

Name

PID

**UNIVERSITY OF CALIFORNIA, SAN DIEGO**

Electrical and Computer Engineering Department

ECE 65 – Spring 2022

*Components and Circuits lab*

Midterm Exam

Closed books, two cheat sheets, and calculators are allowed

Electronic devices are not allowed.

Please put all answers in the provided sheets.

Be sure to write your name and PID on **all pages**.

Please do not begin until told.

**Show your work.**

Good luck.

**Problem 1.** (10 points)

Assume you have a triangular wave with peak-to-peak amplitude of  $12V$  and  $+1V$  DC shift.

- a) Design a diode waveform shaping circuit such that when this input signal is applied to the diode circuit, at the output, the amplitude of the output voltage signal is never above  $5V$  and is never below  $-2V$ .
- b) Parametrically solve your designed circuit.
  - a. Find the transfer function of the circuit.
  - b. Draw the transfer function graph.
- c) Draw two cycles of the input and output signals. You can choose any period that you want for the input signal.

Assume you have access to regular PN junction diodes ( $V_{D0} = 0.7 V$ ), Zener diodes (any desired  $V_Z$ ), and other circuit elements.

**Make sure to use Zener diode(s) in your design.**

**Show your work.**

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**Problem 2.** (10 points)

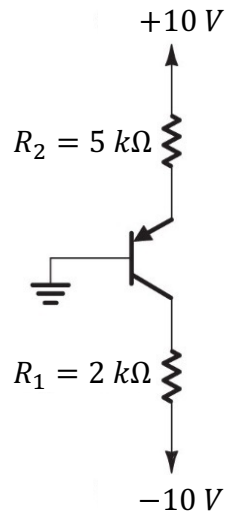
In the following circuit,

- a) Find the collector current, the collector node voltage, and the emitter node voltage.

Include the circuit analysis for checking **all three** cut-off, active, and saturation modes.

- b) Find the largest value to which  $R_1$  can be raised while the transistor remains in the active mode with the same collector current that you calculated in part a.

Assume  $V_{D0} = 0.7\text{ V}$ ,  $\beta = 200$ ,  $V_{sat} = 0.2\text{ V}$ .



**Show your work.**

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