EECS 40, Fall 2007
Prof. Chang-Hasnain

Homework #6

Due at 5 pm in 240 Cory on Thursday, 10/25/07
Total Points: 100

- Put (1) your name and (2) discussion section number on your homework.
- You need to put down all the derivation steps to obtain full credits of the problems. Numerical answers alone will at best receive low percentage partial credits.
- No late submission will be accepted except those with prior approval from Prof. Chang-Hasnain.
- Problems of this HW are from Hambley 4th Edition

Series Resonance (23 pts)

1. P6.73 (6 pts)
2. P6.74 (6 pts)
3. P6.80 (11 pts)

Parallel Resonance (13 pts)

4. 6.83 (7 pts)
5. 6.87 (6 pts)

Second Order Filter (26 pts)

6. 6.89 (8 pts)
7. 6.92 (6 pts)
8. 6.97 (12 pts) You may sketch the Bode plot by hand. What kind of filter is that?

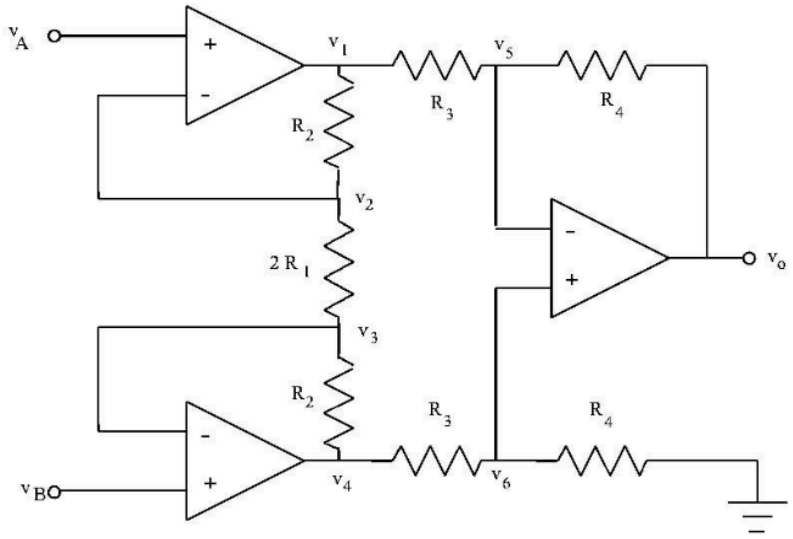
Bonus Problem from Lecture (20 pts)

In Bode phase plots the phase always has a negative slope, which represents a delay. Why does d(phi)/d(omega) having a negative slope represent a delay?

Operational Amplifiers

9. List characteristics of an ideal operational amplifier. Search a schematic of a real operational amplifier. How many primitive elements (transistor, resistors) does it contain. Why do we use such a complicated device for often quite trivial tasks? (4 pts)

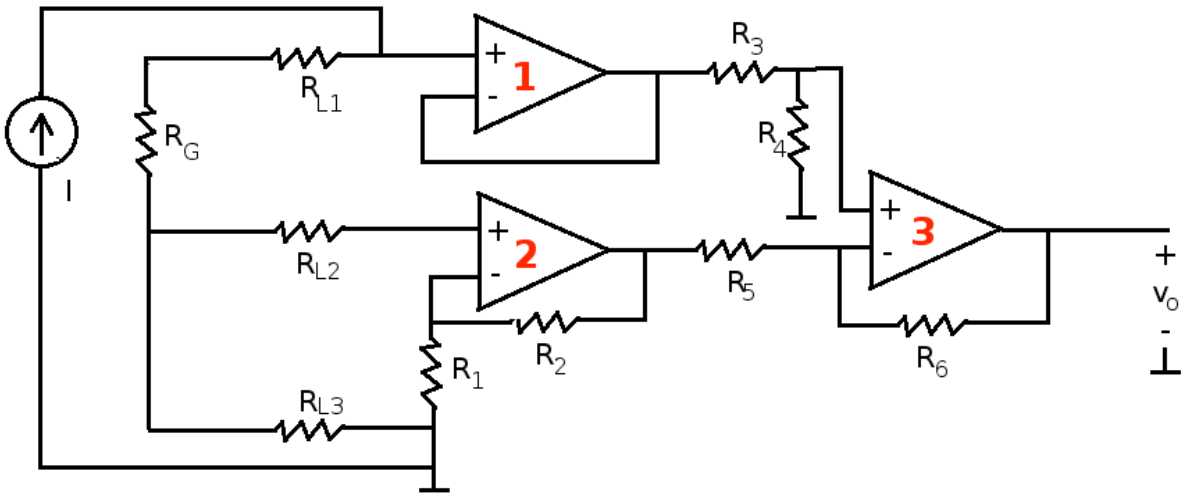
10. (Operational Amplifier) (16 pts)



Calculate v_o as a function of v_A and v_B. On your way, box in every equation you write down that does not follow algebraically from previous equations, but rather uses a circuit analysis fact.

11. (Operational Amplifier) (17 pts)

To measure the temperature in a furnace, a temperature sensitive resistor R_G is used. The evaluation electronics need to be remote from the furnace due to the high temperatures. The lines are modeled by the ohmic resistances R_{Li}. The following circuit shall be used to compensate the impact of the lines. All operational amplifiers may be assumed to be ideal.



a) Identify the basic configurations in which operational amplifiers 1, 2, and 3 are used. What is the purpose of operational amplifier 1? (9 pts)

b) Calculate v_o in dependence on I and all resistances. (8 pts) On your way, box in equations for Vout1, Vout2, Vin3+, and Vo in terms of resistors and I and each other (where you do not have a joint system of equations but simply a linear chain of dependencies, so that plugging in would be easy).

c) Imagine trying to find values for R_{L1} R_1, R_2, ..., R_6 so the affect of the lines is compensated. This is not very hard if RL1 = RL3. (0 points).