0907333 Embedded Systems (Fall 2011)

Quiz 2 Solution

الاسم: رقم التسجيل: رقم الشعبة: 3

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Instructions: Time **10** minutes. Closed books and notes. No calculators. Please answer all problems in the space provided. **No questions are allowed**.

<Good Luck>

Q1. Assuming that the PIC 16F84A operates on a processor clock of 4 MHz, write the initialization code needed to set Timer TMR0 (at address 01h) to generate an interrupt every 10 ms. The Registers INTCON (at address 0bh) and OPTION_REG (at address 81h) are shown below. You need to write the code needed to initialize these three registers properly.

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-x
GIE	EEIE	T0IE	INTE	RBIE	T0IF	INTF	RBIF
bit 7							bit 0

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
RBPU	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0
bit 7							bit 0

bit 7 **$\overline{\text{RBPU}}$**: PORTB Pull-up Enable bit
1 = PORTB pull-ups are disabled
0 = PORTB pull-ups are enabled by individual port latch values

bit 6 **INTEDG**: Interrupt Edge Select bit
1 = Interrupt on rising edge of RB0/INT pin
0 = Interrupt on falling edge of RB0/INT pin

bit 5 **T0CS**: TMR0 Clock Source Select bit
1 = Transition on RA4/T0CKI pin
0 = Internal instruction cycle clock (CLKOUT)

bit 4 **T0SE**: TMR0 Source Edge Select bit
1 = Increment on high-to-low transition on RA4/T0CKI pin
0 = Increment on low-to-high transition on RA4/T0CKI pin

bit 3 **PSA**: Prescaler Assignment bit
1 = Prescaler is assigned to the WDT
0 = Prescaler is assigned to the Timer0 module

bit 2-0 **PS2:PS0**: Prescaler Rate Select bits

Bit Value	TMR0 Rate	WDT Rate
000	1 : 2	1 : 1
001	1 : 4	1 : 2
010	1 : 8	1 : 4
011	1 : 16	1 : 8
100	1 : 32	1 : 16
101	1 : 64	1 : 32
110	1 : 128	1 : 64
111	1 : 256	1 : 128

Instruction clock = 4 MHz / 4 = 1 MHz
Instruction cycle = 1 / 1 MHz = 1 µs
10 ms / 1 µs = 10,000 cycles, this number is larger than 256.
If 10,000 is divided by 64, we get 156 which is less than 256.
256 – 156 = 100 which is the initial number of TMR0.

```
start bsf status,5    ;select memory bank 1

movlw B'00000101'     ;set up T0 for internal input, prescale=64
movwf option_reg

bcf   status,rp0      ;select bank 0

movlw D'100'          ;preload T0, so that 156 cycles to overflow
movwf TMR0

bsf   intcon,inte     ;enable external interrupt
bsf   intcon,gie      ;enable global int
```