ENGR-4300
Fall 2008
Test 4

Name _____

Section 1(MR 8:00) 2(TF 2:00)
(circle one)

Question I (20 points) _____

Question II (20 points) _____

Question III (15 points) _____

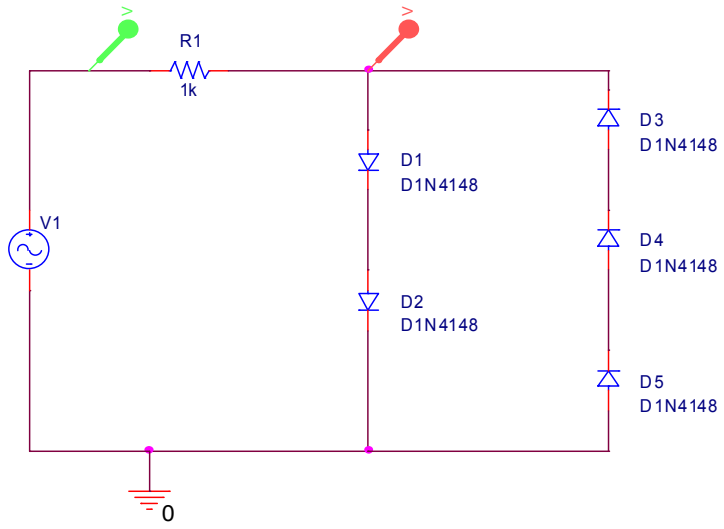
Question IV (20 points) _____

Question V (25 points) _____

Total (100 points): _____

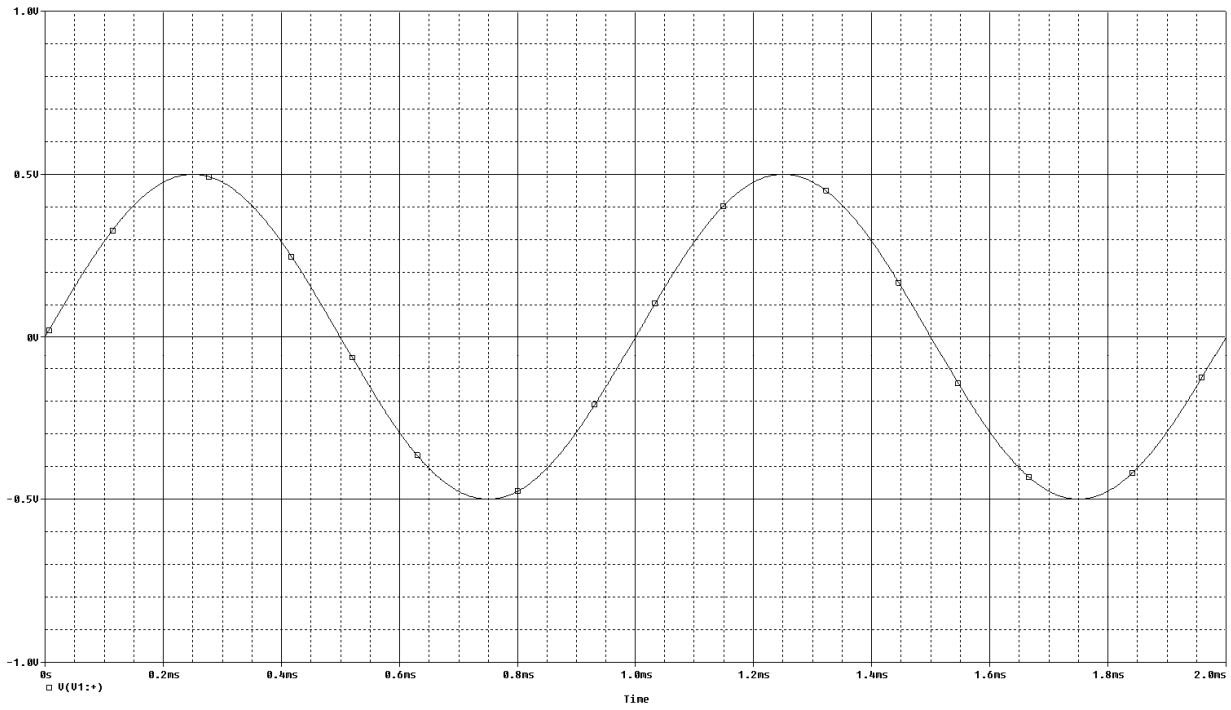
On all questions: SHOW ALL WORK. BEGIN WITH FORMULAS, THEN SUBSTITUTE VALUES AND UNITS. No credit will be given for numbers that appear without justification.

Question I – Diode Limiter Circuits (20 points)



Diodes turn on at 0.6 volts

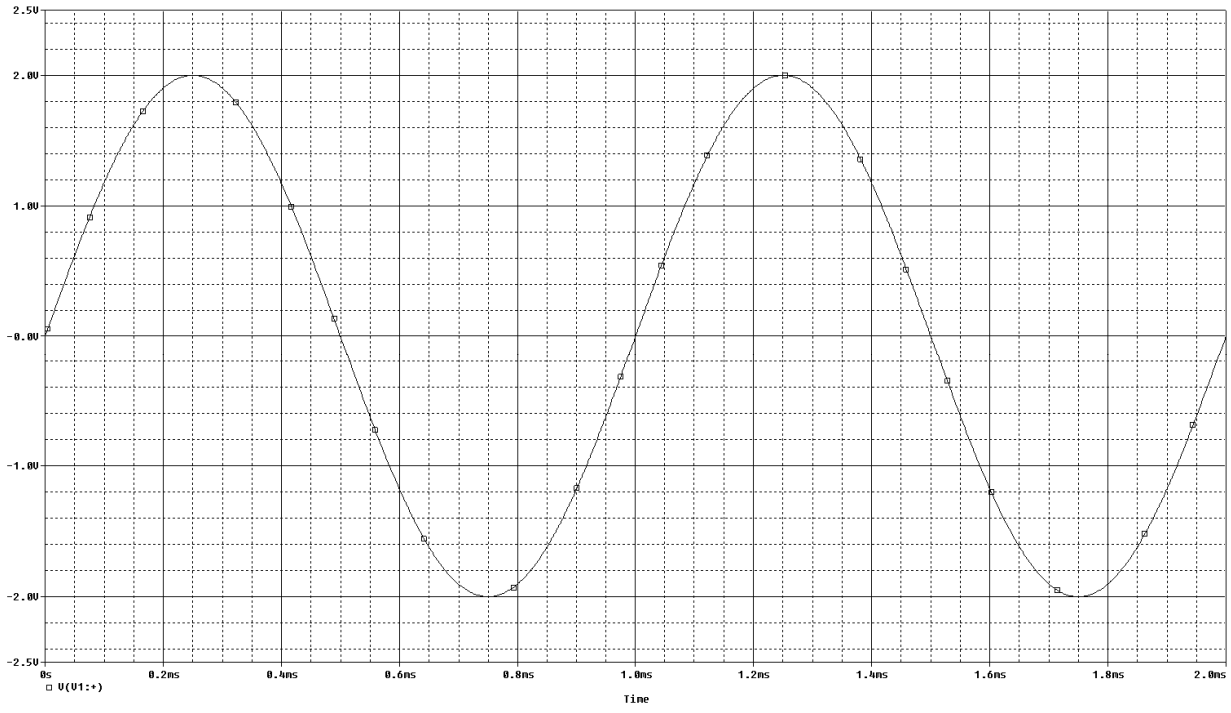
1. (***4pt***) Draw Vout on the input plot shown below: Voff=0V, Vamp=500mV, Freq=1k



Question I – Diode Limiter Circuits (continued)

2. (***2pt***) Draw or explain the reason for the above plot

3. (***4pt***) Draw Vout on the input plot shown below: Voff=0V, Vampl=2V, Freq=1k, (***label the maximum and minimum of the output***)



Question I – Diode Limiter Circuits (continued)

4. (***2pt***) Draw or explain the reason for the above plot

5. (***8pt, 2pt each***) What is the value of current through the resistor R1 when the input voltages are the following: (reminder: Assume Von for each diode is 0.6V)

3 volts:

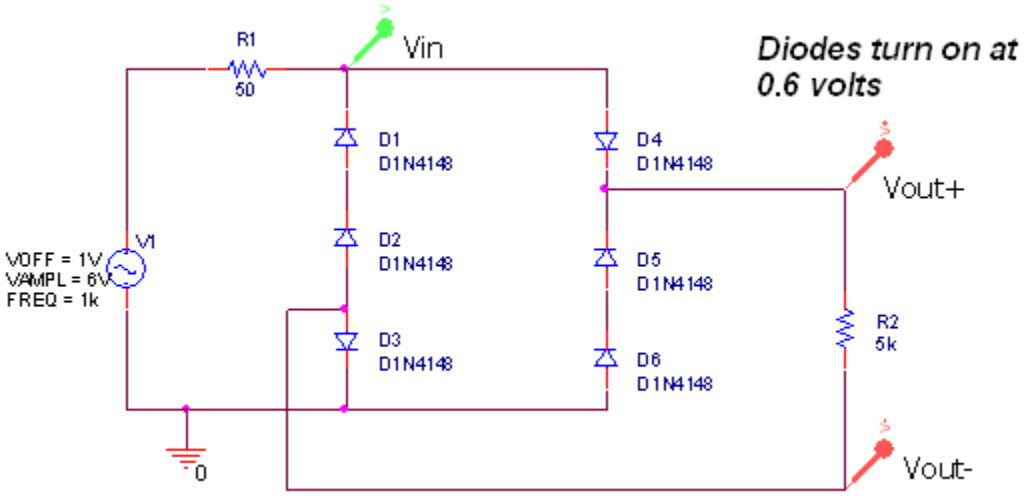
-3 volts:

0.2 volts:

-0.2 volts:

Question II – Diode Rectifier Circuits (20 points)

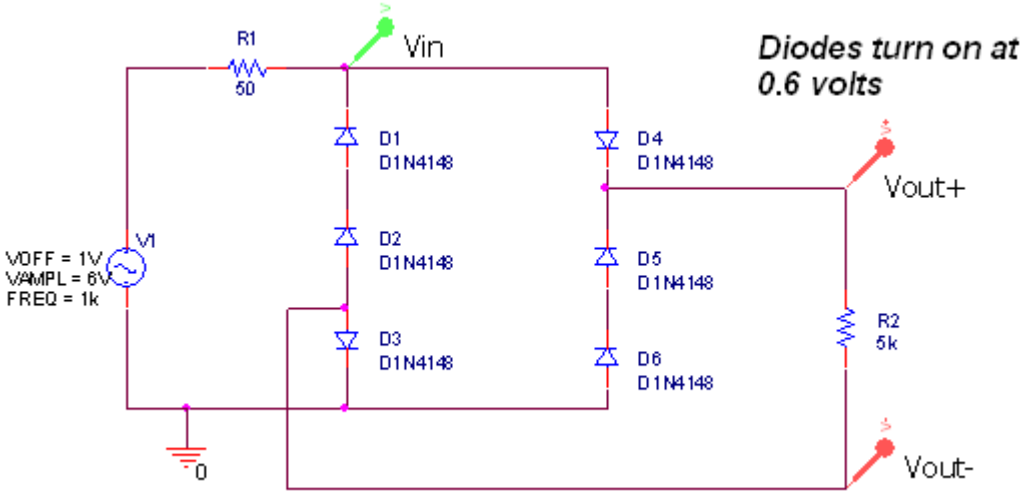
In the rectifier circuit shown below, each of the diodes turn on at ***0.6 volts*** and the resistances are shown.



1. (***2pt***) What type of circuit is it (circle)?

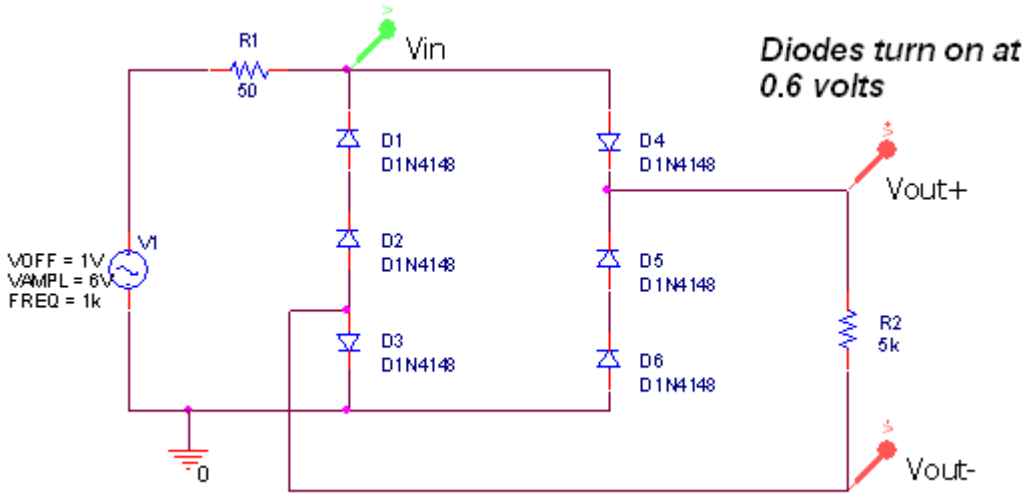
a) half wave rectifier b) full wave rectifier c) voltage limiter d) not listed: write in as _____

2. (***3pt***) Draw the current direction through the diodes and resistor, R2, for the positive cycle of the voltage input (label on diagram below)



Question II – Diode Rectifier Circuits (continued)

3. (***3pt***) Draw the current direction through the diodes and resistor, R2, for the negative cycle of the voltage input (label on diagram below)



4. (***6pt***) What will the voltage between Vout+ and Vout- be for the following input voltages:

Vin=7V

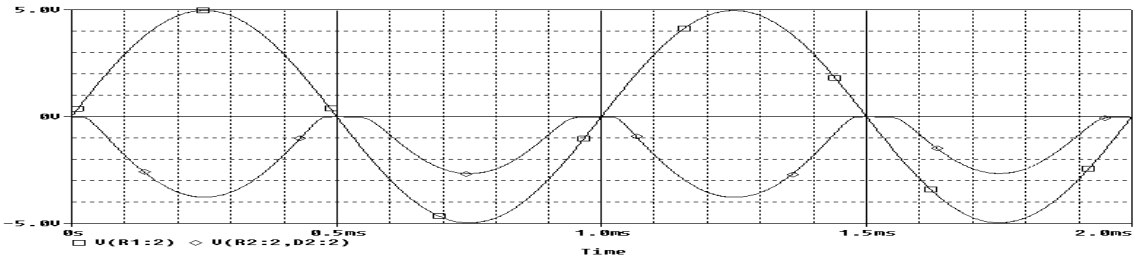
Vin=-5V

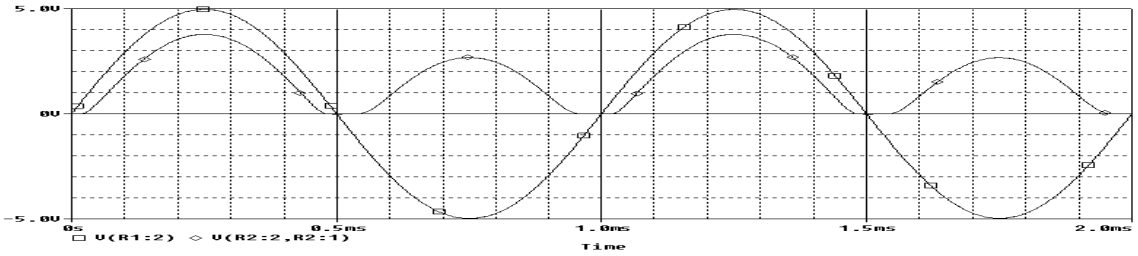
Vin=0V

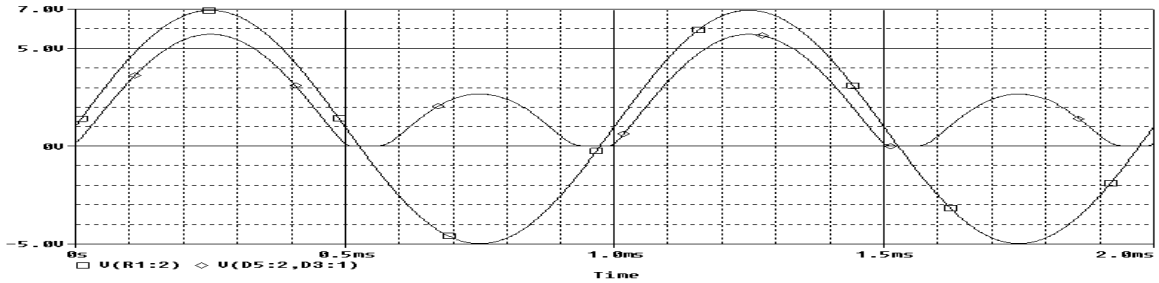
Question II – Diode Rectifier Circuits (continued)

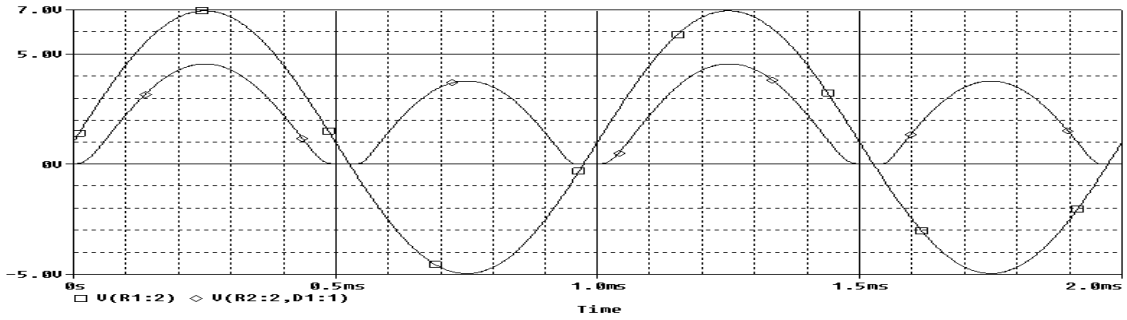
5. (***4pt***) Which of the plots below represent Vin (as specified in the circuit diagram) and Vout+/Vout- ?

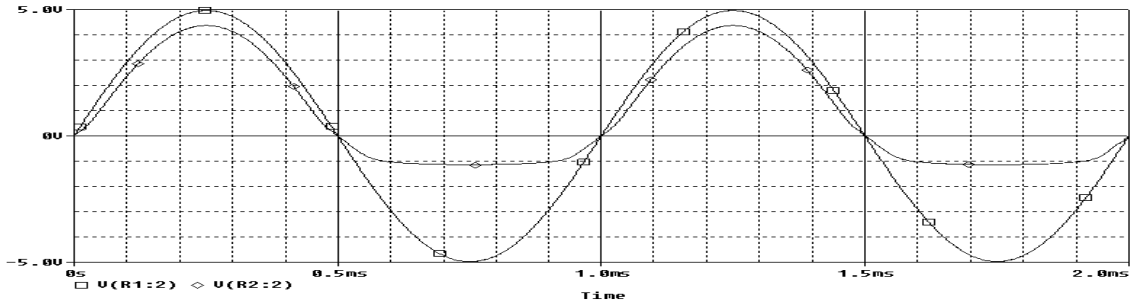
Label on the diagram the value of the ***voltage dropped across the diodes*** in both the positive and negative portion of the voltage cycle.







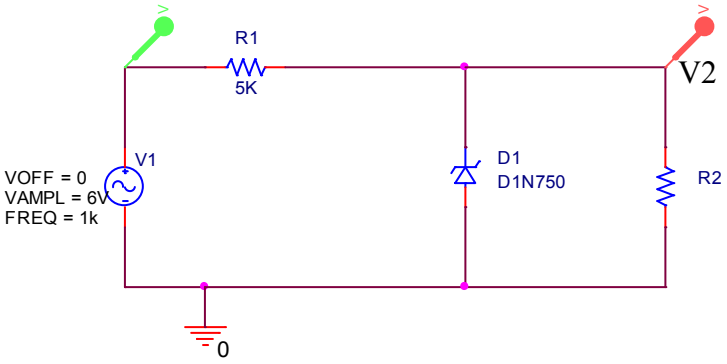




Question II – Diode Rectifier Circuits (continued)

6. (***2pt***) In general, if you want to convert the AC input into something close to DC (smoothing circuit) where would you place the capacitor? (name correct component(s) in description or draw portion of the circuit responsible for smoothing)
Why does a capacitor smooth out the output?

Question III – Zener Diode Circuits (15 points)



The circuit above is a zener diode voltage regulator. Assume the zener voltage of the diode is 4.7 volts and its forward bias voltage is 0.7 volts.

1. (***1pt***) What does a voltage regulator do? (do not use the word ***regulate*** in the definition)

2. (***6pt***) What would the voltage at V2 be when V1=6V if R2 has the following values:

   i.) 1 K ohms

   ii.) 10 K ohms

   iii.) 100 K ohms

Question III – Zener Diode Circuits (continued)

3. (***6pt***) What would the voltage at V2 be when V1 = -6V if R2 has the following values:

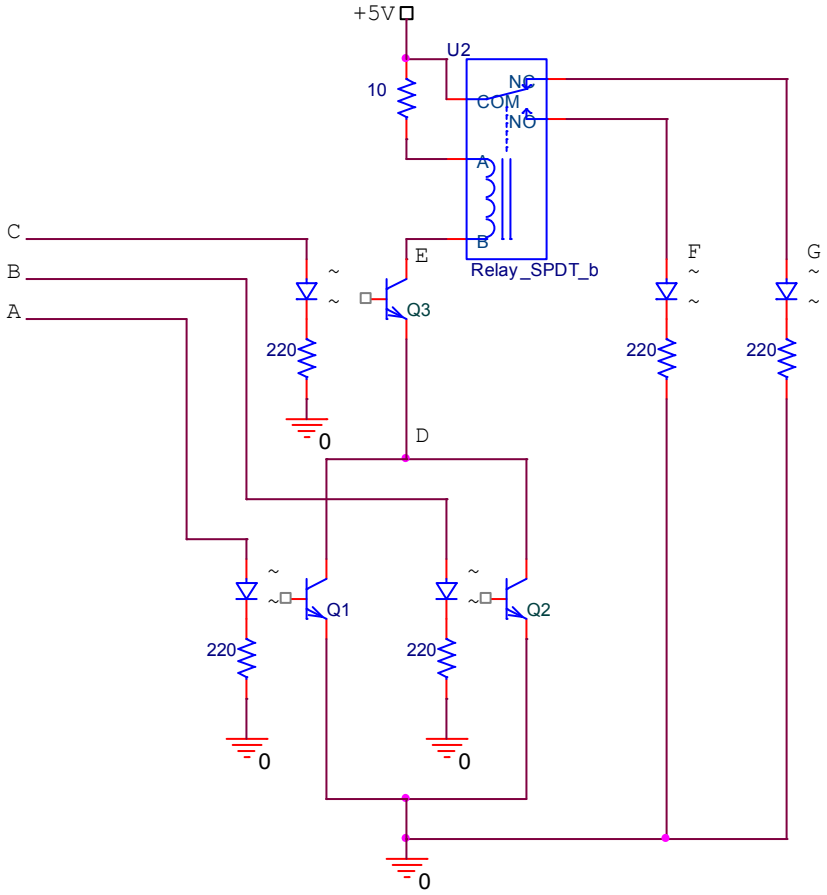
i.) 1 K ohms

ii.) 10 K ohms

iii.) 100 K ohms

4. (***2pt***) Complete the following circuit to mimic within ±0.1V a zener voltage of 5.4V and a turn on voltage of 0.65V using a number of D1N4148 "regular" diodes (***turn on voltage 0.6V***).

Question IV - LEDs and Phototransistor Circuits (20 points)



Above is an optical isolation circuit with LED/phototransistor pairs. The inputs may be in a cage whose reference voltage is 5kV higher than the phototransistor and relay circuit, but the "optical isolation" removes the danger of high voltage getting through. The on resistance of the phototransistors is 20Ω and the resistance of the coil is negligible, although 50mA is needed to turn on the relay.

1. (3pt) Given that inputs A, B & C are such that Q2 & Q3 are fully on and Q1 is off, find the current through the coil.

2. (3pt) Given that inputs A, B & C are such that all the phototransistors Q1, Q2 & Q3 are fully on, find the current through the coil.

Question IV - LEDs and Phototransistor Circuits (continued)

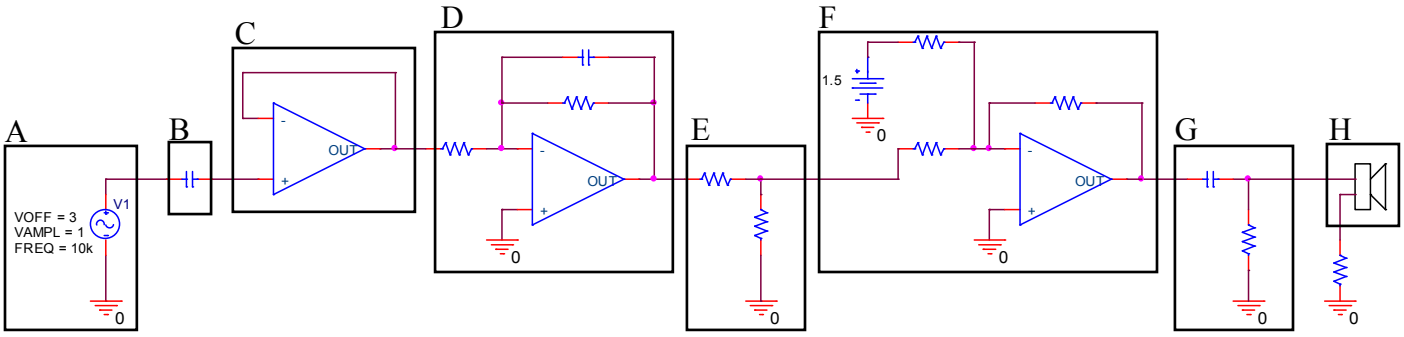
3. (8pt) Fill in the following table:

C	B	A	LED F (on or off?)	LED G (on or off?)
0V	0V	0V		
0V	0V	5V		
0V	5V	0V		
0V	5V	5V		
5V	0V	0V		
5V	0V	5V		
5V	5V	0V		
5V	5V	5V		

4. (4pt) Assuming phototransistor Q1 & Q3 are on and Q2 is off, what is the voltage at D in the circuit above?

5. (2pt) TRUE or FALSE: The Boolean logic expression for LED F being on (or TRUE) is:
C•(B+A).

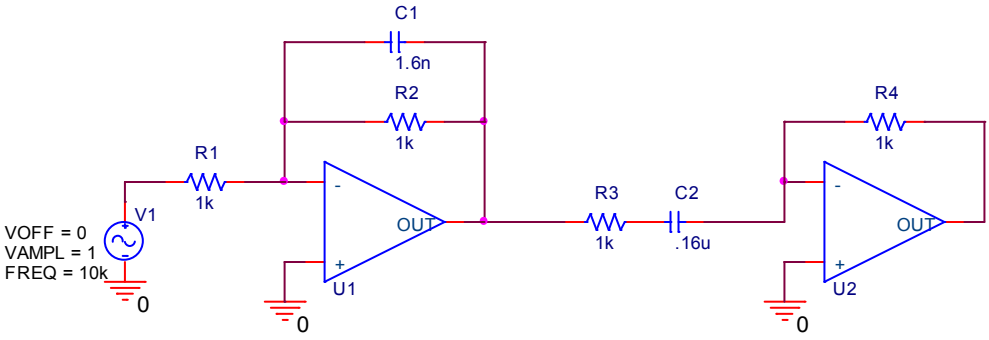
Question V – Signal Modulation and Functionality (25 points)



1. (8pt) Identify the function of each of the blocks in the signal conditioning circuit above.

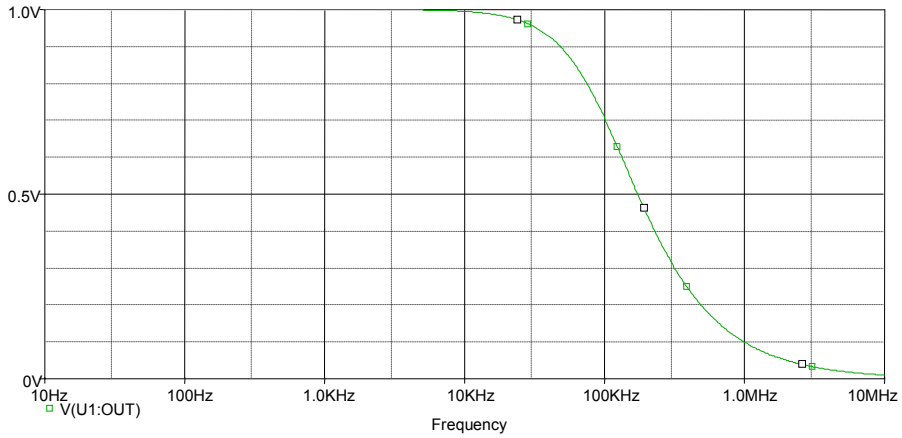
A:	E:
B:	F:
C:	G:
D:	H:

2. (5pt) The following filter consists of a LPF in series with a HPF. The responses of each block are shown. Sketch the response of the combined blocks on the third axes below.

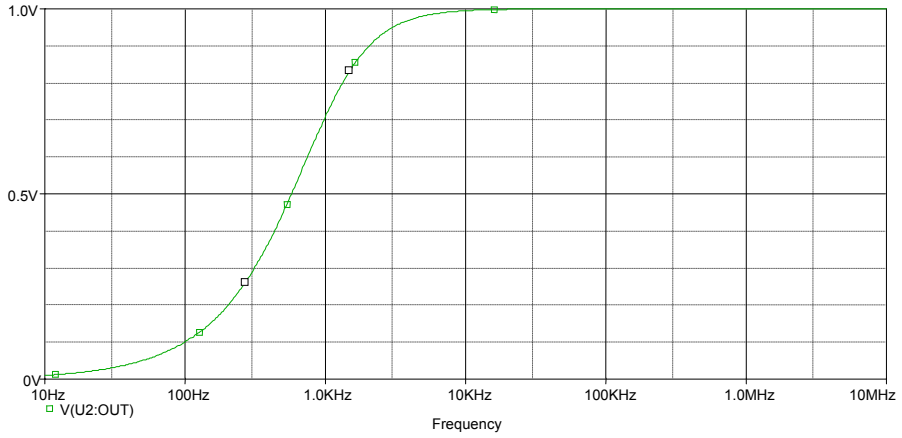


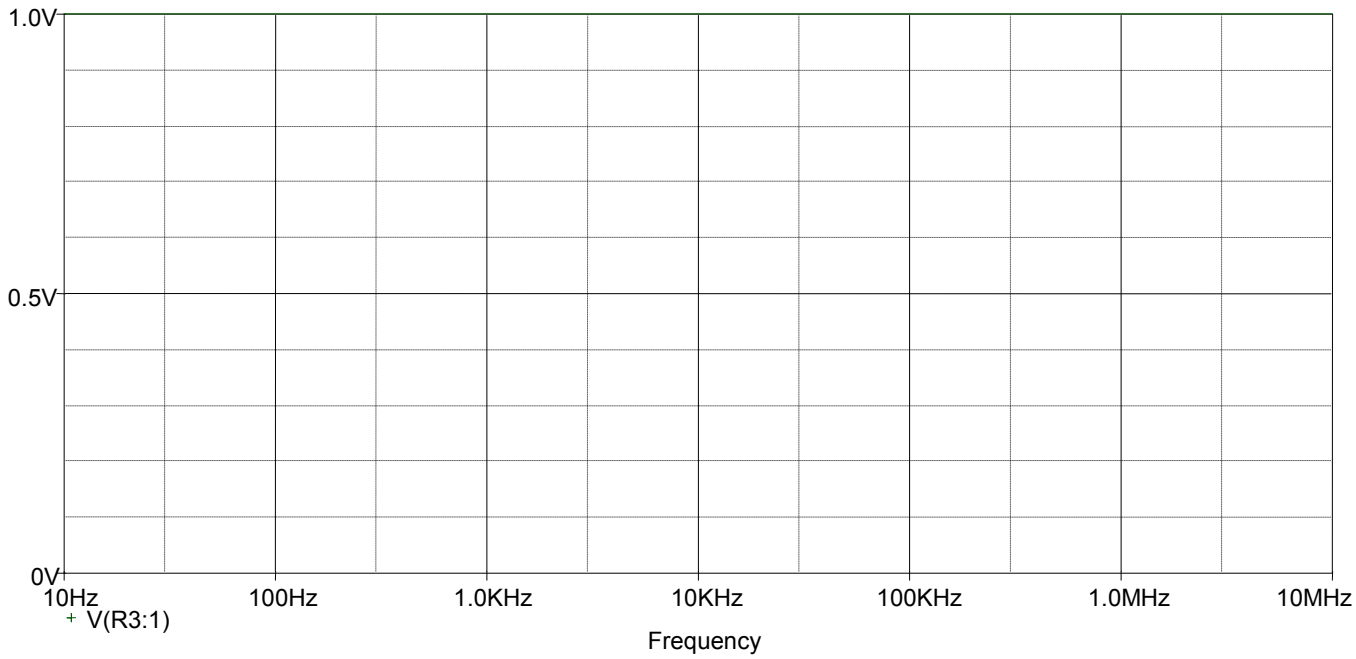
Question V – Signal Modulation and Functionality (continued)

LPF



HPF





Question V – Signal Modulation and Functionality (continued)

3. (6pt) The input to the circuit in 2 is a sine wave whose amplitude is 1V. Find the approximate amplitude of the output sine wave by inspection of the plots above for the following frequencies: 300Hz, 10kHz, & 100kHz. (HINT: remember the frequency axis is a LOG scale.)

a) 300Hz

b) 10kHz

c)100kHz

4. (4pt) If the circuit in 2 were to be used as part of a demodulation system to recover an input signal that had been modulated (new frequencies added that were not part of the original signal), where in the frequency plot (frequency spectrum) should the original signal be located to guarantee that as little as possible of the original signal is lost in the process.

5. (2pt) TRUE or FALSE: Given the same corner frequency and gain, there is no difference between a Miller Integrator and a first order Low Pass Filter.