

ECE 376 - Homework #9

Timer 0/1/2/3 Interrupts. Due Monday, November 6th
Please email to jacob.glower@ndsu.edu, or submit as a hard copy, or submit on BlackBoard

1) Write a C routine using Timer0 interrupts to measure time to 100ns. Using this routine, determine how long a the following operations in C take:

a) LCD display routine

```
long int A;  
A = 3141592654;  
LCD_Out(A, 10, 9);    // time to execute this instruction
```

b) The time it takes you to enter the code 073120 on PORTB

```
TRISB = 0xFF;  
while(!RB0);           // start  
while(!RB7);  
while(!RB3);  
while(!RB1);  
while(!RB2);  
while(!RB0);           // end
```

c) The time it takes you to press RB0, RB1, then RB2 three times

```
TRISB = 0xFF;  
for(i=0; i<3; i++) {    // start  
    while(!RB0);  
    while(!RB1);  
    while(!RB2);  
    while(PORTB);        // release buttons  
}                          // end
```

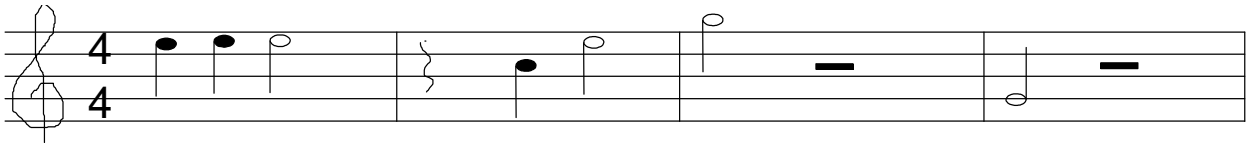
2) Write a C routine using Timer0 / Timer1 / Timer2 / Timer3 interrupts to play 4 notes at the same time when you press button RB0.. RB3 at the same time (each note plays if its input button is pressed)

Input Pin	RB0	RB1	RB2	RB3
Output Pin	RC0	RC1	RC2	RC3
Note	A4	B4	C5	D5
Frequency (Hz)	440.00 Hz	493.88 Hz	523.25 Hz	587.33 Hz
Interrupt	Timer0	Timer1	Timer2	Timer3

Music Box

Write a program to play the first four frames of Super Mario Brothers:

- The tune starts when you press RB0
- Timer1: Sets the frequency of each note
- Timer2: Measures time in ms and sets the duration of each note
- Each note plays for (ms - 30) then is quiet for the last 30ms



#	1	2	3	4	5	6	7	8	9	10
note	E4	E4	E4	-	C4	E4	G4	-	G3	-
Hz										
beats	1/4	1/4	2/4	1/4	1/4	1/2	1/2	1/2	1/2	1/2
ms	200	200	400	200	200	200	200	200	200	600

3) Give a flow chart for your program and interrupt service routines.

4) Write the corresponding C program

5) Verify the

- Frequency of the notes, and
- The duration of the notes

6) Demo (20 points);