ECE 548: Electronic Design I

Lab 3: Diodes

Name: Nick Snyder Major: CE

Objective:

- To understand and experimentally verify the current-voltage (I-V) characteristics of a diode.
- To build a voltage limiter circuit and understand the state of each diode during operation.
- To assemble, test, and understand the half-wave rectifier circuit using diodes.

1. I-V Characteristics of a Silicon Diode

- Construct the circuit in Figure 1 below using the 1N4148 Silicon diode. Note that the polarity band indicates the n-side of the diode. Please refer to the data sheet for the diode specifications. V_S is connected to the DC power supply. Use the digital multimeter to measure the voltage V_O between the diode and the resistor.

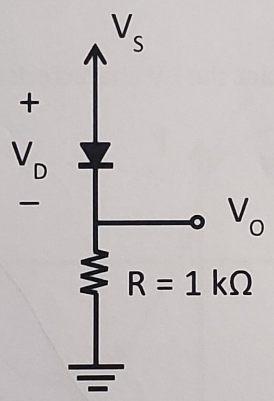


Figure 1

- Vary the DC voltage V_S from -2 V to 2 V and complete the following table.

Table 1

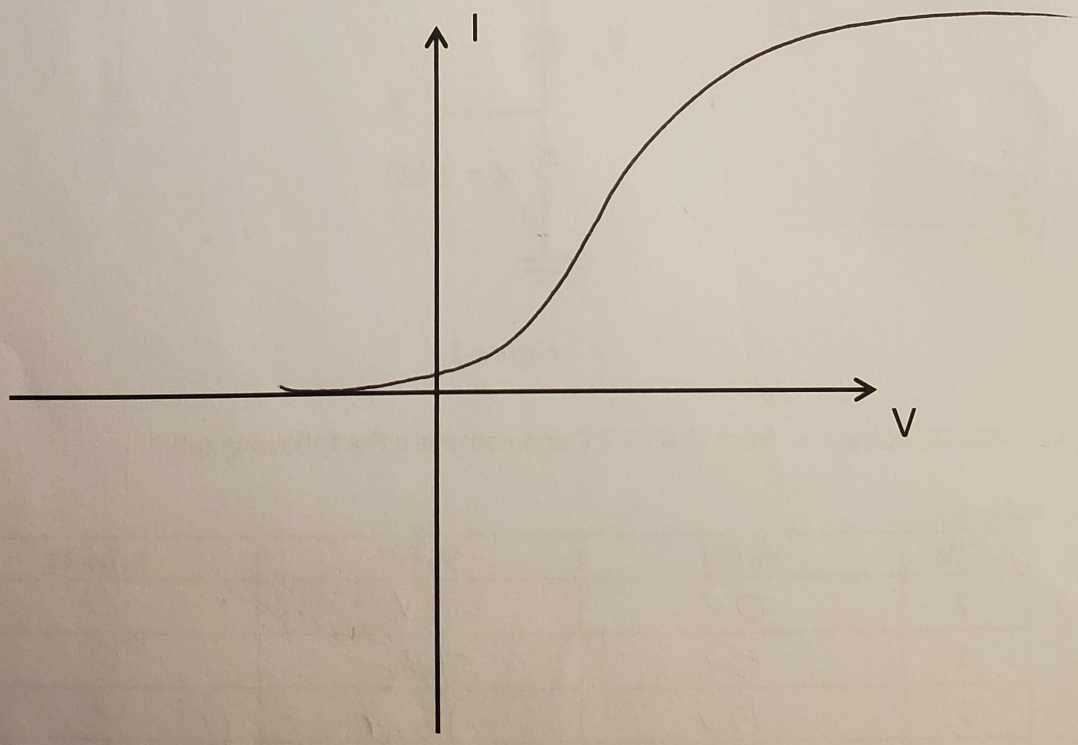
V_S [V]	V_O [V]	V_D [V]	I_D [mA]
-2	0V	-2V	0
-1	0V	-1V	0
0	0V	-13mV	0
0.2	360μV	205mV	0.27μA
0.4	13mV	389mV	13.21μA
0.5	51mV	457mV	46.38μA

0.6	0.111 V	0.495V	104 μA
0.7	0.16 V	0.521V	167 μA
0.8	0.27 V	0.540V	248 μA
0.9	0.353V	0.553V	321 μA
1.0	0.44uV	0.564V	400 μA
1.2	0.623V	0.581V	572 μA
1.4	0.811V	0.593V	738 μA
1.6	0.997V	0.604V	912 μA
1.8	1.18V	0.611V	1.09 mA
2.0	1.38V	0.620V	1.26 mA

- At what V_D does the diode start to conduct?

$V_0 = 0.5\,V$

- Using the data from tables 1 and 2, plot the I-V characteristics in the axes provided below.



Get TA's initial: 3/27

2. Voltage Limiter

- Construct the circuit in Figure 2. Using a function generator, produce a sine wave at $V_S(t)$ with 1kHz frequency and 2 V amplitude. Use channel 1 of oscilloscope to display V_S and channel 2 to display V_O on the scope.

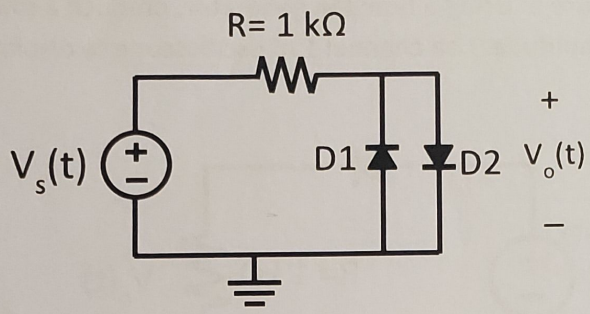
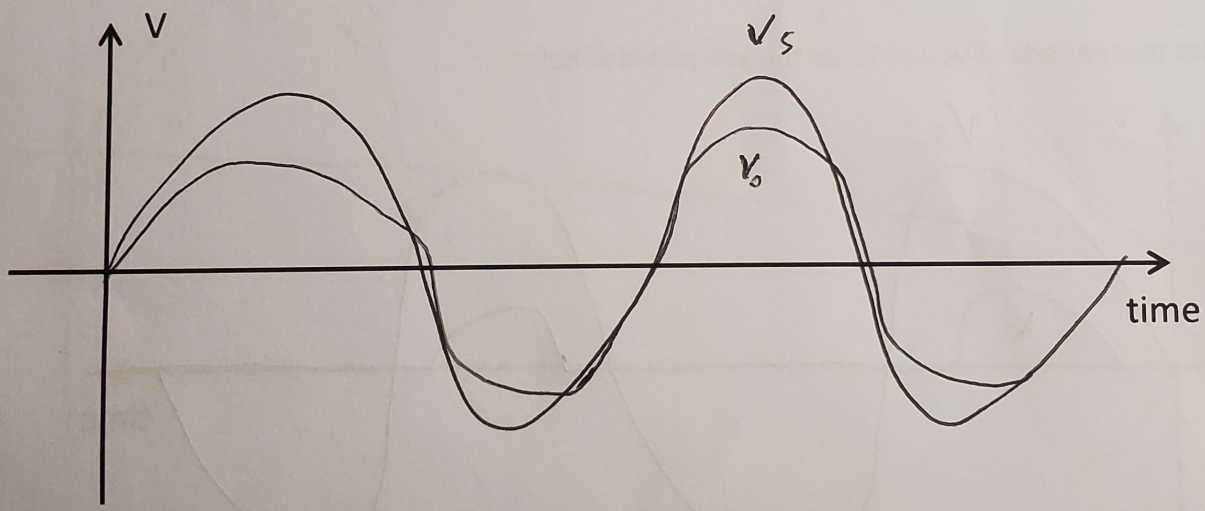


Figure 2

- Plot two periods of V_S and V_O on the axis provided below.



- What are the voltage ranges of $V_S(t)$ for which the following diode conditions apply? Complete the table below.

D1	D2	Range of $V_S(t)$
ON	ON	short circuit
ON	OFF	both 8 40 mA
OFF	ON	
OFF	OFF	open circuit

Get TA's initial: 3/24

3. Half-Wave Rectifier

- Construct the circuit in Figure 2. Using a function generator, produce a sine wave at $V_S(t)$ with 1kHz frequency and 2 V amplitude. Use channel 1 of oscilloscope to display V_S and channel 2 to display V_O on the scope.

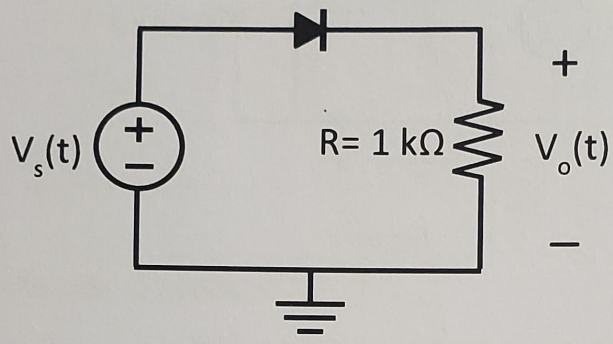
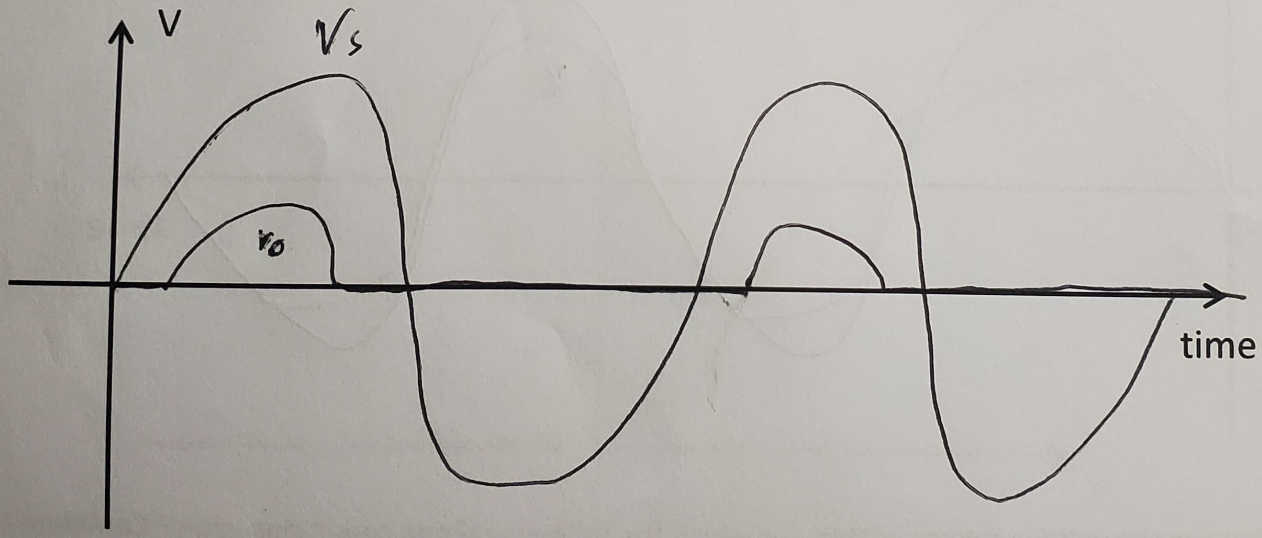


Figure 3

- Plot two periods of V_S and V_O on the axis provided below.



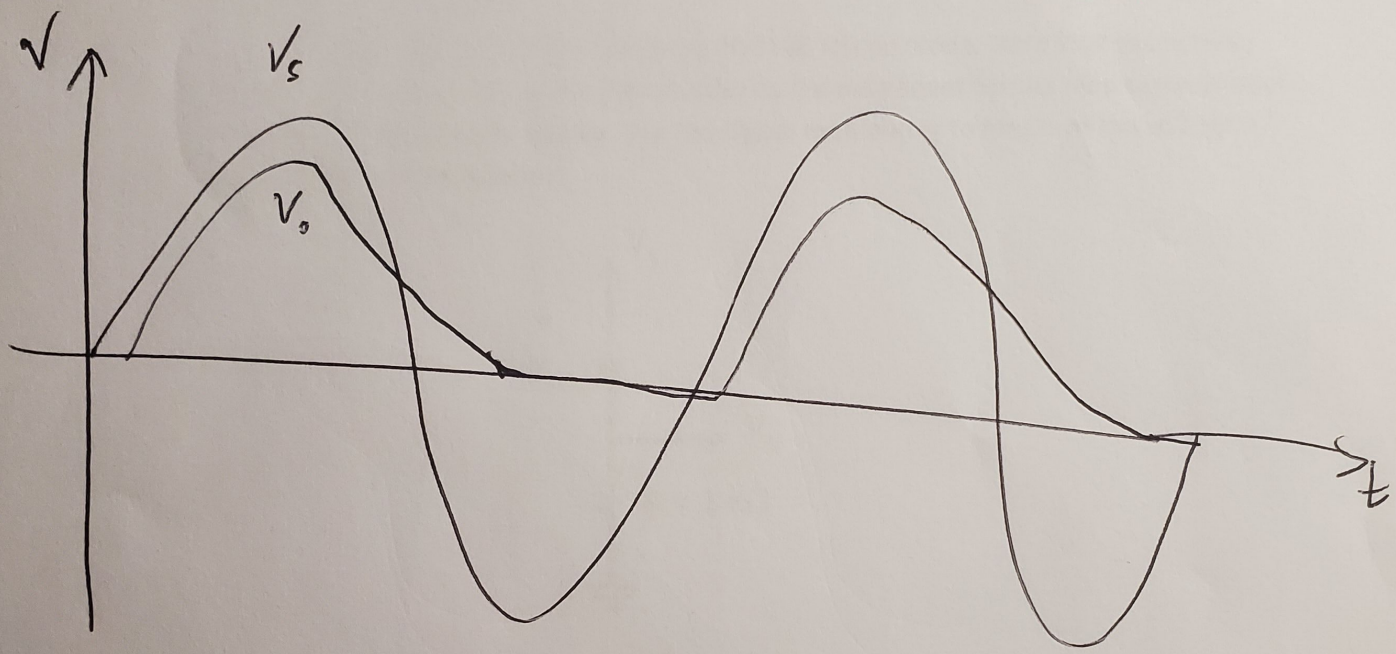
- What is the peak voltage of V_O? How does it compare to the peak voltage of V_S?

V_{op} = 1.02V

V_{sp} = 2V

- From Figure 2, add a 1 μF capacitor in parallel with the 1KΩ resistor and plot the resulting V_O on the above axis.
- What is the maximum, minimum and the magnitude of the "ripple" voltage?

Get TA's initial: 3/27



max 920 mV

min −440 mV

mag 1.3 V