

**ME 461 Prelab #2**  
**Fall 2016**  
**Due at the start of class on 09/14/2016**

**Suggested Reading:**

[Timer A chapter in MSP430x2xx user's guide.](#)

[Lab 2 manual.](#)

1. Solder the RC filter circuit connected to P4.4 needed for exercise 3. See the demo board for help. Use an R value of 10K $\Omega$  and a C value of 0.1 $\mu$ F. Demo board will not be ready until Thursday.

2. In your own words, explain the function of the following three lines of code.

```
// Timer A Config
TACCTL0 = CCIE;
TACCR0 = 32000;
TACTL = TASSEL_2 + MC_1 + ID_2;
```

Also, what is the resulting timer clock rate (assume SMCLK is running at 16MHz)? This is also the rate at which the Timer A interrupt service routine would be called.

3. Suppose Timer A is sourced from SMCLK running at 16MHz. Write what should be the contents of the TACCR0 register for generating the following Timer A ISR rates.

a. Period = 2ms

b. Period = 200 $\mu$ s

*Hint for c and d:* to achieve the following two rates you need to modify a second register due to TACCR0 being only a 16 bit register. What register and what needs to be changed?

c. Period = 6ms

d. Period = 20ms

4. Sketch a 10-kHz, 30% duty cycle PWM signal.

5. Assume that TACCTL1 = OUTMOD\_7 (reset/set). For each of the configurations in problem 3, write the contents of the TACCR1 register for generating PWM duty cycles of 15%, 30%, and 65%. Also write the carrier frequency of the PWM signal.

6. What are the two lines of code necessary to configure the P1.2 pin to be TA1? In other words, what pin can be either P1.2 or TA1 and what lines of code configure it as TA1?

7. Draw the schematic for an RC low pass filter. From the below list of resistors and capacitors, choose values for R and C that results in a cutoff frequency as close as possible to 150Hz. Show your work.

Resistors: 220  $\Omega$ , 470  $\Omega$ , 1 k $\Omega$ , 2.2 k $\Omega$ , 10 k $\Omega$ . Capacitors: 0.01  $\mu$ F, 0.022  $\mu$ F, 0.1  $\mu$ F, 1.5  $\mu$ F.

8. Assume you filtered a 10-kHz PWM signal through the circuit you designed above. Write a simple linear equation that relates output voltage to PWM duty cycle (ignoring the slight ripple) and compute the output voltage for duty cycles of 35%, 50%, and 85%. The PWM signal's low is ground (0V) and its high is 3.3V.