EE 337: Microprocessors Lab
Quiz 2

2nd October, 2016

The exam is for 3 hours. There are four parts and you have to attempt all of them. When you are done with a question (part), you have to demonstrate your solution to your RA and get it graded. You also have to give a copy of your code to the RA. Please do not leave the lab until you have done so.

Your code should be as clean and readable as possible. Use subroutines to break down the problem into sub-problems.

Question 1 [20 Marks]

Part A: Square wave generation [5 Marks]

Write a function called `gen_sig()` which generates a square wave of given frequency (specified in kHz) as output on one of the port pins (say, P3.0), using one of the timers of the AT89C5131A micro-controller.
    Verification: Demonstrate the output to your TA for the following frequencies:

1. 10 kHz

2. 20 kHz

3. 50 kHz

Part B: LCD interfacing [2 Marks]

Interface the 16×2 LCD display with the micro-controller on the Pt-51 board and write a function `lcd_disp()` to display "Hello" on the first line.
    Verification: Show this to your TA.

Part C: SPI and amplitude measurement [5 Marks]

Interface the MCP3008 ADC with the micro-controller on the Pt-51 board using the SPI protocol. Write a function `meas_peak()` that measures the peak value of a continuous sine signal, which has an offset of 2.5V and connected to CH0 of the ADC. The function has to display the following on the LCD display depending upon the peak value of the sinusoid.

- "Range 1" if the peak amplitude is less than 3.3V

- "Range 2" if the peak amplitude is greater than 3.3V

    Verification: Use the Function Generator to generate a sine wave in the frequency range of 1 kHz to 100 kHz, with an offset voltage of 2.5V, and Pk-Pk voltages as shown in Fig. 1. Apply this to CH0 of the ADC and observe that the LCD displays:
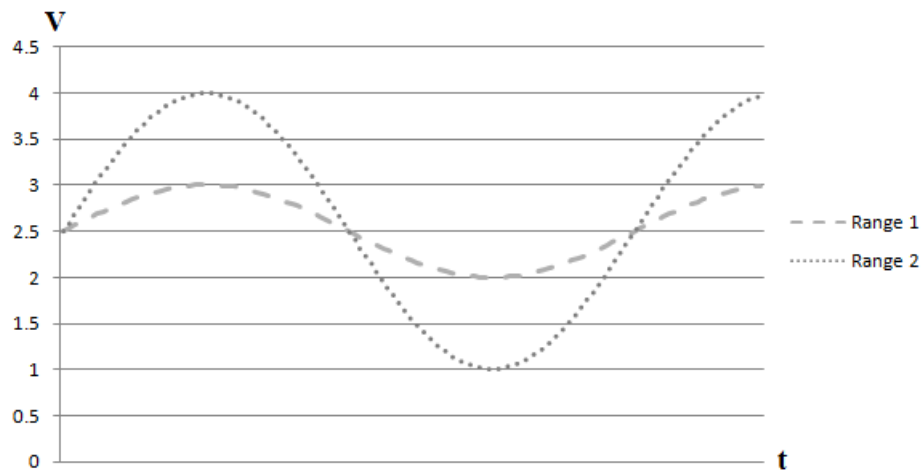
Figure 1: Input sinusoidal signals generated using the Function Generator, to verify your code for Part C.

- "Range 1" for an input sinusoid of amplitude 1V Pk-Pk

- "Range 2" for an input sinusoid of amplitude 3V Pk-Pk

Part D: Voltage-to-frequency conversion [8 Marks]

Using the function `gen_sig()` from Part A, write a program `amp_mod()` that generates a square signal whose frequency depends on the voltage measured by the ADC, as follows:

- 1 kHz if the voltage is between 0V to 1.66V

- 2 kHz if the voltage is between 1.67V to 3.33V

- 5 kHz if the voltage is between 3.34V to 5V

Verification: Use the Function Generator to generate a sine wave of frequency 100Hz which has an offset voltage of 2.5V and a Pk-Pk voltage of 3V (as shown in Fig. 2), apply it to CH0 of the ADC and observe the output for varying amplitudes, to verify your code.
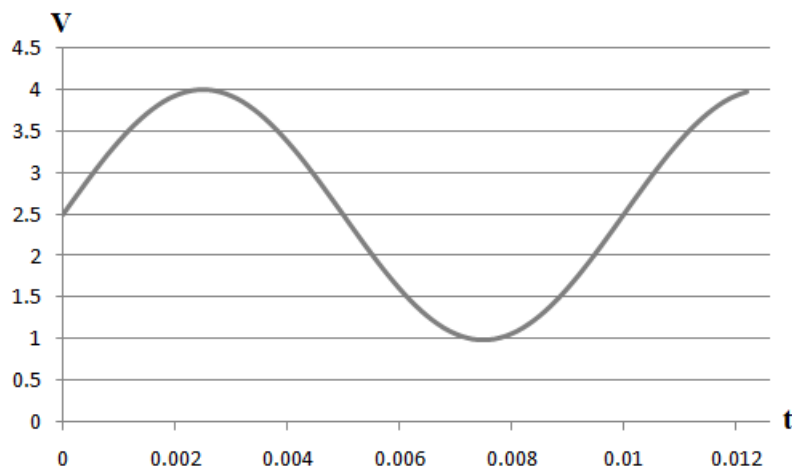

Figure 2: Input sinusoidal signal generated using the Function Generator, to verify your code for Part D.