Rowan University

ECE 09416 & ECE 09504 Power Electronics

Professor Hua Zhang

January 23, 2024

Homework 1: Basic Single Phase Rectifier

This homework is due **January 30, 2023**. Please submit the hardcopy at the beginning of the class to the instructor. If a problem requires simulation, the original code and simulation file need to be attached (For example, the MATLAB code and the LTspice simulation file). The students are suggested to discuss the problems. However, each student must submit an individual work.

- Reading Assignment: Kassakian, Schlecht, Verghese. "Principle of Power Electronics"
  1. Chapter 1
  2. Chapter 3

- Problems:

1. A half-wave rectifier with the *RL* load is shown in Fig. 1. The diode *D* is treated as an ideal component with a zero voltage drop. The parameters are assigned as V_s=110 V (*RMS*), ω=2π×60 rad/s, *L*=20 mH, and *R*=10Ω.

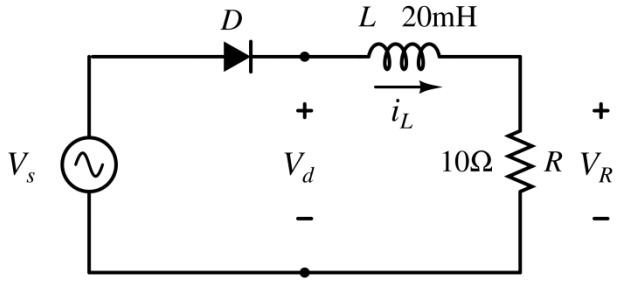

Fig. 1. Half-wave rectifier with the *RL* load when *L*=20 mH and *R*=10Ω.

(a) When D is ON, draw the equivalent circuit topology. Derive the differential equation to describe the circuit. Solve the differential equation, and provide the analytical expression of the output voltage $V_R(t)$.
Pay attention: the solution has been provided in the lecture. However, in this question, students are required to provide the calculation process.

(b) When D is OFF, draw the equivalent circuit topology.

(c) Use LTspice to simulate the circuit performance. Provide the waveform of i_L and V_d.

(d) Use MATLAB to calculate the output voltage $V_R(t)$.

Pay attention: the expression in *(a)* is used in the calculation. **This question is ONLY for the graduate students.**

(e) Please comment on what will happen if the inductor L is super large, for example 1.0H. You may use simulation to support yourself.

(f) Please comment on what will happen if the load resistor is super large, for example 100kΩ or open circuit. Also, you may use simulation to support yourself.