EE 203
Exam 1
Spring 2006

Instructions: There are 10 questions on this exam that are worth 2 pts each and 5 problems worth 16 points each. Answer all questions and solve all problems. All work should be included on the exam itself. Attach additional sheets only if you run out of space on a problem. Students may bring 2 pages of notes to the exam. Calculators are permitted but can not be shared.

Questions:

1. What is the size of the semiconductor industry (in worldwide dollars/year)?

2. If a feedback amplifier is a transresistance amplifier, what are the dimensions of the electrical input variable for the beta amplifier that forms a part of the feedback amplifier?

3. What does it mean for a two-port network variable to be unilateral?

4. What is the purpose of the V_{DD} and V_{SS} pins on an operational amplifier?

5. A function f(t) can be expressed as
   $f(t) = 5\sin(50t + 20°) + .02\sin(100t) - .01\sin(150t - 30°)$
   What is the period of this waveform?

6. A function f(t) can be expressed as
   $f(t) = 5\sin(50t + 20°) + .02\sin(100t) - .01\sin(150t - 30°)$
   What is the THD of this waveform?

7. If a current amplifier has an input impedance of 1K, a current gain of 100, and an output impedance of 100Ω, what would be the voltage gain and the output impedance if this were viewed as a voltage amplifier instead?

8. What is the purpose of placing a large resistor in shunt with the capacitor in the basic op-amp integrator?

9. What are the two key properties of a “null port”?

10. In what year did Black introduced the concept of feedback?

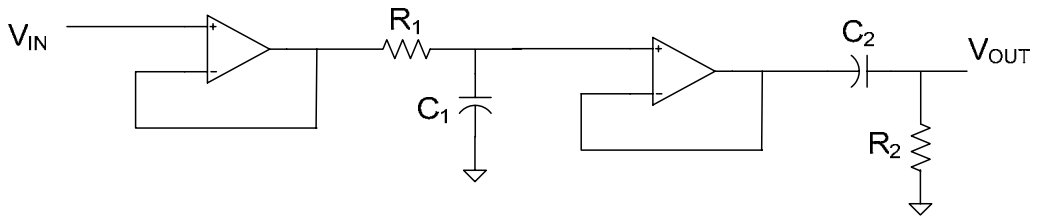
Problem 1
Determine the poles and zeros of the following circuits/systems and state whether the circuit/system is stable or unstable.

a) $T(s) = 5\dfrac{s+6}{s^2+5s+6}$

b) $T(s) = \dfrac{12}{s-5} - \dfrac{3}{s+1}$

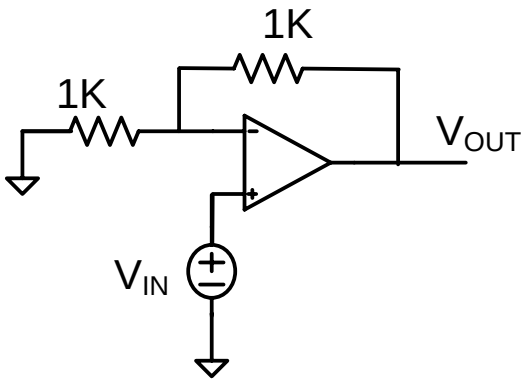
c) $X_o = -2X_o' - 0.1X_o'' + X_i + 7X_i'$ (the "prime" operator denotes differentiation)

d) (assume the op amps are ideal in the following circuit

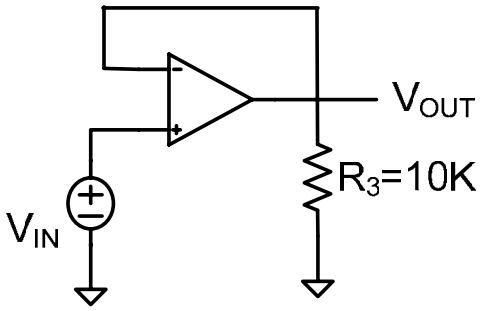


Problem 2

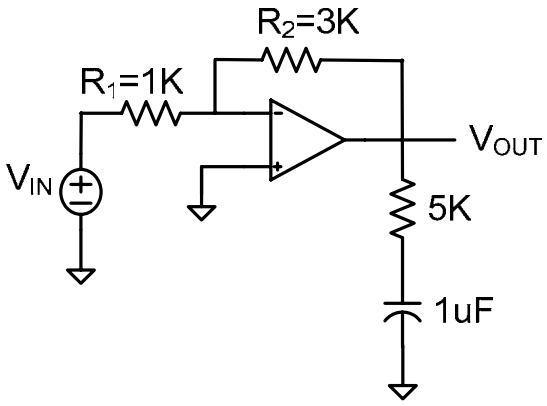
Determine the 3dB bandwidth of the following four systems. Unless stated to the contrary, assume that the GB of the op amps is 1MHz.



(a)



(b)



(c)

$$T(s) = \frac{15}{(s+1)(s+4)}$$

(d) –extra credit

Problem 3

Design a circuit that has an output voltage that satisfies the expression

$$V_{out}(s) = V_1 - 2V_2 + .01\frac{V_3}{s}.$$

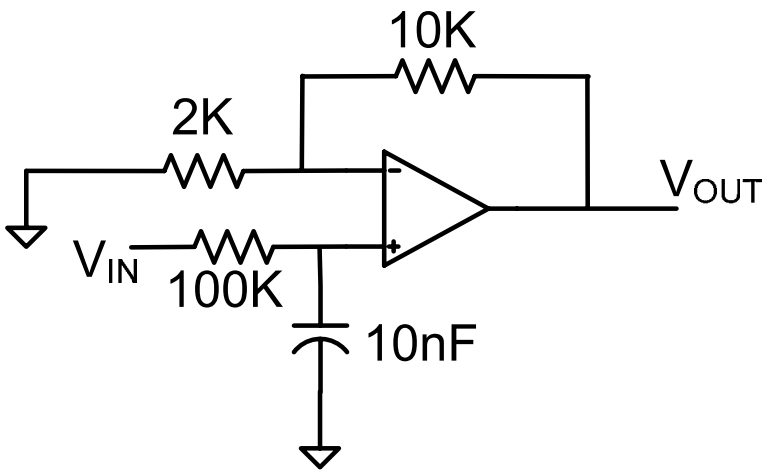
Problem 4 For the circuit shown

a) Obtain an expression for the transfer function.

b) Plot the magnitude of the transfer function

c) Determine the steady state response if $V_{IN}(t) = 0.5\sin(1000t + 45°)$

Assume the op amp is ideal.



Problem 5 The operational amplifier shown is ideal except for a finite dc gain of 50dB. If the input to the circuit is a sinusoid at 5KHz with a p-p voltage of 1V, give the ideal output voltage if the gain is infinite and the percent error in the p-p output voltage due to the finite dc gain of the op amp.