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$\overline{NAME}$ $\overline{FAMILYNAME}$ $\overline{SECTION}$

EEE 202 CIRCUIT THEORY
Second Midterm, Spring 2014-15

No credits will be given for unjustified answers. **Good luck.**

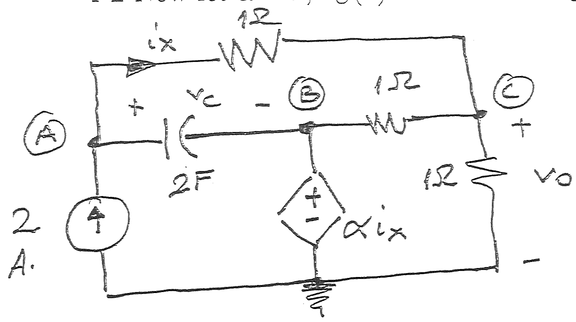
Problem 1	Problem 2	Problem 3	Problem 4	TOTAL

Prob. 1 : (28 pt.s)

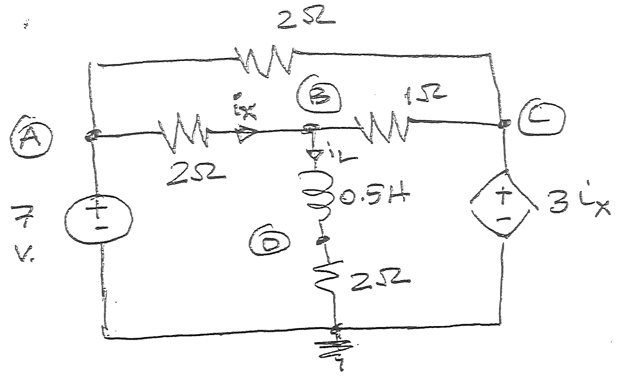
i : (15 pt.s) Consider the following circuit. Assume that the circuit is stable.

i-1 Find the value of α so that $\lim_{t \to \infty} v_o(t) = 3\ V$.

i-2 Now let $\alpha = 2$, $v_C(0) = 3\ V$. Find $v_C(t)$ and $i_x(t)$.



ii : Consider the following circuit. Let $i_L(0) = 1\ A$. Find $i_L(t)$ and $i_x(t)$.

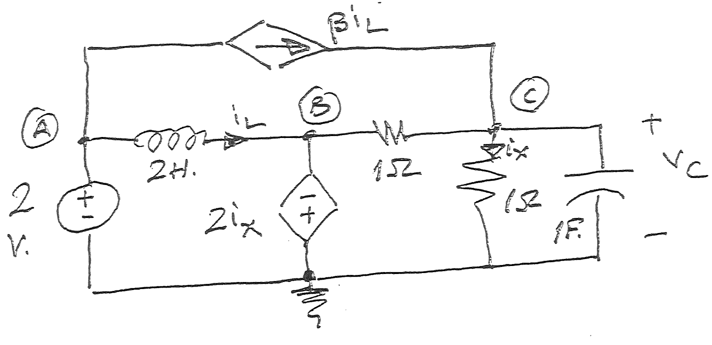


Prob. 2 : (22 pt.s) Consider the following circuit.

i : Find a second order ODE for v_C. (i.e. of the form $\ddot{v}_C + a\dot{v}_C + bv_C = u$. Note that some coefficients may depend on β).

ii : Find the range of β so that the solution $v_C(t)$ contains a damped sinusoid term (i.e. a term $e^{-\alpha t}\cos(\omega t + \phi)$).

iii : Let $\beta = 3$, $v_C(0) = 2\ V$, $i_L(0) = 1\ A$. Find $v_C(t)$ and $i_L(t)$.

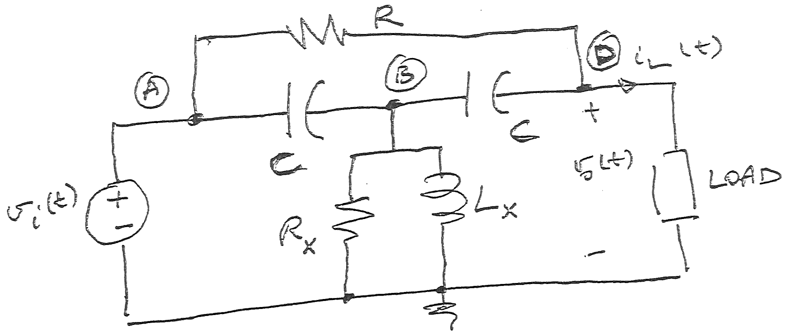


Prob. 3 : (25 pt.s) Consider the following circuit. Assume that $v_i(t) = V_i \cos \omega t$ and that the circuit is in sinusoidal steady state. The load represents an arbitrary (nonzero and finite) impedance.

i : Assume that we measured $i_L(t) = 0\ A$. Find R_x and L_x in terms of ω, R and C.

ii : Now assume that the load is as given below (in fig. 2). Let $v_i(t) = 4\cos 1000t\ V$, $C = 1\ \mu F$, $L_x = 0.5\ H, R_x = 2\ k\Omega$, $R = 1\ k\Omega$. Find $v_o(t)$.

iii : Find the average power dissipated in the load.



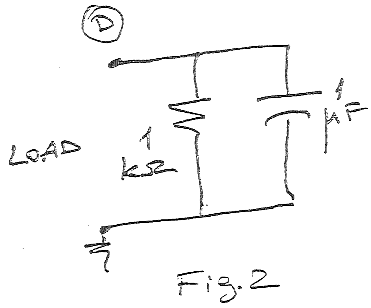
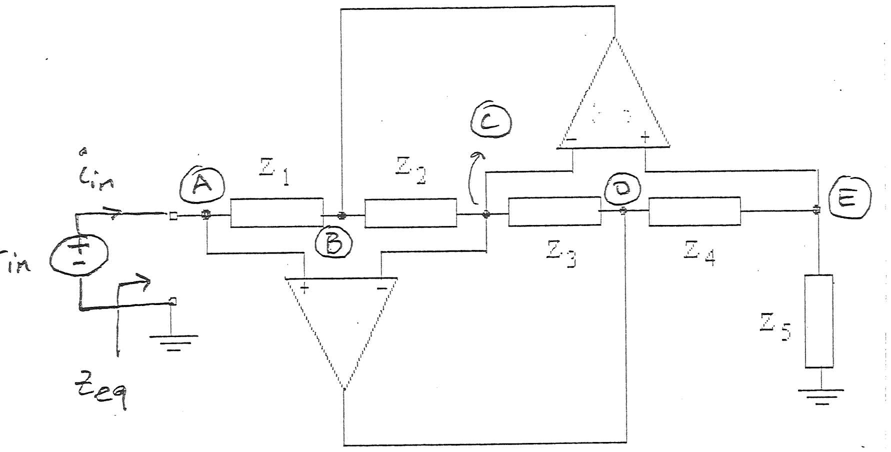


Fig. 2

Prob. 4 : (25 pt.s) Consider the following circuit. Assume that $v_{in}(t) = V_i \cos \omega t$, the op-amps are linear, operate in linear region, and that the circuit is in sinusoidal steady state. Here Z_1, Z_2, Z_3, Z_4, Z_5 represent arbitrary impedances.

i : Find $Z_{eq} = \frac{V_{in}}{I_{in}}$ in terms of impedances $Z_1,\ Z_2,\ Z_3,\ Z_4,\ Z_5$.

ii : Choose four of these impedances as resistors of equal value R, and the last impedance as a capacitance C such that this circuit is equivalent to the circuit shown below (fig.2). Find L_{eff} in terms of R and C. Which impedances can be chosen as the capacitor to obtain this result?



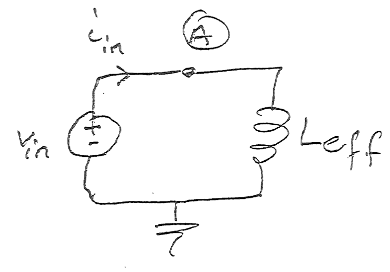


Fig. 2.