

# EEL 3302; ELECTRONICS I

CAD #5 – 11/26/07

Student \_\_\_\_\_

(Print Name Clearly)

## INSTRUCTIONS

1. All CAD assignment write-ups must contain the following elements presented in order.
  - a) This page with name and signature affixed.
  - b) A summary page containing PSPICE results compared with formulae and calculator (“by hand”) results, together with an explanation of any differences. Summary is page 1.
  - c) A complete PSPICE circuit diagram (schematic) showing the bias voltages and currents, a complete listing of the PSPICE output file, and all graphs required by the assignment for each separate simulation. You may have to repeat this section several times depending on the assignment.
  - d) The “by hand” calculations and any associated required figures.
2. Use a comprehensive word processing application (such as WORD<sup>®</sup>) to assemble your report. All pages must have a printed header or footer (your choice) containing the CAD assignment number, student name, date and page number. All tables, schematics, graphs, and drawings must be captioned starting with Table 1, Figure 1, etc. Reference the page and figure caption for data presented on the summary page. Mark the location on any graph where data is taken for the summary page. Orient figures to give the largest possible presentation and do not place more than one figure on a page. Reverse the PSPICE graph background from black to white. The “by hand” calculations and figures may be handwritten but all other requirements must be satisfied. Use 8½” x 11” new unused printer paper for all PSPICE results and the “by hand” calculations and any associated required figures. Do not print or write on the back side of any page. “Portrait” pages must have the top aligned with the top of the stack. “Landscape” pages must have the top aligned with the left of the stack. Secure all pages with one staple in the far upper left corner of the stack. All material on each page should be visible. Work failing to conform to these specifications will not be accepted and a grade of “0” will be assigned. Late write-ups will not be accepted without good cause, e.g., documented medical problem, employer required travel.
3. Students are encouraged to collaborate in the initial effort where the emphasis is on understanding and determining a course of action. Students are prohibited from any collaboration, cooperation and conversation in the performance of the simulation, “by hand” analysis and write-up. Write-ups that are unacceptably similar will be challenged and may be considered as academic dishonesty.

This work is solely the product of my effort. I have neither given nor received assistance related to this assignment, and I have read, understood and complied with the requirements of this assignment to the best of my knowledge.

\_\_\_\_\_  
(signature)

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## CAD #5 – 11/26/07

This CAD exercise demonstrates the operation of a uA741 operational amplifier with varying degrees of feedback.

Construct a PSPICE test setup with three independent amplifier circuits wired for non-inverting closed-loop gains of 10, 1000, and for non-inverting open-loop gain. In each closed-loop case use a 1.0k $\Omega$  resistor between the amplifier inverting input and ground. Ground the open-loop amplifier inverting input. Calculate the feedback resistor value that gives the required gain using the datasheet value for open-loop gain. In the open-loop case place a 1.0k $\Omega$  resistor across the amplifier differential input. In all cases place a 100M $\Omega$  resistor from the amplifier output to ground. The 100M $\Omega$  resistor serves no circuit function but is included to keep PSPICE from reporting an error. Use  $\pm 15\text{Vdc}$  for power.

Perform a PSPICE dc analysis to verify that each amplifier circuit is functioning properly.

Perform a PSPICE ac analysis to determine the amplifier circuit voltage gain frequency response for each amplifier circuit over the frequency range from 1 Hz to 10MHz. Plot all three amplifier circuit voltage gain frequency responses in dB on the same graph. Mark the low-frequency gain at 1Hz on each trace. Reduce the input voltage sources to zero.

Perform a PSPICE ac analysis to determine the amplifier circuit output resistance frequency response for each amplifier circuit over the frequency range from 1 Hz to 10MHz. Plot all three amplifier circuit output resistance frequency responses on the same graph. Mark the low-frequency output resistance at 1Hz on each trace. Remove the ground connection from the open-loop amplifier inverting input.

Perform a PSPICE ac analysis to determine the amplifier circuit input resistance frequency response at the amplifier inverting input for each amplifier circuit over the frequency range from 1 Hz to 10MHz. Plot all three amplifier circuit input resistance frequency responses on the same graph. Mark the low-frequency input resistance at 1Hz on each trace.

Your report should contain the schematic, the output file printout, and the plots.

Use the open-loop simulation results for all of the following calculations. Calculate the amplifier circuit 3dB bandwidth, low-frequency voltage gain, input resistance and output resistance for each of the closed-loop amplifier circuits by hand.

In the tabulated results, compare the data sheet open-loop values ( $A_V$ ,  $R_{out}$ ,  $R_{in}$ ) with the simulated open-loop results. Compare the calculated closed-loop values based on simulated open-loop results with simulated closed-loop results.

This assignment is due at the beginning of class on Wednesday, December 12, 2007.