ECE 376 - Test #3: Name _____

Spring 2025. Open-Book, Open Note.

1) Edge Interrupts: Write a C program which uses edge interrupts for a game show:

- When button C is pressed, the lights on PORTC and PORTD are turned off in the main loop
- When button A is pressed,
  - If PORTD is off, the lights on PORTC turn on (A buzzed in first)
  - If PORTD is on, the lights on PORTC remain off
- When button B is pressed,
  - If PORTC is off, the lights on PORTD turn on (B buzzed in first)
  - If PORTC is on, the lights on PORTD remain off

Specify the interrupts used and their initialization.

Button C pin used	Button A Pin Used, Interrupt Used, Set-Up (rising/falling0	Button B Pin Used, Interrupt Used, Set-Up (rising/falling0

Specify the interrupt service routines (or main routine if using that for Button C)

Main Loop	Button A interrupt	Button B interrupt

2) Timer Interrupts: Write a C program which uses timer interrupts for a game show:

- Timer2 is set up to interrupt every N clocks
  - N = 10,000 + 1000 * birth month (1..12) + 100 * birthday (1..31)
  - Example: May 12th would result in N = 10,000 + 5*1000 + 12*100 = 16,200
- Every Timer2 interrupt, it checks three buttons
  - Player A: RB0
  - Player B: RB1
  - Reset: RB7
- If RB7 is pressed lights on PORTC and PORTD are turned off
- If RB0 is pressed (player A)
  - If PORTD is off, the lights on PORTC are turned on (A buzzed in first)
  - Otherwise, the lights on PORTC remain off
- If RB1 is pressed (player B)
  - If PORTC is off, the lights on PORTD are turned on (B buzzed in first)
  - Otherwise the lights on PORTD remain off

Intialization: Specify A/B/C for Timer2

N # clocks between interrupts 10,000 + 1000 * birth month + 100 * birth day	A, B, C Timer2 Initialization

Specify the main routine and the Timer2 interrupt service routine

Main Routine	Timer2 Interrupt Service Routine

3) Capture Interrupts: Use Timer1 Capture interrupts for a game show.

- When button C is pressed,
  - PORTC and PORTD are turned off and
  - A's time and B's time are set to zero (default)
- When button A is pressed,
  - The time buton A was pressed is recorded as a 32-bit time accurate to 100ns (one clock)
  - If A's time is less than B's time, the lights on PORTC are turned on (A buzzed in first)
  - If A's time is more than B's time, the lights on PORTC remain off
- When button B is pressed,
  - The time button B was pressed is recorded as a 32-bit time accurate to 100ns (one clock)
  - If B's time is less than A's time, the lights on PORTD are turned on (B buzzed in first)
  - If B's time is more than A's time, the lights on PORTD remain off

Specify the initialization for each interrupt used

Timer1 pre-scalar	Capture 1 rising / falling / 4th rising / 16h rising	Capture 2 rising / falling / 4th rising / 16h rising

Specify the main routine and the interrupt service routines

Main Loop	Timer1	Capture 1	Capture 2
`while(1) {`	`if (TMR1IF) {`	`if (CCP1IF) {`	`if (CCP2IF) {`

4) Digital Filter Design: Assume X and Y are related by the following transfer function:

$$Y = \left(\frac{7(s+40)}{(s+2)(s+D)(s+M)} \right) X = G(s) \cdot X$$

where D is your birthday (1..31) and M is your birth month (1..12). Give the transfer function of a digital filter which has the same time & frequency response as G(s).

- Assume a sampling rate of 15ms (T = 0.015)