HIGH

ABET Check-Up

Electrical and Computer Engineering Department
University of New Mexico

Fall 2011

9/9

Problem 1

Three voltage sources $v_1(t)$, $v_2(t)$ and $v_3(t)$ are connected in series to a network, where (SCORE = 9)

$$v_1(t) = 1.0\cos(100t + 45°) \quad V$$
$$v_2(t) = 1.0\cos(100t + 180°) \quad V$$
$$v_3(t) = 1.0\cos(130t - 135°) \quad V$$

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

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

a) $V_1 = 1.0\angle 45° V$ or $-1.0\angle -135° V$ 3

$V_2 = 1.0\angle 180° V$ or $-1.0\angle 0° V$

$V_3 = 1.0\angle -135° V$ or $-1.0\angle 45° V$

b) $V_1 + V_2 = 1.0\left(\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}} - 1\right) = 1.0(1.707 + j\,0.707)$

$= 1.848\angle 22.5° V$

$V = 1.848\cos(100t + 22.5°)V + 1.0\cos(130t - 135°)$

Problem 2

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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. (Score 24)

	Resistor, R	Capacitor, C	Inductor, L
Impedance, Z Units: ohms	R	$\frac{1}{j\omega C}$	$j\omega L$
Admittance, Y Units: siemens	$\frac{1}{R}$	$j\omega C$	$\frac{1}{j\omega L}$
Resistance, R Units: ohms	R	0	0
Conductance, G Units: siemens	$\frac{1}{R}$	0	0
Reactance, X Units: ohm	0	$\frac{1}{j\omega C}$	$j\omega L$
Susceptance, B Units: siemen	0	$j\omega C$	$\frac{1}{j\omega L}$

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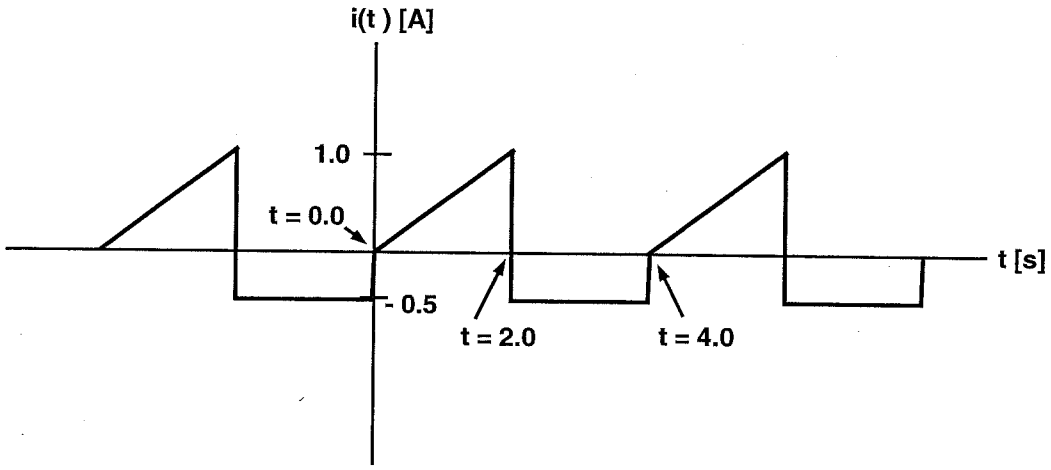
Problem 3 (score = 18)

The periodic current, i(t), shown below flows through a 10 Ω 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



$Z = 10\Omega + j\omega 10H + \frac{1}{j\omega 10F}$

a) $P_R(t) = i(t)^2 R$ $P_L(t) = 10H\, j\omega\, i^2(t)$ $P_C(t) = \frac{i^2(t)}{j\omega 10F}$

b $P_R = \frac{1}{2} I^2 R$ $P_L = 0$ $P_C = 0$

AVERAGE

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Problem 1

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$$v_1(t) = 1.0\cos(100t + 45°) \quad V$$
$$v_2(t) = 1.0\cos(100t + 180°) \quad V$$
$$v_3(t) = 1.0\cos(130t - 135°) \quad V$$

change freq?

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

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

a)

$V_1 = 1 + j100 = 1\angle 45$

$V_2 = 1 + j100 = 1\angle 180°$

$V_3 = 1 + j130 = 1\angle -135°$

b) $V = 3 + j330$ X

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Problem 2

$V = IR$

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. (Score 24)

	Resistor, R	Capacitor, C	Inductor, L
Impedance, Z Units: Ω ✓	$\frac{V}{I}$		
Admittance, Y Units: $\frac{1}{\Omega}$ ✓	$\frac{I}{V}$		
Resistance, R Units: Ω ✓	$\frac{V}{I}$		
Conductance, G Units: Farad. ✗			
Reactance, X Units: Henry. ✗			
Susceptance, B Units: ✗			

10Ω 0H 10F

Problem 3 (score = 18)

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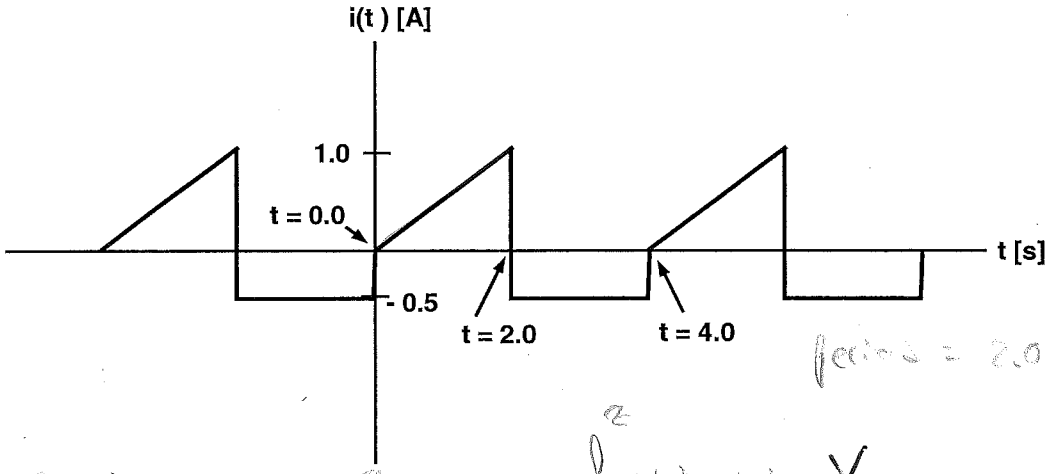
The periodic current, i(t), shown below flows through a 10 Ω resistor, a 10 H inductor, and a 10 F capacitor. Find (or write down an expression for)

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



period = 2.0 s.

a) $P(t) = VI = I^2R = V\int_0^t i(t)\,dt$ X

b) Resistor $P = (1)^2(10) = 10$

Inductor $P = \frac{1}{2}(10) = 10$ ← 0

Capacitor $P = \frac{1}{2}(10) = 10$ ← 0

LOW

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Problem 1

Three voltage sources $v_1(t)$, $v_2(t)$ and $v_3(t)$ are connected in series to a network, where (SCORE = 9)

$$v_1(t) = 1.0\cos(100t + 45°) \quad V$$
$$v_2(t) = 1.0\cos(100t + 180°) \quad V$$
$$v_3(t) = 1.0\cos(130t - 135°) \quad V$$

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

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

(a) $V_1(t) = 1\angle 100t + 45°$ = $\cos(100t + 45) + j\sin(100t + 45)$

$V_2(t) = 1\angle 100t + 180°$ = $\cos(100t + 180) + j\sin(100t + 180)$

$V_3 = 1\angle 130t - 135°$ = $\cos(130t - 135°) + j\sin(100t - 135)$

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Problem 2

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. (Score 24)

	Resistor, R	Capacitor, C	Inductor, L
Impedance, Z Units:			
Admittance, Y Units:			
Resistance, R Units: Ohms	$R = \frac{V}{I}$		
Conductance, G Units: mho's	$\frac{1}{R}$ or $\frac{I}{V}$		
Reactance, X Units:			
Susceptance, B Units:			

Problem 3 (score = 18)

The periodic current, i(t), shown below flows through a 10 Ω 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

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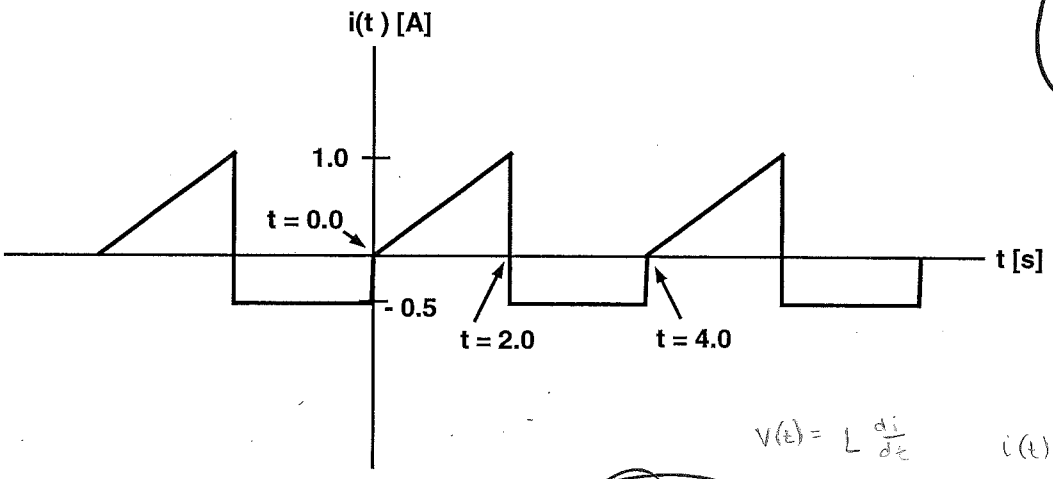

$V(t) = L\frac{di}{dt}$ $\quad i(t) = C\frac{dv}{dt}$

(a) $P = VI(t)$ $\quad V = IR$ $\quad P = RI^2$

$P = 10\, i(t)^2 + VI + VI$

$P = 10\, i(t)^2 + LI\frac{di}{dt} + CV\frac{dv}{dt}$