ECE 3200 Electronics II
Spring 2018
Exam #1

NAME: _____

INSTRUCTIONS:

1. **THIS EXAM IS CLOSED BOOK AND CLOSED NOTES.**
2. **YOU MAY USE ONE OF THESE CALCULATORS.**
   Circle the one, if any, that you are using:

   Casio fx-115/fx-991

   HP 33s/35s

   TI 30X/36X
3. **All other electronic devices, including watches, must be stowed away**.
4. Work each problem in the provided space.
5. Show ALL work required to arrive at a solution for either full or partial credit.
6. READ the entire question before answering.
7. Have your student ID on your desktop for inspection by the instructor.
8. SIGN the honesty pledge at the bottom of the page. Exams without a signature will receive no credit.

I have neither given nor received assistance from anyone in regards to completion of this exam. I have followed the instructions as provided on this sheet. I HAVE VERIFIED THAT THIS EXAM HAS (9) PAGES.

SIGNATURE: _____ DATE: _____

Maximum exam score is 40/35 (problem 5 is worth (5) points extra credit).

1. A time-varying signal from a sensor ranges from 0V to 1V. The bandwidth of the signal is 10kHz.

    a. (2 points) What is the minimum number of output bits per sample for an A/D converter if the maximum allowed quantization error is 1mV? Assume that

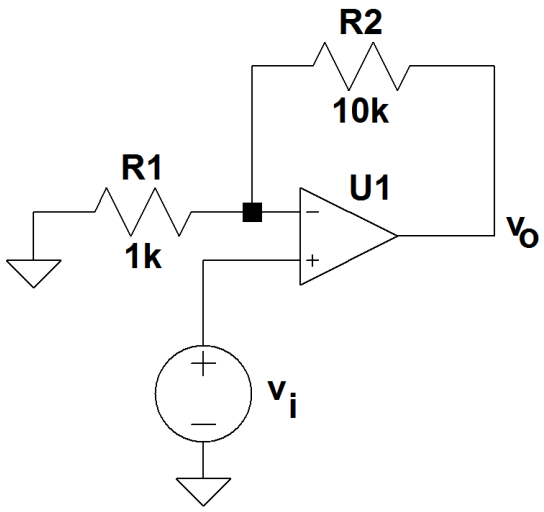
        i. the converter does NOT need to encode voltages below 0V and above 1V; and

        ii. that the voltage later assigned to each A/D output bit code is at the midpoint of its conversion band.

    b. (2 points) What is the minimum required sampling rate to prevent signal aliasing?

    c. (1 point) What is the resulting rate of bits delivered by the A/D converter (in bits per second)?

2. (10 points) The operational amplifier is ideal *except* for an open-loop gain of A=1000. Find the closed-loop voltage gain of this circuit.
   Hints:
   Suggest using circuit analysis with the VCVS model of the op-amp with a finite gain OR model the circuit as a negative feedback system.



EXTRA WORK SPACE FOR PROBLEM 2

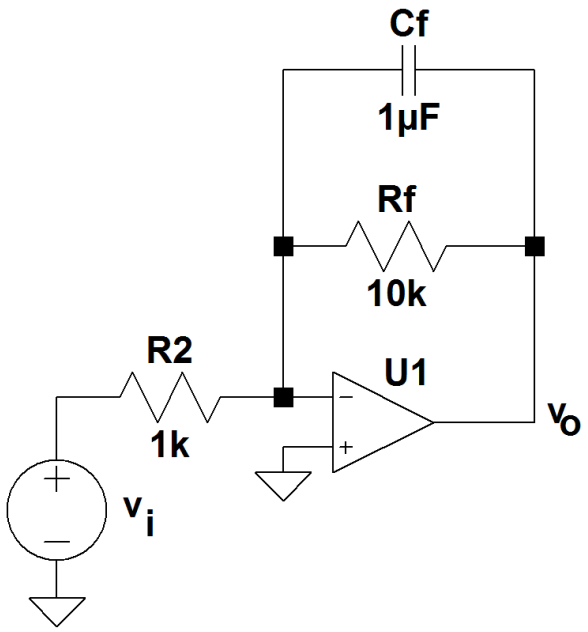
3. The operational amplifier is ideal.

   a. (1 point) Find the low-frequency voltage gain.

   b. (1 point) Find the high-frequency voltage gain.

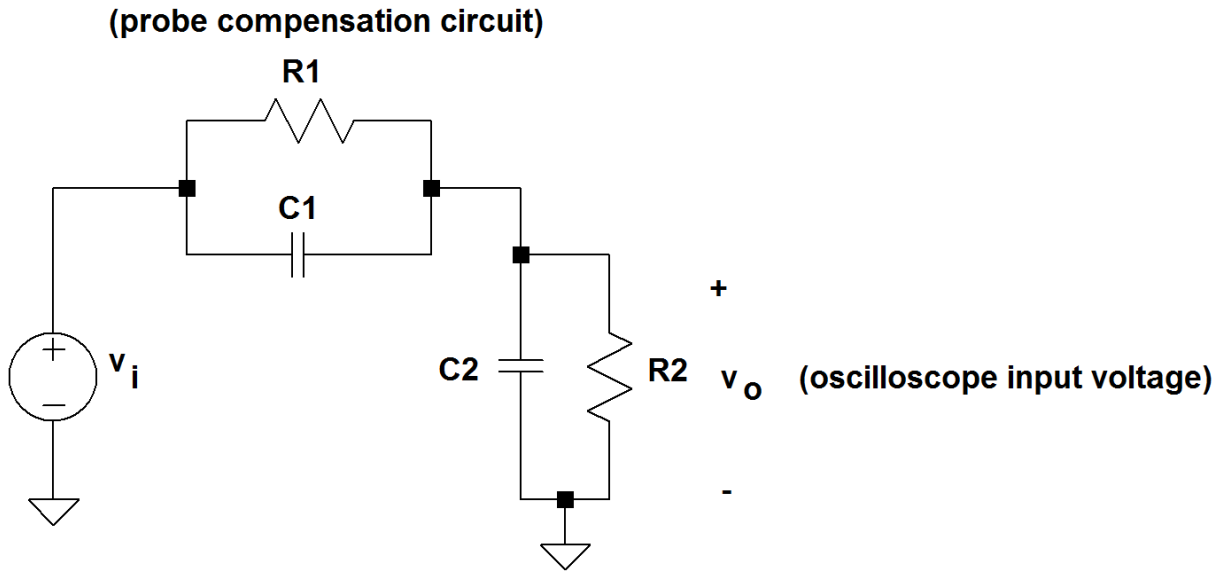
   c. (4 points) Find the transfer function $T(s) = \frac{V_o(s)}{V_i(s)}$.

   d. (4 points) Sketch the Bode magnitude plot of $T(s)$. A straight-line approximation is sufficient.



EXTRA WORK SPACE FOR PROBLEM 3

4. (10 points) Find a non-trivial relationship between the resistors and capacitors so that the voltage gain $\frac{V_o(s)}{V_i(s)}$ is independent of frequency.



EXTRA WORK SPACE FOR PROBLEM 4

5. EXTRA CREDIT
    a. (2 points) Specify component values for the circuit of problem 4 to yield a voltage gain of 1/10 if R2=1MΩ and C2=10pF.
    b. (3 points) Show that the input impedance 'seen' by the source is 10x the oscilloscope input impedance.