ME218a Midterm Exam

Due by 4pm on 10/27/95

Name:_____

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

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Sign Here

Include this as the cover sheet for you soultions

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Total_____

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Problem #1 15 Points

You have a signal of interest that is a sin wave at 15kHz of 1V (pk-pk) amplitude, centered at 0V. However, it is corrupted by 60Hz noise (superimposed) with an amplitude of 100mV. Design the simplest possible filter that will reduce the noise level to no more than 5mV, while introducing no more than 3% loss in the 5kHz signal. The output should remain centered around 0V.

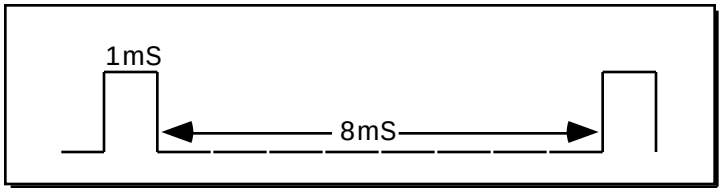
Problem #2 10 Points

For reasons that will become clear later this quarter, your boss has instructed you to design the filter to provide an output of at least 0.97V pk-pk centered at 2.5V. Redesign your filter from problem #1 to this new specification.

Problem #3 10 Points

Just as you finish that design, your boss asks "How will the output for both the 5kHz and 60Hz signals change if the output is connected to a 2kΩ load to ground?"

Problem #4 15 Points



Given a 1kHz square wave clock, design a circuit to produce a waveform like that shown above.

Problem #5 10 Points

Your uncle has designed a new Lazer® LED made from nearly pure unobtanium. He calculates the characteristics of the LED to be $V_f = 2.7V$ @ $I_f = 340mA$. He has asked you to design a drive circuit (using parts from your lab kit) that will light the LED when the output from a 74C04 is high. He has thoughtfully provided you with a 0-50V variable power supply that you can use to power your circuit.

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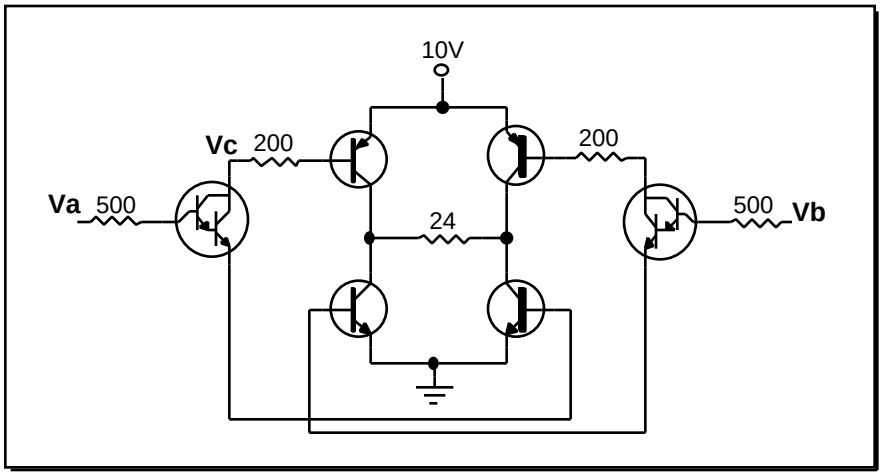
Problem #6 20 Points

For the circuit shown below, use 'Rules of Thumb' to answer the following questions:



a) What is the voltage necessary at point Va to make the maximum current flow in the 24Ω resistor?

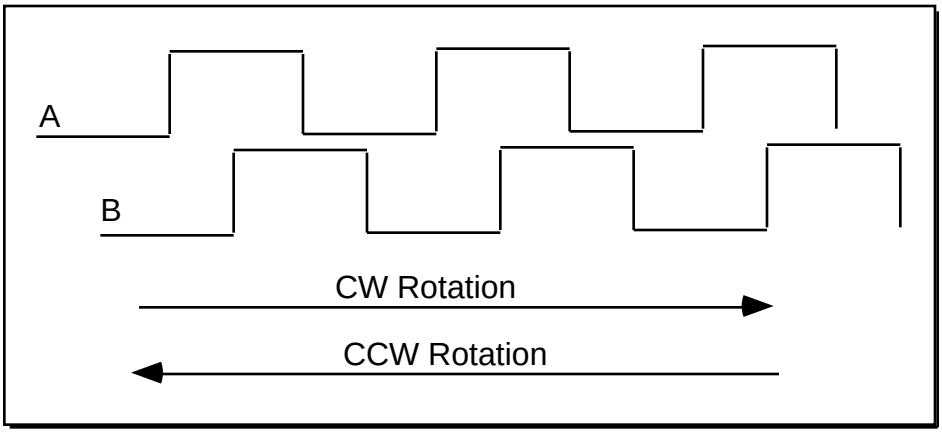
b) Under those conditions, in which direction is the current flowing in the 24Ω resistor? How much current flow?

c) What is the voltage at point Vc under those conditions?

d) How much current must be source or sunk at point Va to insure that all active transistors are in saturation? Indicate source/sink and magnitude.

e) How much current would flow in the 24Ω resistor if both Va and Vb were brought to 5V?

Problem #7 10 Points



You have been given a sensor that produces the two outputs, A & B as shown above. When turned Clockwise, it produces these two waveforms reading from left to right. When turned Counter-Clockwise, it produces these waveforms reading from right to left. You are to design a circuit to take these two inputs and produce a single output that will be high if the sensor is rotating Clockwise and low if it is rotating Counter-Clockwise.

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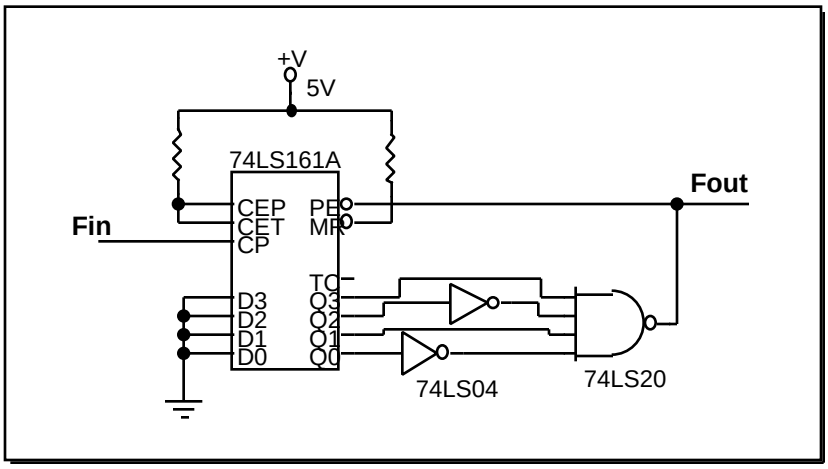
Problem #8 10 Points



In the circuit shown above, what is the maximum frequency of the Fin clock, and what is the frequency relationship, Fin:Fout?