

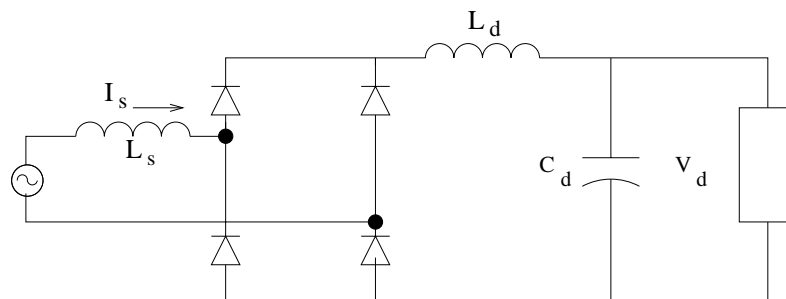
ECE 320
Energy Systems I
Sample Exam #3

1 _____ / 30 pts
2 _____ / 30 pts
3 _____ / 16 pts
4 _____ / 24 pts
Total _____ / 100 pts

Note:

This sample exam is largely made up of problems on topics covered since exam #2. The problems on topics from the first two-thirds of the course are available in sample exams #1 and #2.

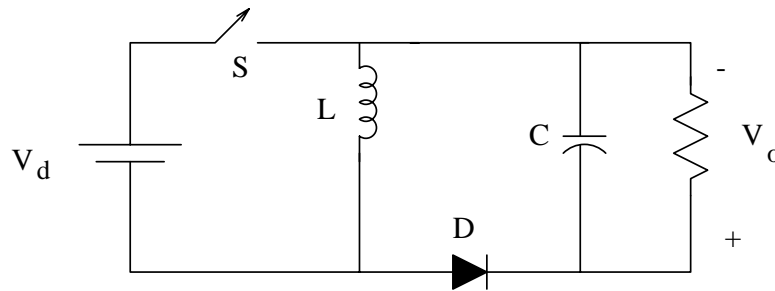
1. (30 pts) You are given a single phase diode rectifier, as shown below. Do the following:
 - (a) Assume that $L_d = 0\Omega$ and C_d is large. Plot the ac current versus time for one 400 Hz cycle. Determine the angles at which conduction begins in degrees. Also determine the peak current and dc current.
 - (b) In many cases it is desirable to have continuous conduction. Describe potential benefits to having continuous conduction. How would the circuit need to be modified from the conditions of part A to achieve continuous conduction? Would the voltages need to change?



- $V_d = 310\text{ V}$
- $v_s(t) = 360\sin(2\pi 400t)$
- $X_s = 0.4\ \Omega$ at 400 Hz.

2. (30 pts) For the converter shown below, determine the following:

- What type of converter is it?
- Duty cycle
- We want to limit ΔV_o to 0.5% of the output voltage. Determine the necessary capacitance. What would happen if a smaller capacitor was used?



Where:

- $V_d = 25 \text{ V}$
- $V_o = 18 \text{ V}$
- $L = 0.2 \text{ mH}$
- $f_s = 5 \text{ kHz}$
- $R = 3.25 \text{ } \Omega$

3. (20 pts) Short Answer.

- (a) (10 pts) You are given a boost converter. You measure the input voltage to be 15 V from a 100W source, and have an output current of 4 A. Assuming no power losses determine: input current, output voltage, duty ratio. The filter inductance is $100 \mu H$ and the switching frequency is 10 kHz.
- (b) (6 pts) Given a diode rectifier with a large dc filter capacitor, how does the average dc voltage normally relate to the RMS ac voltage if there is now ac side inductance.

4. (24 pts) Answer the following questions.

- (a) What does the commutation overlap angle represent?
- (b) What must be present in the circuit for commutation overlap to occur?
- (c) Will there be commutation overlap if the diode current goes to zero before $\theta = 180^\circ$? Explain?
- (d) How does commutation overlap impact the dc voltage? Explain