ENGR 305 – Lab 3

Diode Rectifiers (Formal Lab Report)

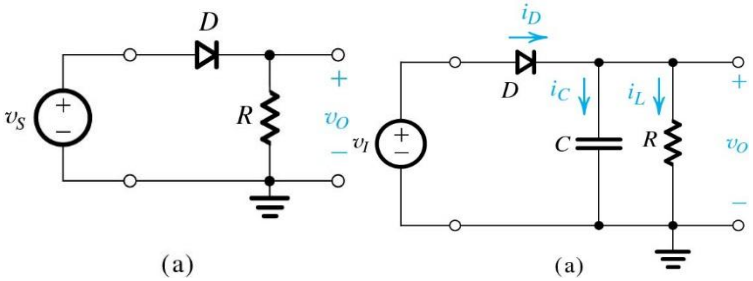
OBJECTIVES:

To study diode-based rectifier circuits by:

- Analyzing, simulating, and building rectifier circuits.
- Note that many diode-based circuits are easy to assemble. In this lab, you will build circuits that only require a few simple components.

MATERIALS:

- Laboratory setup, including breadboard
- Junction diodes (1N4002)
- Several wires, resistors, and capacitors of varying sizes



Half-wave rectifier

Peak rectifier

PART I: SIMULATION

Half-wave rectifier

Consider the half-wave rectifier shown in the figure. Simulate the circuit using a $10 - V_{pk-pk}$ 1-kHz sinusoid and a 1N4002 diode, with $R = 10k\Omega$. Provide a plot of $v_I \; vs. \; t$ and $v_O \; vs. \; t$. Set up the 1N4002 model as in Lab 2.

We want a sinusoidal voltage source. Right-click on voltage source and click on *advanced.*

- Choose SINE:
  - Amplitude – 10 (V)
  - Frequency – 1000 (Hz)

Leave the rest blank and click OK. Right-click on the resistor and enter 10k. Now the circuit is ready for simulation.

Under *simulate,* choose *Transient*. For the stop time enter 0.005 (s) (this is 5 periods of the waveform). Then run the program.

Next, take the mouse and click on the node between the diode and the resistor. This plots V(n002). This is the output waveform.

We can also plot the input voltage by clicking above the voltage source. This is V(n001).

The half-wave rectifier allows only the positive half cycle.

Notice also that the output voltage peak is lower than the input voltage peak by one diode drop.

Peak rectifier

Consider the peak detector shown in the figure. Simulate the circuit using a $10 - V_{pk-pk}$ 1-kHz input sinusoid for the two following sets of parameters. For both simulations, provide a plot of $v_I \; vs. \, t$ and $v_O \; vs. \, t$ and report the peak voltage (V_p) and the ripple voltage (V_r).

- Peak detector I: Use $R_L = 1k\Omega$, $C = 47\ \mu F$, 1N4002 diode
- Peak detector II: This time use $R_L = 100\ \Omega$, $C = 47\ \mu F$, 1N4002 diode

  Note: add a 47-µF capacitor in parallel with the resistor for the simulation. Enter 47u for the value. Run it again to get the result.

PART 2: MEASUREMENTS

- For each circuit, assemble the circuit, apply the required waveform using a function generator, and capture the input and output voltage waveforms on an oscilloscope.
- For the peak rectifier, record the values of V_p and V_r.
- Using a digital multimeter, measure all resistors to three significant digits.

PART 3: POST-MEASUREMENT EXERCISE

- What conclusions do you draw from the two different peak rectifiers?

NOTE: In order to display the waveform correctly on the oscilloscope, the output impedance from the function generator must match the input impedance of the oscilloscope. This can be accomplished by setting the impedance of the function generator to "High Impedance" as described in the following:

a. For 33120A function generator:
   i. Push "Shift" then "Menu".
   ii. Push "<" or ">" button to get "D: SYS MENU".
   iii. Push "∧" or "∨" button to get "50 OHM".
   iv. Push "<" or ">" button to get "HIGH Z".
   v. Push "Enter".

b. For 33220A function generator:
   i. Push "Utility" and select "Output Setup".
   ii. Select "High Z" and then Push "Done".