ME218a Final Exam

Due by 5pm on 12/12/96

Name:_____

I Certify that I have taken this examination in compliance with the Stanford University Honor Code.

_____

This is the cover sheet for what you turn in !

#1_____

#2_____

#3_____

#4_____

Total_____

ME218a Final Examination 1996

Problem #1 25 Pts

The Electronic Goldmine is selling a relative humidity (RH) sensor that changes its resistance linearly with humidity. It is reported that in Arizona (10% RH) it has a resistance of 11K Ohms and in a steamy shower (100% RH) it has a resistance of 8K Ohms.

Please design a signal conditioning circuit that will use the sensor to produce a 0.5-4.5V output signal over the 10%-100% Relative Humidity range.

Your circuit may use only a 5V supply. You have a single LMC6484 (quad Op-Amp) available, any standard size passive components (R,C, L, Diodes) you might choose.

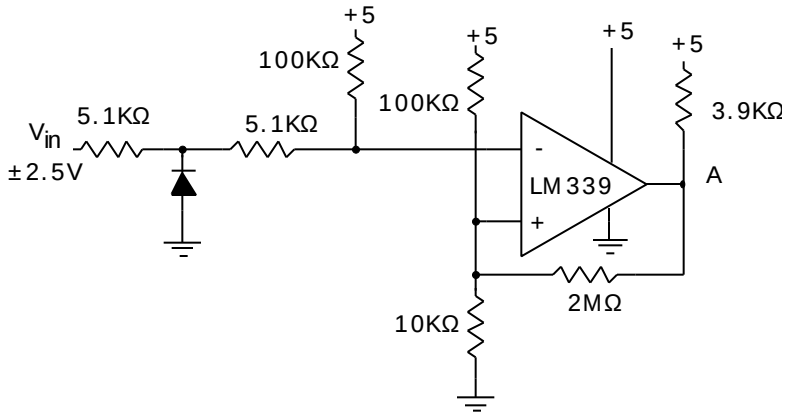
Problem #2 25 Pts.

Use Rule of thumb diode characteristics

Treat the LM339 as having ideal input and output characteristics.

Threshold voltages should be specified as the voltage required at V_{in} to cross the threshold.

Report voltage levels to the nearest mV



a) What is the positive going threshold ?

b) What is the negative going threshold ?

c) What is the maximum current that V_{in} must sink ?

d) What is the maximum current that V_{in} must source ?

e) What is the maximum common mode voltage that the LM339 experiences in this design ?

f) What is the minimum voltage seen by the inputs to the LM339 in this design ?

g) Does the answer in part f meet the LM339 Specs ? If not, how would you change it to meet specs ?

h) When the LM339 output is low, how much current must it sink ?

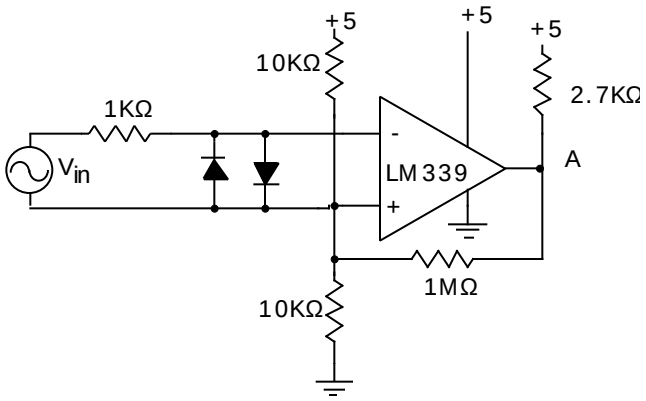
ME218a Final Examination 1996

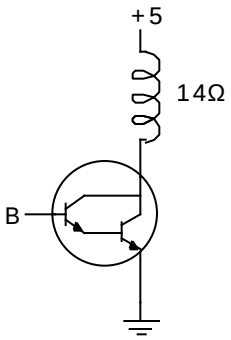
Problem #3 25 Pts.

Use Rule of thumb diode characteristics

Treat the LM339 as having ideal input and output characteristics.

Report voltage levels to the nearest mV





If Vin is a +/-1V sine wave:

a) What is the maximum common mode voltage that the LM339 experiences in this design ?

b) What is the minimum common mode voltage that the LM339 experiences in this design ?

c) What is the voltage measured at the negative input to the LM339,when V_{in} = 1V ?

d) What is the voltage measured at the negative input to the LM339,when V_{in} = -1V ?

e) If point A in the circuit above was connected to point B , how would the answer in part c change ?

f) If point A in the circuit above was connected to point B , how would the answer in part d change ?

Problem #4 25 Pts.

In new England, the dominate storms come off of the north Atlantic Ocean and are colloquially referred to as "Nor'Easters". I'm trying to build a "Nor'Easter" detector using an old Edmund Scientific anemometer and wind vane. I would like you to submit a design proposal, using the two sensors described below, that will detect an approaching "Nor'Easter".

The wind vane has a potentiometer sensor to indicate the wind angle. This potentiometer has a base resistance of 100K Ohms. The potentiometer is somewhat unusual in that it is free to rotate through 360˚. At its low resistance point, measured at the wiper, it has 0 resistance. After rotating through an angle of 359˚ Clock-Wise, it exhibits a resistance of 100K Ohms. Rotating one more degree takes it back to 0 Ohms. In this way, the resistance of the vane is a measure of its absolute position.

To measure the wind speed the anemometer has a tiny multi-pole generator. The frequency and the amplitude of the voltage that it produces varies linearly with wind speed. At 30MPH the amplitude of the signal is +/- 0.6Vand the frequency is 30Hz. At 60MPH, the amplitude is +/- 1.2V and the frequency is 60Hz.

The "Nor'Easter" detector should light an LED indicator whenever the wind speed exceeds 25MPH when the wind direction is +/- 45˚ from North East.

I should be able to construct a prototype of your design using real components that you have encountered during the course.