ME218a Final Exam

Due by 5pm on 12/16/93

Name:_____

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

_____

#1_____

#2_____

#3_____

Total_____

Problem #1 35 Pts

Your consulting firm has been contracted by NASA to assist in the design of a new Heated Arctic Glove. Unfortunately they didn't call you first, so you are stuck with some of the specifications. In particular, the NASA project engineer has already chosen the sensor to be used, even though they knew nothing about the impact on the control circuitry. Your job now is to take this sensor, CRZ-3012 (see attached data sheets), and design a circuit to use it to measure temperature over a sensing range from 10 - 50 ˚C. The output of your circuit should be between 0 and 4.5V over the sensing range. Due to constraints in the battery pack, you have only +5V available to you for your design.

Problem #2 35 Pts.

Dave, the progenitor of Dave's Dominoes, needs some help. He's trying to measure when the welding current in a resistance welder begins relative to the clamping force exerted by the welder. Dave is doing the measurements using a microprocessor based instrument that he has designed. Because of battery limitiations, only +5V power is available. He is very busy with the pressure measurement circuit right now, and has decided to sub-contract to you the welding timing sub-system. Originally, Dave had convinced another former 218er to help him, but Tina just defended her PhD thesis and is now in need of some rest. Being a good 218 student, she made some measurements before beginning to design. Based on these measurements, she can tell you that the signal of interest is an 8V Peak-Peak AC signal at 60Hz with approximately 100mV of high frequency noise riding on it. She also determined that the welder always switches the current on at a zero crossing of the 60Hz signal.

What Dave needs is:

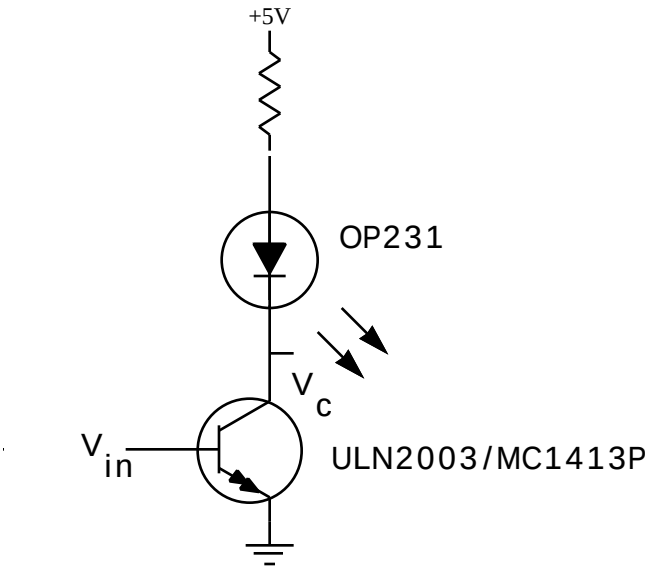
1) A signal from you that has a rising edge as close as possible to the beginning of the welding current. This TTL level signal should rise when the current begins and remain high until reset by a line from Dave's circuit. This reset line will be normally high and go low momentarily when Dave wishes to reset your circuit.

2) A count of the number of half-cycles over which the weld is active. Through careful measurements, Tina has determined that the welder never fires for longer than 10 cycles. This count should be presented on a set of lines at TTL logic levels and should be held until reset by the same signal as in #1.

Since the timing is a critical aspect of Dave's overall project he would like you to estimate how accurately your edge coincides with the beginning of the welding cycle. Provide a specific numeric estiamte.

To help Dave understand your circuit, please provide a written description of your circuit that refers to and explains the operation of the schematic diagram.

Problem #3 30 Pts.



Referring to the drawing above, and based on typical performance specs for the devices specified:

1) What V_C would you expect for I_C = 100mA ?
2) What standard value would you choose for the resistor to limit I_C to as close as possible to 100mA ?
3) If V_{in} = 0V, how much current would you expect to flow through the OP231 ?
4) If V_{in} = 0V, what would you expect V_C to be ?
5) What minimum input voltage and current are required to achieve I_C = 100mA ?