Version 1 Student ID: _____

Department of Electrical and Software Engineering

Schulich School of Engineering

ENCM 511: Embedded Systems Interfacing

MIDTERM TEST II SAMPLER SET

NOTE: This document provides an example of the "style" of questions, but does not reflect the number of questions to be asked in the mid-term test.

Notes:

- Answer ALL questions.
- Show ALL working.
- This is a closed-book test.
- You are allowed to use an approved calculator.
- Write your ID number on every page.
- Poorly presented answers, while otherwise correct, may not score full marks.
- State any assumptions you make, especially as needed to clarify your answers.
- Part marks may be awarded.
- Time Allowed: 1 hour and 10 minutes.

EXAMPLES FOR QUESTION ONE

(a) Should interrupt service routines include function calls? Why/Why not? What can go wrong if ISRs are poorly designed?

Hint: Lecture 7/8 and discussions

(b) Write the C code for an interrupt service routine (ISR) for the CN interrupt that sets a global variable `int16_t button_release` only when a push button connected to RA4 (PB2) is pushed. Assume that we have push buttons connected to RA4 (PB2) and RA2 (PB1) and that both these digital input ports are configured to trigger CN interrupts. You may assume that the correct configuration bits have already been set to enable the CN interrupts and internal pull-ups, as per our driver project hardware setup. Comment your code meaningfully.

Global #defines (You can add more if you wish):

```
#define PB1 PORTAbits.RA2
#define PB2 PORTAbits.RA4
```

Global Variables (You can add more if you wish):

```
uint16_t button_release;
uint16_t button_state;
```

Code:

```
void __attribute__((interrupt, no_auto_psv)) _CNInterrupt(void) {









}
```

(c) Explain the differences between a “power-saving super loop” and a regular “super loop”. How do these approaches compare regarding real-time characteristics?

Hint: Lecture 11 and discussions

EXAMPLES FOR QUESTION TWO

(a) When we talk about microcontrollers and communication protocols, we often use terms like "synchronous", "baud rate", "parity" and others. What do each of these terms mean?

Hint: Lecture 9 and discussions

(b) Write the C code required to set a baud rate of 4800 in the UART2 module in our PIC microcontroller, given that we are using an 8 MHz system oscillator.

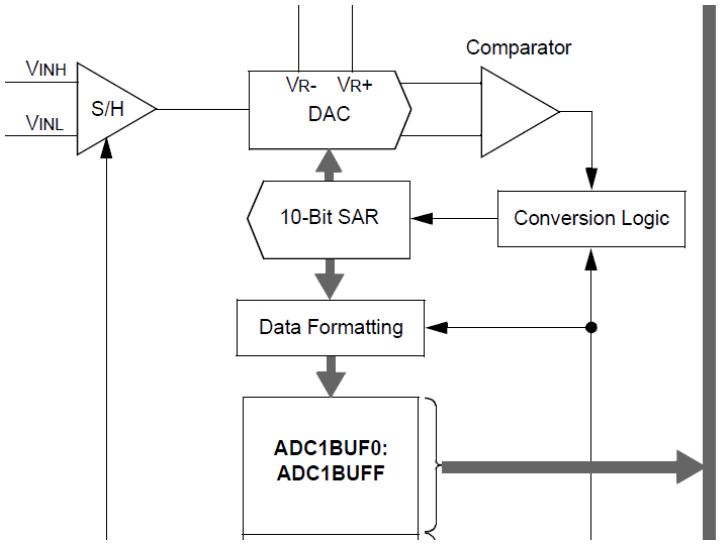
Hint: Lecture 9 and discussions, Datasheet chapter 18

EXAMPLES FOR QUESTION THREE

(a) What is the meaning of the "**resolution**" of an ADC?

Hint: Lecture 10 and discussions

(b) Consider the block diagram of the ADC in our PIC microcontroller:



How is each of these components used in the process of successive-approximation-based ADC? What is successive-approximation? How does it work?

Hint: Lecture 10 and discussions

(c) What is meant by **parallelism**? Is it different from concurrency? If so, how?

Hint: Lecture 11 and discussions

(d) Real-time operating systems (RTOSs) can be used in complex embedded system designs. What features do typical RTOSs provide? Explain.

Hint: Lecture 11 and discussions