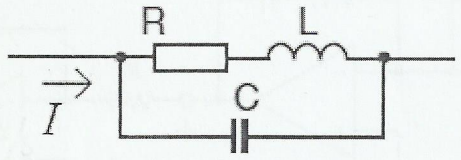
Student Name: _____

EE201 Final Jan. 09, 2014

1) The circuit below is operating in the sinusoidal steady state, and the phasor current I is passing through it. It is given that $f = 50$ Hz, $R = 10\Omega$, $L = 100\mu$H, $C = 1\mu$F, $I = 1$A (rms). What is the *total impedance*, and, how much total *complex power* is dissipated on this circuit?



$\omega = 2\pi 50 = 314$ rad/s

$$Z = \frac{1}{j\omega C} \,//\, (R + j\omega L)$$

$$= \frac{R + j\omega L}{1 - \omega^2 LC + j\omega RC} = \frac{10 + 0.0314j}{1 + 0.003\,1j} \cong 10\,\Omega$$

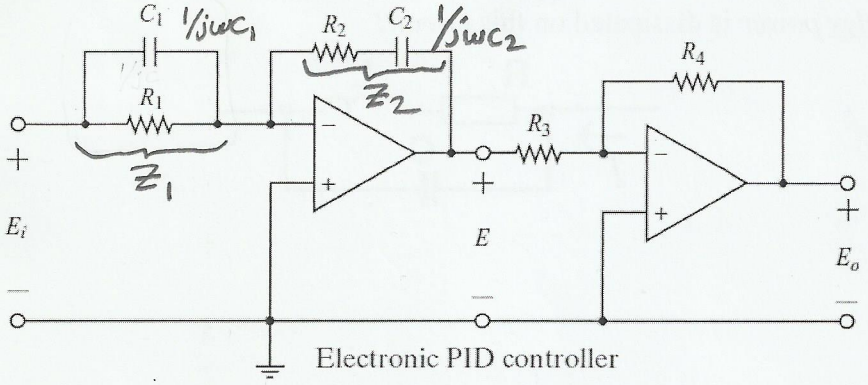
$$S = Z \cdot I^2 = 10 + j0 \ \text{VA}$$

Note: Total time allowed is 100 min. Please show all your work and write legibly.

2) The circuit below is operating in the sinusoidal steady state, and the voltage variables shown are the phasor voltages.

a) Find the E_o/E_i gain (in terms of the angular frequency ω).

b) Determine the values of R_1 , R_2 , R_3 , R_4 , C_1 , C_2 such that $\frac{E_o}{E_i} = 30\frac{(j\omega+1)^2}{j\omega}$.



a)

$$Z_1 = \frac{1}{j\omega C_1 + \frac{1}{R_1}}$$

$$Z_2 = R_2 + \frac{1}{j\omega C_2}$$

$$\frac{E_o}{E_i} = \left(-\frac{Z_2}{Z_1}\right)\cdot\left(-\frac{R_4}{R_3}\right) = \left(j\omega C_1 + \frac{1}{R_1}\right)\cdot\left(R_2 + \frac{1}{j\omega C_2}\right)\cdot\frac{R_4}{R_3}$$

$$= \frac{R_4\cdot(j\omega C_1 R_1 + 1)(j\omega C_2 R_2 + 1)}{j\omega C_2 R_1 R_3}$$

b) Choose: $R_1 \cdot C_1 = 1$, $R_2 C_2 = 1$, $\frac{R_4}{C_2 R_1 R_3} = 30$

For example: $R_1 = R_2 = 100\ K\Omega$

$C_1 = C_2 = 10\ \mu F$

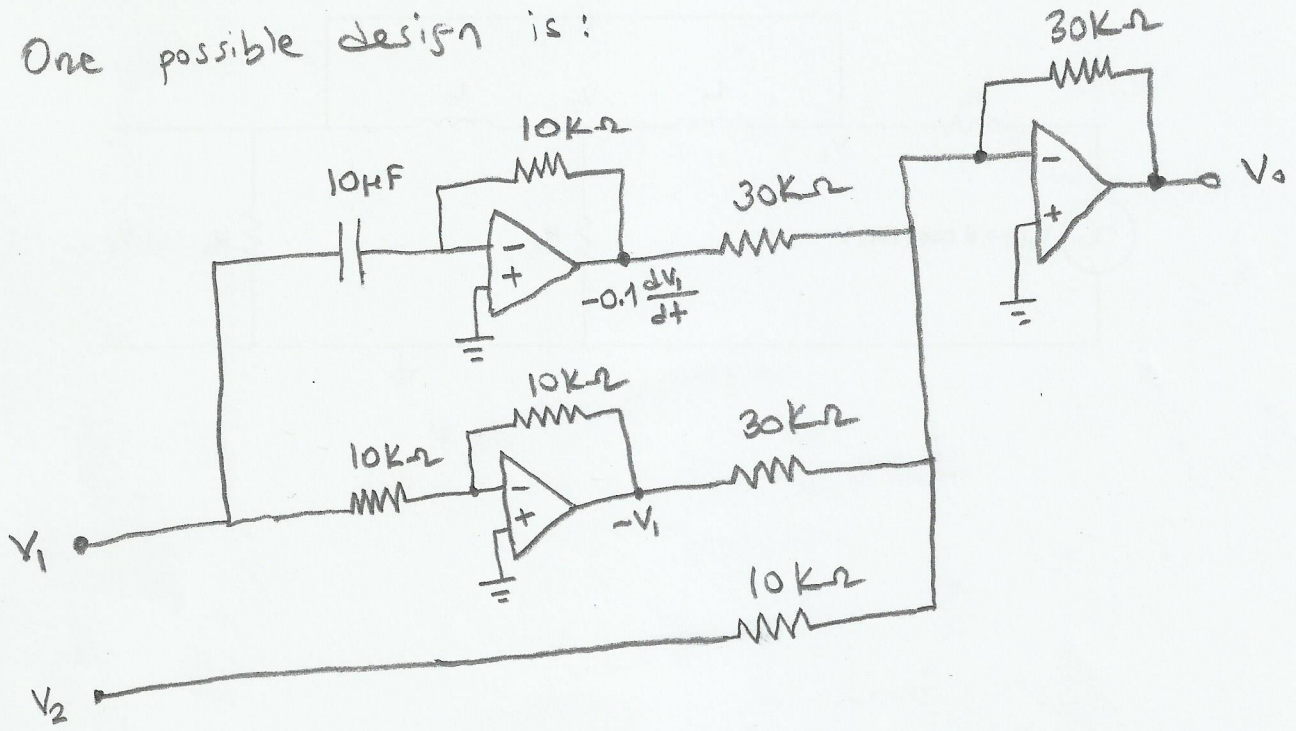
$R_3 = 10\ K\Omega$

$R_4 = 300\ K\Omega$

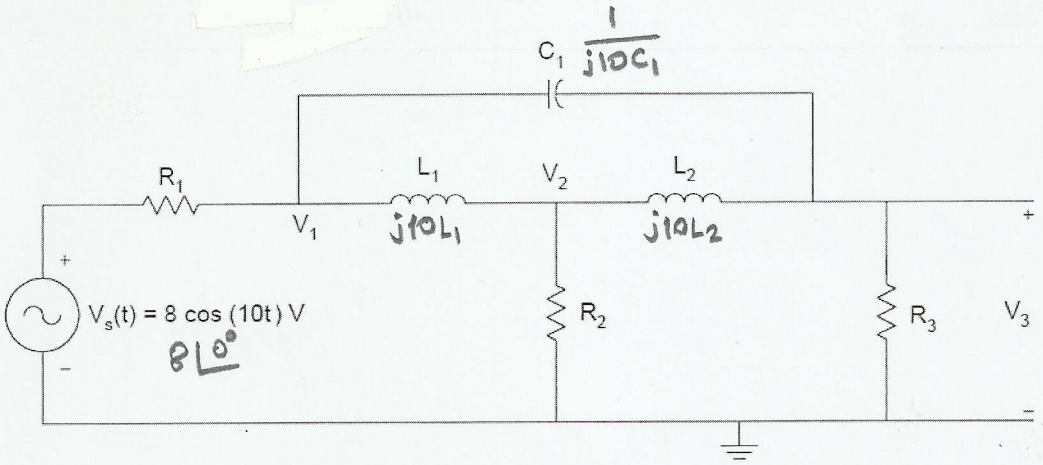
3) Implement a circuit with two voltage inputs V_1 and V_2 ; and one voltage output V_o such that:

$$V_o = V_1 - 3V_2 + 0.1\frac{dV_1}{dt}$$

One possible design is :



4) The circuit below is operating in the sinusoidal steady state. Write three equations which are necessary to solve for the phasor voltages V_1, V_2, V_3. **Do not** solve the equations; just write them correctly and completely.



Equation 1:

$$\frac{V_1 - 8}{R_1} + \frac{V_1 - V_2}{j10L_1} + \frac{V_1 - V_3}{\frac{1}{j10C_1}} = 0$$

Equation 2:

$$\frac{V_2 - V_1}{j10L_1} + \frac{V_2}{R_2} + \frac{V_2 - V_3}{j10L_2} = 0$$

Equation 3:

$$\frac{V_3 - V_1}{\frac{1}{j10C_1}} + \frac{V_3 - V_2}{j10L_2} + \frac{V_3}{R_3} = 0$$