

CPE 301 - MICROPROCESSOR SYSTEM DESIGN
Fall 2013

HOMEWORK No. 12 - DUE (beginning of class) November 26

NOTE: All programs must be handed in as printouts of Arduino Sketch files which have compiled without errors.

Read Chapter 9 in the textbook, then answer Questions 9.1 through 9.7 for HW12.

(The following question 9.1 has been **MODIFIED** from the textbook.)

9.1 Determine the appropriate bit settings for TCCR1A, TCCR1B, OCR1A, and TIMSK1 using the following specific details:

- use **NORMAL MODE**,
- disconnect both OC1 pins,
- use a pre-scale division of **AN APPROPRIATE VALUE**,
- use the **TIMER OVERFLOW FLAG** interrupt,
- use a **TIMER COUNT INITIAL** value such that you receive 1 interrupt per second.

9.2 Create a function that initializes timer 1 based on the values determined in problem 9.1.

9.3 Create an ISR for timer 1. (Look ahead at 9.7)

9.4 Determine the appropriate bit settings for PCICR and PCMSK2 using the following specific details:

- use Port D4 as an input pin,
- disable the internal pull-up resistor,
- using Port D4 corresponds to Pin Change interrupt 20.

9.5 Create a function that initializes the Pin Change interrupt based on the values determined in problem 9.4.

9.6 Create an ISR for Pin Change interrupt 20. (Look ahead at 9.7)

9.7 Create a program that utilizes the timer interrupt and the pin change interrupt in order to measure the frequency of a periodic signal on Port Pin D4. You can do this by saving and then clearing a counter each time the timer interrupt occurs (at a rate of once per second). Additionally, you can increment the counter by the number of low-to-high and high-to-low transitions on pin D4 with the pin change interrupt. Your main loop should monitor when the timer interrupt goes off, and then write the frequency to the serial port for the user to see. Note: your setup function should call your two initialization functions, and then enable global interrupts in the SREG register.

NOTE: The following Question 9.8 will be used for an EXTRA CREDIT LAB EC02 - it is NOT part of the HW12 assignment.

9.8 Connect a controllable signal generator source to port pin D4. Warning: you should calibrate the signal before connecting it to the Arduino. Do so by connecting the signal generator to an oscilloscope and verify you have a 0-5V source. Be sure to note the frequency. Use the program created in problem 9.7. Compare your output with that determined by the oscilloscope. Note: don't forget the pin change interrupt occurs on both rising and falling edges, so you will need to account for that in your output to the user.