

## Homework Assignment #4

Due: **April 18, 2019, before midnight**

1. **(40 pt)** Assume that there is an external sensor device. The device has a UART interface to receive and send its sensor data. The device expects 1200 Baud Rate.
  - a. **(10 pt)** You are supposed to use your PIC24 microcontroller to communicate with the sensor device. Find the correct U1BRG value and the Baud rate error (in %). Assume that the microcontroller runs at 16 MHz and BRGH = 0.

$$\begin{aligned}UxBRG &= (16\text{MHz}/(16*1200))-1 = 832.333 \\ \text{Baud Rate} &= 16\text{MHz}/(16*(832+1)) = 1200.48 \\ |1200.48-1200|/1200 &= 0.04\%\end{aligned}$$

- b. **(10 pt)** Find the correct U1BRG value and the Baud rate error (in %) if your microcontroller runs at 12 MHz and BRGH = 0.

$$\begin{aligned}UxBRG &= (12\text{MHz}/(16*1200))-1 = 624 \\ \text{Baud Rate} &= 12\text{MHz}/(16*(624+1)) = 1200 \\ |1200-1200|/1200 &= 0\%\end{aligned}$$

- c. **(20 pt)** Briefly discuss the Baud rate error of the aforementioned cases. Is the error critical for UART communication? Briefly explain why.

The error is not critical in a UART communication, it's in the name Universal Asynchronous Receiver/Transmitter, the key word being Asynchronous. Because the communications reset with each start bit, the error doesn't matter.

2. **(60 pt)** Caesar Cipher is a simple way to encrypt a sequence of characters. For details about Caesar Cipher, please read carefully [here](#). Implement a C program using the UART of PIC24 microcontroller that decrypts the following encrypted text

QEB NRFZH YOLTK CLU GRJMP LSBO QEB IXWV ALD

to the original text

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG

Reuse the code of Discussion 8 (`disc08_UART.c`) and use the provided UART input file (`hw4_uart_caesar_cipher_in.txt`). As we did in Discussion 8, you will need to simulate the UART stimulus and write to the UART 1 Output window.

- a. **(40 pt)** Submit your source code (filename: `hw4_uart_caesar_cipher_(your x500 id).c`) and the screen capture of the UART 1 Output window displaying the deciphered original text (filename: `hw4_uart_caesar_cipher_(your x500 id).[jpg | png]`).
- b. **(20 pt)** Briefly describe how your program decrypts the input.

We are using a cipher of 3, which means that three needs to be added to each character, except for the last three characters, in which case 26-3, or 23, must be subtracted, as ASCII is not a circle. Also, we only want to decrypt the characters, (which are all capital letters), and so the code is done with if statements, in such a way that if the if statements do not apply the code just keeps whatever is in the character being looked at. This code of course uses the PGetch and PPutch functions from discussion 8 to handle UART communications.