ECE 548: Electronic Design I

Lab 4: Rectifier Circuits

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Objective:

- To build a half-wave and a full-wave rectifier and verify the voltage waveform.
- Measure the conduction interval and verify with the theoretical values.

1. Half-Wave Rectifier

- Construct the circuit in Figure 1. Using a function generator, produce a sine wave at $V_S(t)$ with 100 Hz frequency and 5 V amplitude. Use channel 1 of oscilloscope to display V_S and channel 2 to display V_O on the scope.

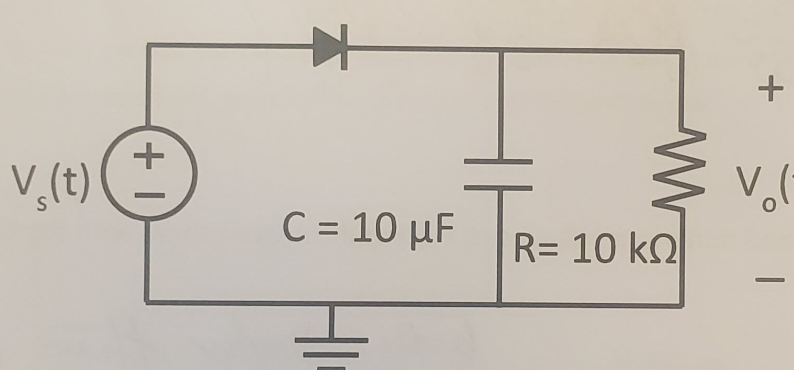
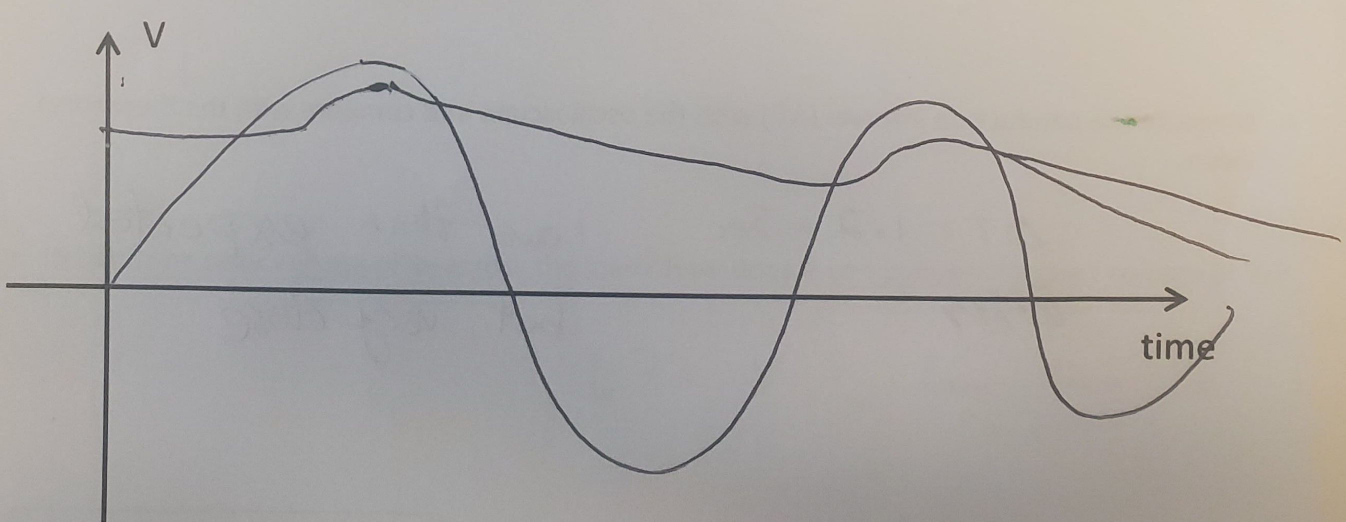


Figure 1

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



- Calculate the maximum and the minimum voltage for $V_O(t)$.

$V_{max}\left(\frac{0.01}{10000 \cdot 0.00001}\right)$

$0.19V$

$V_p - V_{th} = 2.5 - 0.6 = 1.9V = V_{max}$

$V_{max} - V_r = 1.9 - 0.19 = 1.71V = V_{min}$

- Calculate the conduction interval (ΔT) and the conduction angle (θ_c)

$\theta_c = \cos^{-1}\left(1 - \frac{1.9}{2.5}\right) = 1.328ra$

$\Delta T = \frac{1.328}{100} = 1.328\, msec$

- Measure the maximum and minimum voltages at $V_O(t)$ and compare them with the theoretical values.

max: 2.18 V

min: 1.96V

both higher than expected

- Measure the conduction interval (ΔT) with the oscilloscope and compare with the theoretical value.

ΔT: 1.2 mSec

lower than expected but very close

Get TA's initial:

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2. **Full-Wave Bridge Rectifier**

- Construct the circuit in Figure 2. Using a function generator, produce a sine wave at $V_S(t)$ with 100 Hz frequency and 5V amplitude. Connect channel 1 of oscilloscope to one end of the load resistor R_L (to measure V_1) and channel 2 to the other end (to measure V_2).

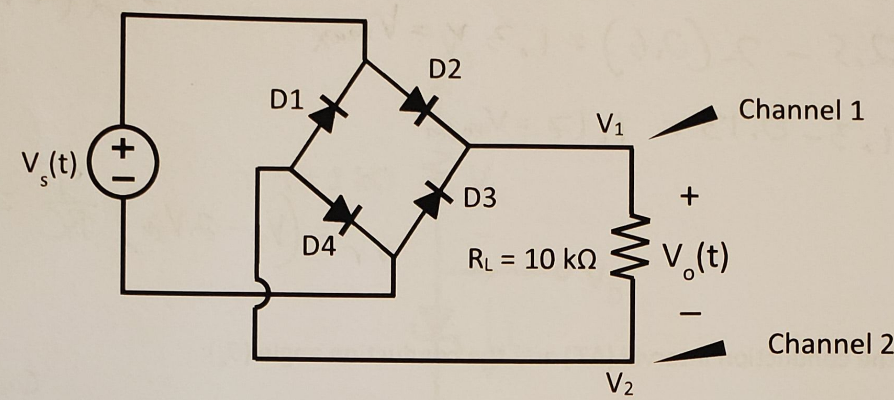
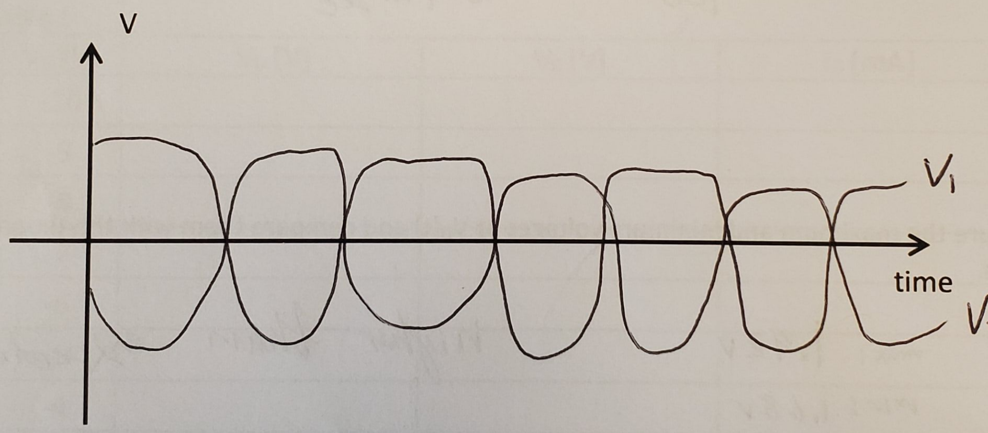


Figure 2

- Display $V_1 - V_2$ on the oscilloscope by "adding" channel 1 and inverse of channel 2. Plot several periods of the resultant waveform on the axis provided below.



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

1.72 V , lower than V_s

- Now add a 10 μF capacitor in parallel with the load resistor to obtain a crude DC voltage with a ripple.

- Calculate the maximum and the minimum voltage for $V_O(t)$.

$5 - 2(0.6) = 3.8$

$2.5 - 2(0.6) = 1.3\,V = V_{max}$

$1.3 - 0.13 = 1.17 = V_{min}$

0.38

$V_r = (V_p - 2V_{th}) \frac{T}{RC} = \cancel{0.13}\,V$

- Calculate the conduction interval (ΔT) and the conduction angle (θ_c)

$\cos^{-1}\left(1 - \frac{0.38}{5}\right) =$

0.39 rad

$\theta_c = \cos^{-1}\left(1 - \frac{0.13}{2.5}\right) = 0.324$ rad

$\Delta T = \frac{0.324}{100} = 3.24$ m sec

- Measure the maximum and minimum voltages at $V_O(t)$ and compare them with the theoretical values.

max: 1.92 V

min: 1.68 V

higher than expected

- Measure the conduction interval (ΔT) with the oscilloscope and compare with the theoretical value.

~~2.5 msec~~

lower than expected

0.8 m sec

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