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2/8

Problem 1 (8 pts)

For each circuit element, R, L, and C, in the table, write down the expression for the impedance, Z, admittance, Y, resistance, R, conductance, G, reactance, X, and susceptance, B at an angular frequency ω . Also, below Z, Y, R, G, B, and X give its SI units.

	Resistor, R	Capacitor, C	Inductor, L
Impedance, Z Units: <u>Ohms</u> ✓	$Z = R$ ✓	$Z = \frac{-1}{j\omega C}$ ✗	$Z = j\omega L$ ✓
Admittance, Y Units: _____	$Y = \frac{1}{R}$ ✓	$Y = -j\omega C$	$Y = \frac{1}{j\omega L}$
Resistance, R Units: <u>Ohms</u> ✓	$R = R$ ✓	$\frac{1}{j\omega C} / 0$	$j\omega L / 0$
Conductance, G Units: <u>0</u>	$\frac{1}{R}$ ✓	$-j\omega C$ ✗	$\frac{1}{j\omega L}$ ✗
Reactance, X Units: _____			
Susceptance, B Units: _____			

Problem 3 (8 pts)

Three voltage sources $v_1(t)$, $v_2(t)$ and $v_3(t)$ are connected in series to a network, where

$$v_1(t) = 1.0 \cos(100t + 45^\circ) \text{ V}$$

$$v_2(t) = 1.0 \cos(100t + 180^\circ) \text{ V}$$

$$v_3(t) = 1.0 \cos(130t - 135^\circ) \text{ V}$$

Note that v_3 has a different frequency than v_1 and v_2 .

8
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Missing

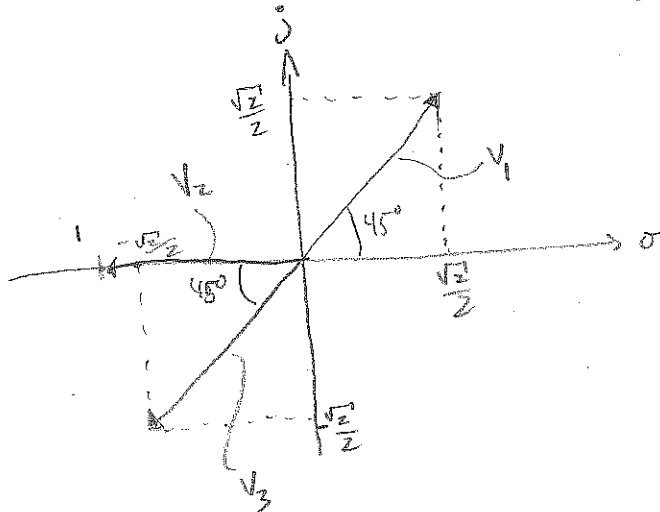
- Write down two forms of the phasors of v_1 , v_2 , and v_3
- Draw the phasors of v_1 , v_2 , and v_3 in the complex plane
- Superpose these phasors as much as possible to find the simplest expression you can for the total series voltage $v(t) = v_1 + v_2 + v_3$

- 1 $\angle 45^\circ$
1 $\angle 180^\circ$
1 $\angle 135^\circ$

a) $V_1 = \cos(100t + 45^\circ) \Rightarrow e^{j45} \Rightarrow \cos(45) + j\sin(45) = \frac{\sqrt{2}}{2} + j\frac{\sqrt{2}}{2}$

$V_2 = \cos(100t + 180^\circ) \Rightarrow e^{j180} \Rightarrow \cos(180) + j\sin(180) = -1 + j(0)$

$V_3 = \cos(130t - 135^\circ) \Rightarrow e^{-j135} \Rightarrow \cos(135) - j\sin(135) = -\frac{\sqrt{2}}{2} - j\frac{\sqrt{2}}{2}$



c) $V_1 + V_2 = \frac{\sqrt{2}}{2} - 1 + j\frac{\sqrt{2}}{2} = 0.765 e^{-67.5} \Rightarrow 0.765 \cos(100t - 67.5^\circ)$

$\Rightarrow V_1 + V_2 + V_3 = 0.765 \cos(100t - 67.5^\circ) + \cos(130t - 135^\circ)$

good

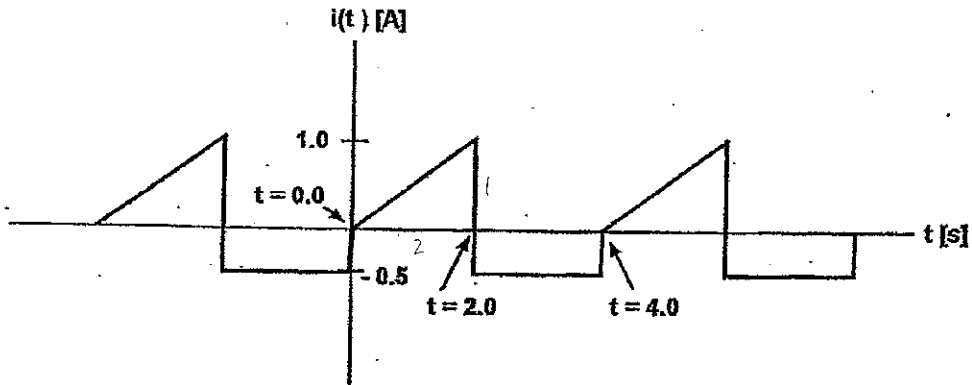
3

$\frac{2}{9}$

Problem 2 (9 pts)

The periodic current, $i(t)$, shown below flows through a 10Ω resistor, a 10 H inductor, and a 10 F capacitor. Find (or write down an expression for)

- a) the real instantaneous power dissipated in the resistor, the inductor, and the capacitor
- b) the (time) average real power dissipated in the resistor, the inductor, and the capacitor



$T = 4.0 \text{ s}$

$$P_{\text{average}} = \frac{\frac{2}{2} - 0.5(2)}{4} = 0$$

$$p(t) = \begin{cases} i(t) = 2t & 0 \leq t < 2 \\ i(t) = 0.5 & 2 \leq t < 4 \end{cases}$$

but you need more than this

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$\frac{1}{8}$

Problem 1 (8 pts)

For each circuit element, R, L, and C, in the table, write down the expression for the impedance, Z, admittance, Y, resistance, R, conductance, G, reactance, X, and susceptance, B at an angular frequency ω . Also, below Z, Y, R, G, B, and X give its SI units.

	Resistor, R	Capacitor, C	Inductor, L
Impedance, Z Units: _____			just ✓
Admittance, Y Units: _____			
Resistance, R Units: <u>Ohms</u> ✓			
Conductance, G Units: _____			
Reactance, X Units: _____			
Susceptance, B Units: _____			

Problem 3 (8 pts)

current the same

Three voltage sources $v_1(t)$, $v_2(t)$ and $v_3(t)$ are connected in series to a network, where

$$v_1(t) = 1.0 \cos(100t + 45^\circ) \text{ V}$$

$$v_2(t) = 1.0 \cos(100t + 180^\circ) \text{ V}$$

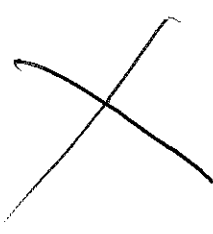
$$v_3(t) = 1.0 \cos(130t - 135^\circ) \text{ V}$$

Note that v_3 has a different frequency than v_1 and v_2 .

- Write down two forms of the phasors of v_1 , v_2 , and v_3
- Draw the phasors of v_1 , v_2 , and v_3 in the complex plane
- Superpose these phasors as much as possible to find the simplest expression you can for the total series voltage $v(t) = v_1 + v_2 + v_3$

$$\angle 100 \cdot 45^\circ$$

$$\angle 100 \cdot 180^\circ$$

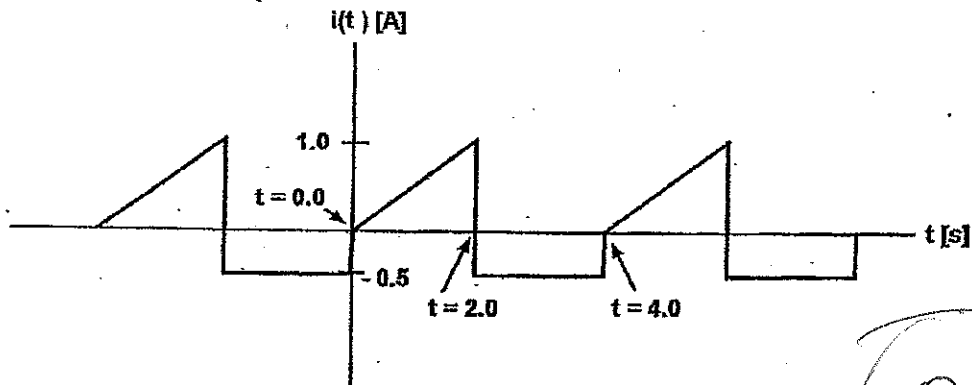

$$\frac{0}{8}$$

3

Problem 2 (9 pts)

The periodic current, $i(t)$, shown below flows through a $10\ \Omega$ resistor, a $10\ \text{H}$ inductor, and a $10\ \text{F}$ capacitor. Find (or write down an expression for)

- a) the real instantaneous power dissipated in the resistor, the inductor, and the capacitor
- b) the (time) average real power dissipated in the resistor, the inductor, and the capacitor



$$P = IV$$
$$P = I^2 R$$



0/9

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Problem 1 (8 pts)

For each circuit element, R, L, and C, in the table, write down the expression for the ^{2/8} impedance, Z, admittance, Y, resistance, R, conductance, G, reactance, X, and susceptance, B at an angular frequency ω . Also, below Z, Y, R, G, B, and X give its SI units.

	Resistor, R	Capacitor, C	Inductor, L
Impedance, Z Units: <u>Ω</u>	$Z = R$ /	$Z = \frac{-j}{\omega C}$ X	$Z = j\omega L$ /
Admittance, Y Units: <u></u>	$Y = \frac{1}{R}$ /	$Y = j\omega C$ /	$Y = \frac{1}{j\omega L}$ /
Resistance, R Units: <u>Ω</u>	$R = R$ /		
Conductance, G Units: <u>G</u>			
Reactance, X Units: <u></u>			
Susceptance, B Units: <u></u>			

$Z = R + jX$

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$$v_2(t) = 1.0 \cos(100t + 180^\circ) \text{ V}$$

$$v_3(t) = 1.0 \cos(130t - 135^\circ) \text{ V}$$

Note that v_3 has a different frequency than v_1 and v_2 .

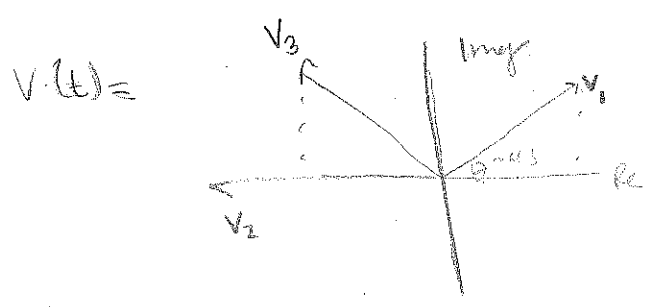
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NO

a) $v_1(t) \rightarrow V_1 = 1 \angle 45^\circ$
 $v_2(t) \rightarrow V_2 = 1 \angle 180^\circ$
 $v_3(t) \rightarrow V_3 = 1 \angle -135^\circ$

$V_1 e^{j\omega t} = 1 e^{j100(45^\circ)}$
 $= 1 e^{j100(180^\circ)}$
 $= 1 e^{j130(135^\circ)}$

$e^{j4500} \quad \cos(4500t) + j \sin(4500t)$
 $e^{j18000} \quad \cos(18000t) + j \sin(18000t)$
 $e^{j-17550} \quad \cos(-17550t) + j \sin(-17550t)$



(c) X

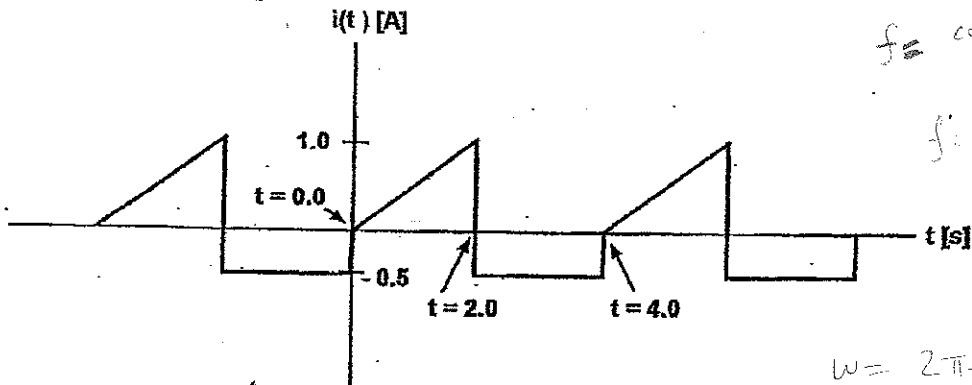
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Problem 2 (9 pts)

The periodic current, $i(t)$, shown below flows through a 10Ω resistor, a 10 H inductor, and a 10 F capacitor. Find (or write down an expression for)

- a) the real instantaneous power dissipated in the resistor, the inductor, and the capacitor
- b) the (time) average real power dissipated in the resistor, the inductor, and the capacitor



$$f = \frac{\text{cycles}}{\text{sec}} = 2.5$$

$$f = \frac{1}{T} \quad T = 4$$

$$\omega = 2\pi f$$

$$\omega = \pi/2$$

$R = 10$
 $L = 10$
 $C = 10$



$$P_{\text{inst}} = 1V(\cos \omega t + 5\sin \omega t)$$

$$= (1.5)V(\cos \omega t + 5\sin \omega t)$$

$$V = 1/4$$

③ $P_{\text{avg}} = I_{\text{rms}} V_{\text{rms}} ?$