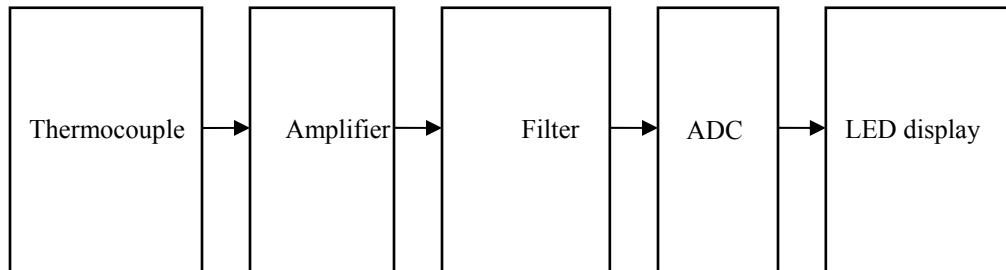


ELG4135: Quiz 3

Question 1 (5 marks)

The following figure shows an example of a measurement system. The thermocouple is a transducer that converts temperature to a small voltage; the amplifier increases the magnitude of the voltage; the filter allows certain band of frequency to move forward; the ADC (analog-to-digital converter) is a device that changes the analog signal to a coded digital signal; and the LEDs (light emitting diode) display the value of the temperature.



Part 1: Amplifier

The signal from the thermocouple needs to have its voltage amplified to a level of 4 V (rms). The impedance of the thermocouple is $R_s = 10 \text{ k}\Omega$ and the output voltage from the thermocouple is $v_s = 20 \text{ mV}$ (rms). Draw a non-inverting amplifier circuit to provide the needed gain. Find the appropriate values of the components.

Part 2: Low Pass Filter

A low pass filter is needed to attenuate the noise at high frequencies but still let through frequencies to the ADC. Draw the circuit diagram of the low pass filter. Design an active filter with an input impedance of $10\text{ k}\Omega$, cutoff frequency of 3 kHz , and a unity gain. Find the appropriate values of the components.

Part 3: ADC Circuit

If the full scale value of the analog voltage from the filter to 3-bit ADC is 4 V . What is the resolution of the output?

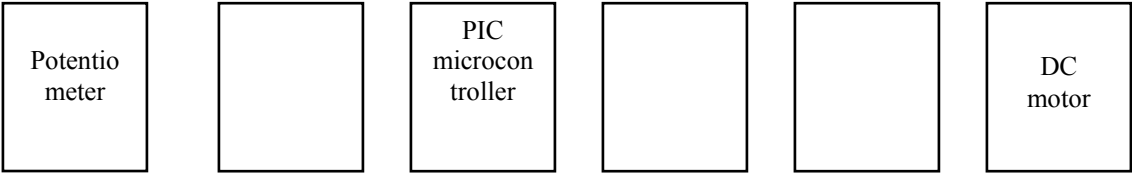
Question 2 (5 marks)

(a) Draw the circuit diagram of a 4-bit digital-to-analog converter (DAC) and determine the expression relating v_o to the binary input bits.

(b) Consider the above DAC, what value of R_F will give the output range of $-10\text{ V} \leq v_o \leq 0\text{ V}$?

Question 3 (Bonus 2 marks for the midterm)

The following functional diagram represents a DC motor op-amp speed controller (Power amp motor driver). Insert the name of the right devices inside the empty boxes. Provide the function and specifications of each device in the diagram.



Unit	Function and specifications
Potentiometer	
PIC microcontroller	
DC motor	