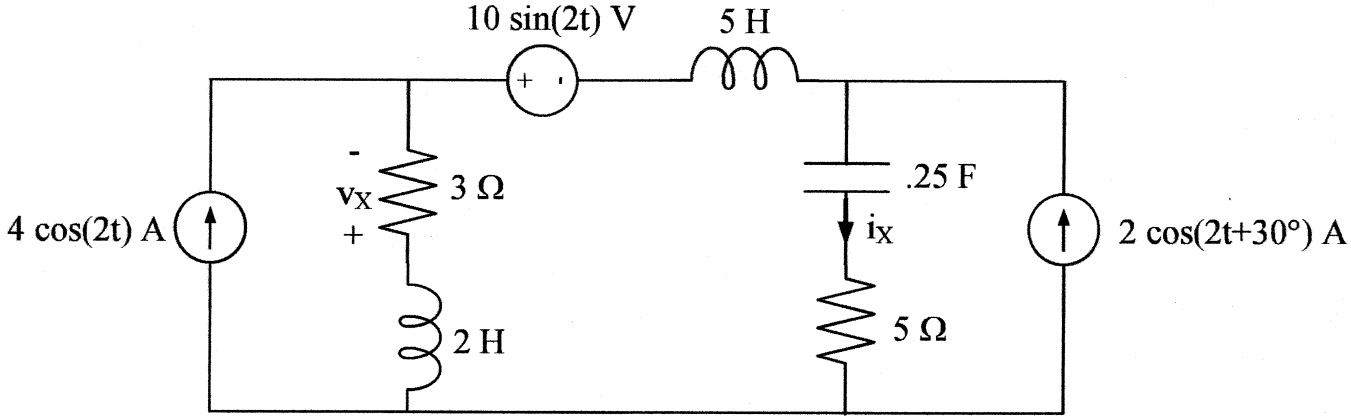
a) Convert the circuit from the time domain to the frequency domain.
b) Using either nodal or mesh analysis, solve for the phasor current, $\mathbf{I}_X$, and the phasor voltage $\mathbf{V}_X$.
c) What is the time domain current, $i_X(t)$ and the time domain voltage, $v_X(t)$? (Note: only the real parts of the time domain current/voltage are required.)
d) Find the average power, P, delivered by each source and absorbed by each impedance.

Legible and logical work please!!

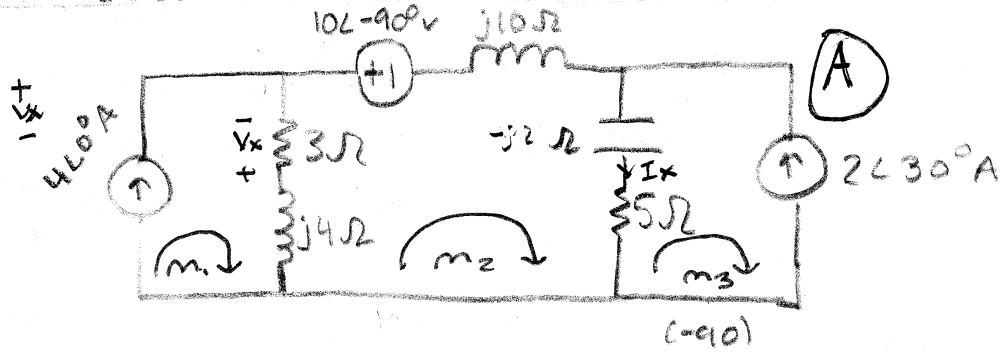


$\omega = 2$ rad/s

a) ◦Sources
- $4\cos(2t)$ A → $4\angle 0°$ A
- $10\sin(2t)$ V → $10\angle -90°$ V
- $2\cos(2t+30°)$ → $2\angle 30°$ A

◦ impedances
- 3Ω → 3Ω
- 5Ω → 5Ω
- 2H → $j\omega L = j\,2\cdot 2 = j4\Omega$

5H = $j\cdot 5\cdot 2 = j10\Omega$
.25F = $-j/2\cdot .25$



$I_1 = 4\angle 0°$ A
$I_3 = -2\angle 30°$ A
$V_x = 3(I_2 - I_1)$

$-j4(I_2 - I_1) - 3(I_2 - I_1) - 10\angle -90° - j10(I_2) + (j\tfrac{1}{2})(I_2 - I_3) - 5(I_2 - I_3) = 0$

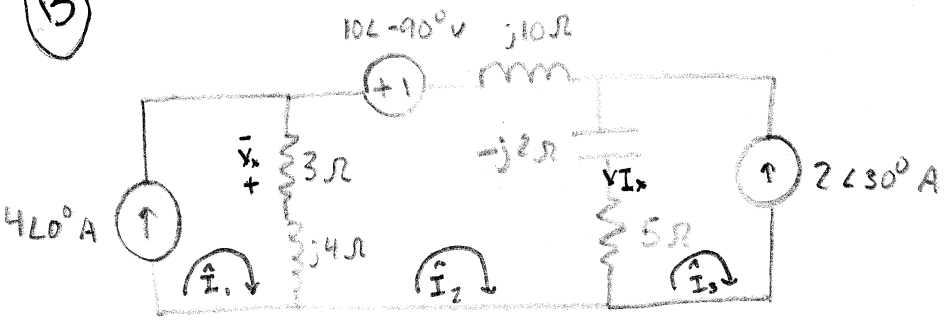
$-j4(I_2 - 4) - 3(I_2 - 4) + 10j - j10(I_2) + 0.5j(I_2 + (\sqrt{3}+i)) - 5(I_2 + (\sqrt{3}+i)) = 0$

$-j4I_2 - 3I_2 - j10I_2 - 0.5jI_2 - 5I_2$

$I_2(-8 - 13.5j) + 16j + 12 + 10j - 0.8 + 0.866j - 5\sqrt{3} - 5j = 0$

$I_2(-8 - 13.5j) + 2.84 + 21.866j = 0 \Rightarrow I_2 = 1.29 + 0.55j$

(B)



Know:

$I_x = I_2 - I_3$

$V_x = 3(I_2 - I_1)$

$I_1 = 4\angle 0°$

$I_3 = -2\angle 30°$

$= 2\angle -150°$

n_2: $-(3+j4)(I_2 - I_1) - 10\angle -90° - (5-j2)(I_2 - I_3) - j10I_2 = 0$

$-3I_2 - j4I_2 - 5I_2 + j2I_2 - j10I_2 = 10\angle -90° + (3+j4)(-I_1) + (5-j2)(-I_3)$

$I_2(-8-j12) = -10i + (3+j4)(-4) + (5-j2)(\sqrt{3}+i)$

$I_2(-8-j12) = -10i + (3+j4)(-4) + (5-j2)(\sqrt{3}+i)$

$I_2(-8-j12) = -1.33 - 24.46j$

$I_2 = 1.46 + 0.86j$

$I_2 = 1.69\angle 30.55°$

$I_x = (1.69\angle 30.55) - (2\angle -150) = 3.69\angle 30.255°$

$V_x = 3((1.69\angle 30.55) - (2\angle -150)) = 11.09\angle 30.255°$

~~$I_x = (2.47\angle -5.76) - (2\angle -150) = 4.26\angle 10.18°$~~

~~$V_x = 3((2.47\angle -5.76) - (4\angle 0)) = 4.69\angle -170.87°$~~

(C)

$i_x(t) = 3.69\cos(2t + 30.255)\,A$

$v_x(t) = 11.09\cos(2t + 30.255)\,V$

0.3234 ∠ -163.015

(D)

- Sources

- $4\angle 0°$ A: $P=(V_{rms})(I_{rms})\cos(\theta_V-\theta_I)$
  $P=(4)(4)\cos(0)$
  $P=16$ w del
- $10\angle -90°$ V: $P=(V_{rms})(I_{rms})\cos(-90-30.55)$
  $P=(10)(1.69)\cos(-90-30.55)$
  $P=-8.6$ w abs, 8.6 w del
- $2\angle 30°$ A $P=(V_{rms})(I_{rms})\cos($
  $(2)(2)(30+150)$
  $P=-4$ w abs, 4 w del

} 28.6 w del

- Impedances

- 3Ω $P=3(|I_1-I_2|)^2$
  $3(14-1.69)^2=16.0083$ w abs
- $j4\Omega$ $P=0$
- $-j2\Omega$ $P=0$
- $j10\Omega$ $P=0$
- 5Ω $P=5(|I_3-I_2|)^2$
  $=5(2-1.69)^2=0.4805$ w abs

} 16.4805 w abs

$-(3+4j)(I_2-I_1)-10\angle -90° - j10-(5-j2)(I_2-I_3)$

$-(3+4j)(I_2-I_1)-(5-j2)(I_2-I_3)-j10I_2=10\angle -90°$

$(-3-4j)(I_2-I_1)+(-5+j2)(I_2-I_3)-j10I_2=10\angle -90°$

$-3I_2-4jI_2-5I_2+j2I_2-j10I_2+(-3-4j)(-I_1)+(-5+j2)(-I_3)=10\angle -90°$

$I_2(-8-j12)=10\angle -90°-(-3-4j)(-I_1)-(-5+j2)(-I_3)$

$I_2(-8-j12)=10\angle -90°+(3+4j)(I_1)+(5-j2)(I_3)$

$I_2(-8-j12)=-10i+(3+4j)(4)+(5-j2)(-\sqrt{3}-i)$