Name_____

ELC 3314 – Electronic Design
Spring 2018
Test 1 – February 15, 2018
Closed Book/Closed Notes
1 hour and 15 minutes

1. The exam is closed-book/closed-notes.

2. A calculator may be used to assist with the test. No laptops or tablets are allowed. No cellular phones may be used in any way during the test. Unauthorized electronic device use will result in disqualification.

3. You must circle or box your answers to get full credit.

4. All work and steps toward a solution must be clearly shown to obtain credit.

5. Partial credit may be given provided that the grader can clearly follow your work to the extent that an understanding of the problem is demonstrated.

6. No collaboration is allowed on this examination. Only Dr. Baylis or the teaching assistant may be consulted for clarification.

7. You may attach extra sheets to the exam if necessary. Each page should contain your name, the problem number, and the page number for that problem.

Please sign the statement below. YOU MUST SIGN THE STATEMENT OR YOU WILL GET A ZERO FOR THIS EXAMINATION!!!

I hereby testify that I have neither provided or received information from unauthorized sources during the test and that this test is the sole product of my effort.

Signed _____   Date_____

PROBLEM 1 (20 points): An amplifier has a short-circuit current gain of 18, an input resistance of 6 Ω, and an output resistance of 100 Ω.

(a) (5 points) Draw the current-amplifier model for the amplifier, including numerical values for all parameters.

(b) (10 points) Draw the voltage-amplifier model for the amplifier, including numerical values for all parameters.

(c) (5 points) If the amplifier is connected to a load resistance of 60 Ω, what is the voltage gain $A_v = v_o/v_i$?

PROBLEM 2 (20 points): Find the value of output voltage v_o for the following circuit. Assume that both of the op amps are ideal and assume that negative feedback is occurring in the circuit.

5 Ω   15 Ω

100 Ω

10 Ω

4 Ω

13 Ω

3 V

300 Ω

6 Ω

300 Ω

60 Ω

80 Ω v_o

300 Ω
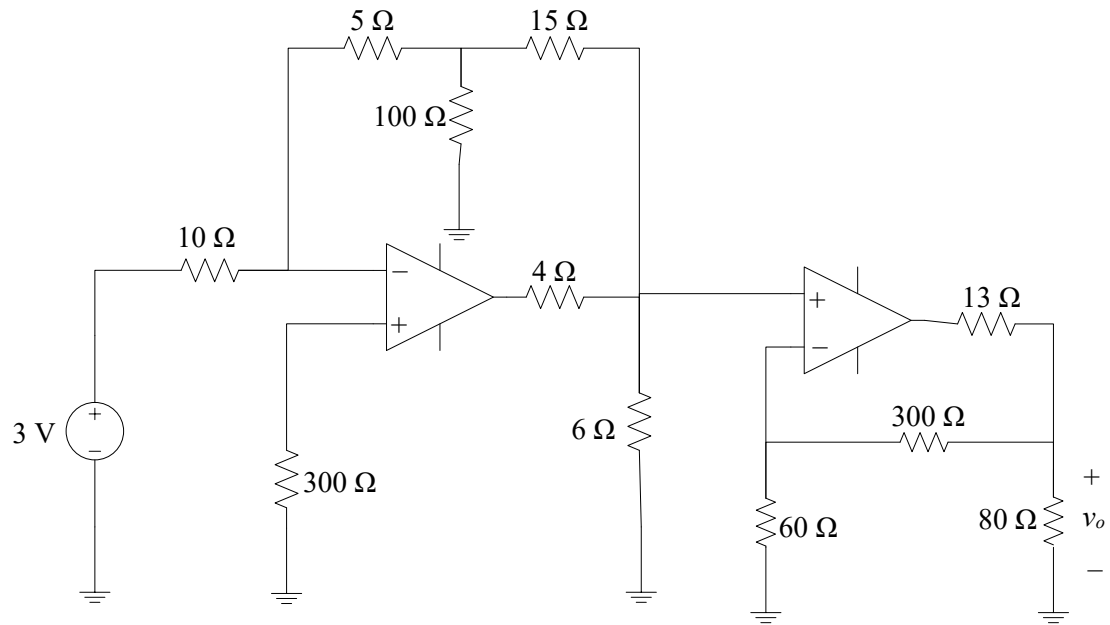
PROBLEM 3 (20 points): Provide answers to the following separate op-amp problems:

(b) (10 points) An op-amp has a maximum output voltage range from -10 V to +10 V. The slew-rate limit is 44 V/µs. Find the full-power bandwidth of the op-amp.

(b) (10 points) A different amplifier must be designed using an op-amp to produce a 800 kHz sine-wave output voltage having a peak amplitude of 3 V. What is the minimum slew-rate specification required to amplify this waveform without distortion?

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PROBLEM 4 (20 points): Find V for the following circuit, assuming that the diodes are ideal. <u>Check all your diode assumptions and show these assumption checks.</u>
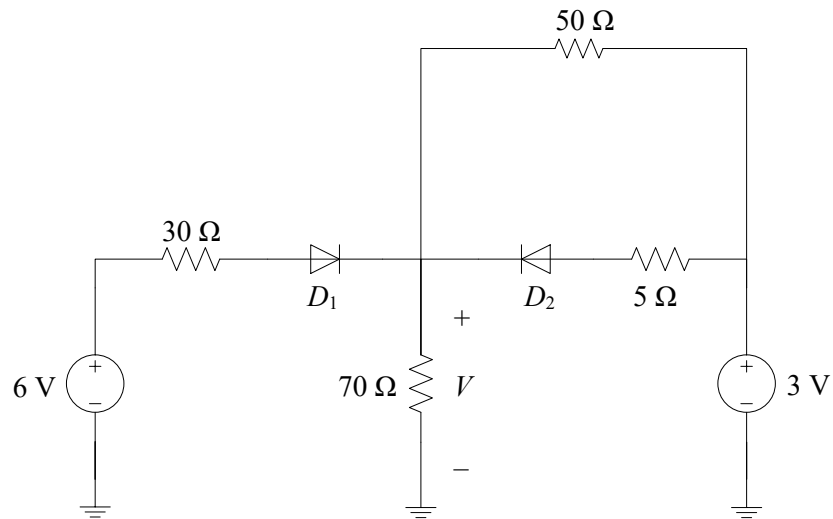
(Extra workspace on next page)

(Extra workspace for Problem 4):

PROBLEM 5 (20 points): The current through a given silicon *pn* junction diode is given by the
Shockley equation:

$$i_D = I_s \left[e^{\frac{v_D}{nV_T}} - 1 \right]$$

where $V_T = 26 \times 10^{-3}$ V, $n = 1.0$, and $I_s = 3 \times 10^{-14}$ A.

(a) (10 points) Find the quiescent bias current I_{DQ} for a quiescent bias voltage $V_{DQ} = 0.7$ V.

(b) (10 points) Find the dynamic resistance for a quiescent bias voltage $V_{DQ} = 0.7$ V.