EE 230 NAME ______________________

Exam 1

Fall 2006

Instructions: The points allocated to each problem on this exam are as indicated. 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 1 page of notes to the exam. Calculators are permitted but can not be shared.

Questions:

1. (2pts) What is the size of the semiconductor industry ($ annual sales)?

2. (2pts) When it is stated that a circuit is “unilateral”, what does this mean?

3. (2pts) What is the ideal output impedance of a transresistance amplifier?

4. (3pts) What are three of the most important properties of a feedback amplifier?

5. (6pts) If a transducer has a very small output voltage, a cascade of several voltage amplifiers is often used to amplify the small signal to a much larger voltage level. As an alternative, the signal could be amplified by putting this small signal to the input of a transconductance amplifier. The transconductance amplifier output could then serve as an input to a transresistance amplifier. By alternately cascading transconductance and transresistance amplifiers with appropriate gains, a large voltage gain could be obtained.

   a) If the overall voltage gain required is 10,000 and if a cascade of 6 alternating transconductance/transresistance amplifiers are used and if the trnasconductance amplifiers all have a gain of 200A/V, what gain is required for the transresistance amplifiers if they are all identical?

   b) If the transconductance and transresistance amplifiers are nonideal (that is, the input and output impedances are not ideal), the nonideal input and output impedances problem can be overcome by placing buffers between the stages. The required input and output impedance characteristics of these buffers would be different than that of the voltage buffers discussed in class. What would be the ideal input and output impedance of these buffers that would be placed between the output of the transconductance stage and the input of the transresistance stages?

6. (4pts) An amplifier has an input voltage of $Vin=.025\sin(1000t+45^o)$. The output voltage was measured to be $V_{OUT}=0.6\sin(1000t+60^o)+0.02\sin(1000t+75^o)$.

a) What is the gain of the amplifier

b) What is the THD of the amplifier (in dB)

7. (5pts) Consider an application that requires a voltage amplifier that ideally has a voltage gain of 500 that is to drive a 1KΩ load. Assume the input source has an output impedance of 200Ω. If the actual amplifier used has an open-loop voltage gain of 500 but has an input impedance of 10KΩ and an output impedance of 200Ω, what will be the percent error in the actual gain of the amplifier?

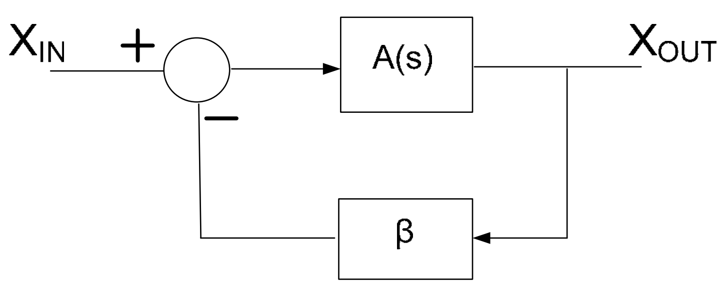
8. (20 pts) Determine the poles and zeros of the following circuits/systems and state whether the circuit/system is stable or unstable.

a) $$T(s) = 5\frac{s+3}{s^2+3s+2}$$

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

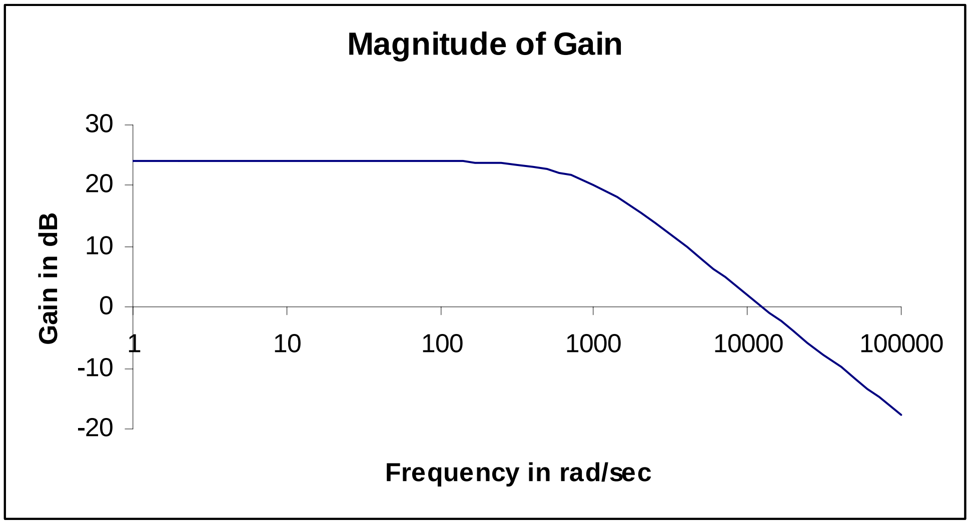
c) $X_o = 2X_o' - \int X_o + X_i - 4X_i'$ (the "prime" operator denotes differentiation)

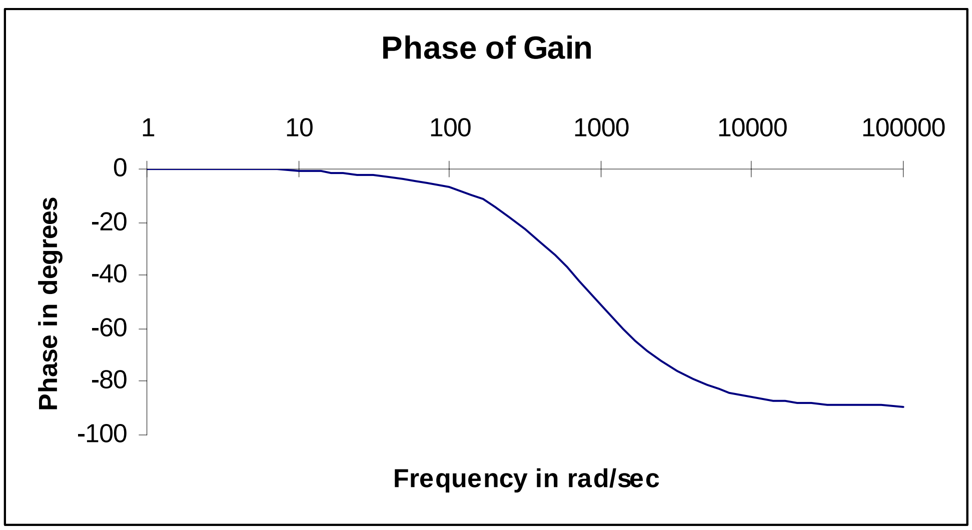
c) Assume $A(s) = 25\frac{s+1}{s^2-s+3}$ and β=1/5 in the following system.



Problem 9 (20pts) An amplifier that has a gain that can be modeled as a 1st-order transfer function. The magnitude and the phase of the gain are shown where the horizontal axis is in rad/sec.

a) Determine the half-power frequency of the amplifier
b) Determine the dc gain of the amplifier
c) Determine the pole of the amplifier
d) Determine the steady-state response if the input is $V_{IN}=0.4\sin(200t+30^{o})$





Problem 10 (16pts) Design a circuit that has an output voltage that satisfies the expression

$$V_{out}(s) = V_1 + 2V_2 - 4\frac{V_3}{s}.$$

Problem 11 (20pts) Assume the operational amplifier is ideal.

a) Draw the s-domain equivalent circuit

b) Draw the phasor-domain equivalent circuit

c) Obtain the transfer function $T(s) = \frac{V_{OUT}(s)}{V_{IN}(s)}$

d) Determine the sinusoidal steady state response if Vin=0.1sin1000t, R_1=1K, R_2=10K, C_1=0.1uF and L_1=2μH.