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Birzeit University - Faculty of Information Technology
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Real-Time Applications and Embedded Systems

Instructor: Dr. Ahmad Afaneh

Q1. Write a function (not a full program) in PIC assembly to perform the following task (35 points)

Write a function to decide if the value in W is divisible by 3 the function should set the carry flag in the status register to 0 if W is divisible by 3 otherwise set the carry flag to 1.

Example 1

W 00001001

C X

W 00001001

C 0

Example 2

W 00001101

C X

W 00001101

C 1

Before

After calling the function

Num2 equ 3

```

div   CIRF   Result, Result; calculated
      movf   Num2, W ; Num2 = 3
      bcf   Status, C ; set C flag
subl  INCF   Result ; count loop start
      subwf Num1 ; Num1 = 30
      btfss Status, Z ; exact ans?
      goto no
      goto yes; show results
neg   btfsc  Status, C
      goto subl
      decf  Result
      movf  Num2, W
      addwf Num1
      movf  Result, W
      addlw 030
      bsf  Select, RS ; Reg select output bit
      movlw 1

```

```

      btfsc Status, Z ; check remainder if equal zero
      goto Set1

```

30

```

      bcf Status, C ; if yes clear carry

```

```

Set1:
      bsf Status, C ; no set carry.

```

```


      movlw 1
      cirf Mod ; into low digit store
      bsf Status, Z ; high digit = 0
      movlw D'10' ; load 10
      ; Mod most sig bit
      ; 10 least sig bit
      endd;


```

```

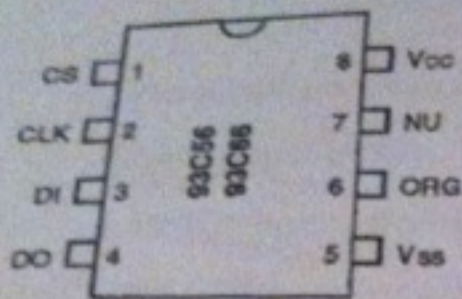
      movf Num1, W ; Remainder
      show

```

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Q2. Write a function to perform the write operation on the 93C56 - Serial EEPROM (40 points)



Name	Function
CS	Chip Select
CLK	Serial Data Clock
DI	Serial Data Input
DO	Serial Data Output
Vss	Ground
ORG	Memory Array Organization
Test	Connect to Vss or Vcc
Vcc	Power Supply +5V

30

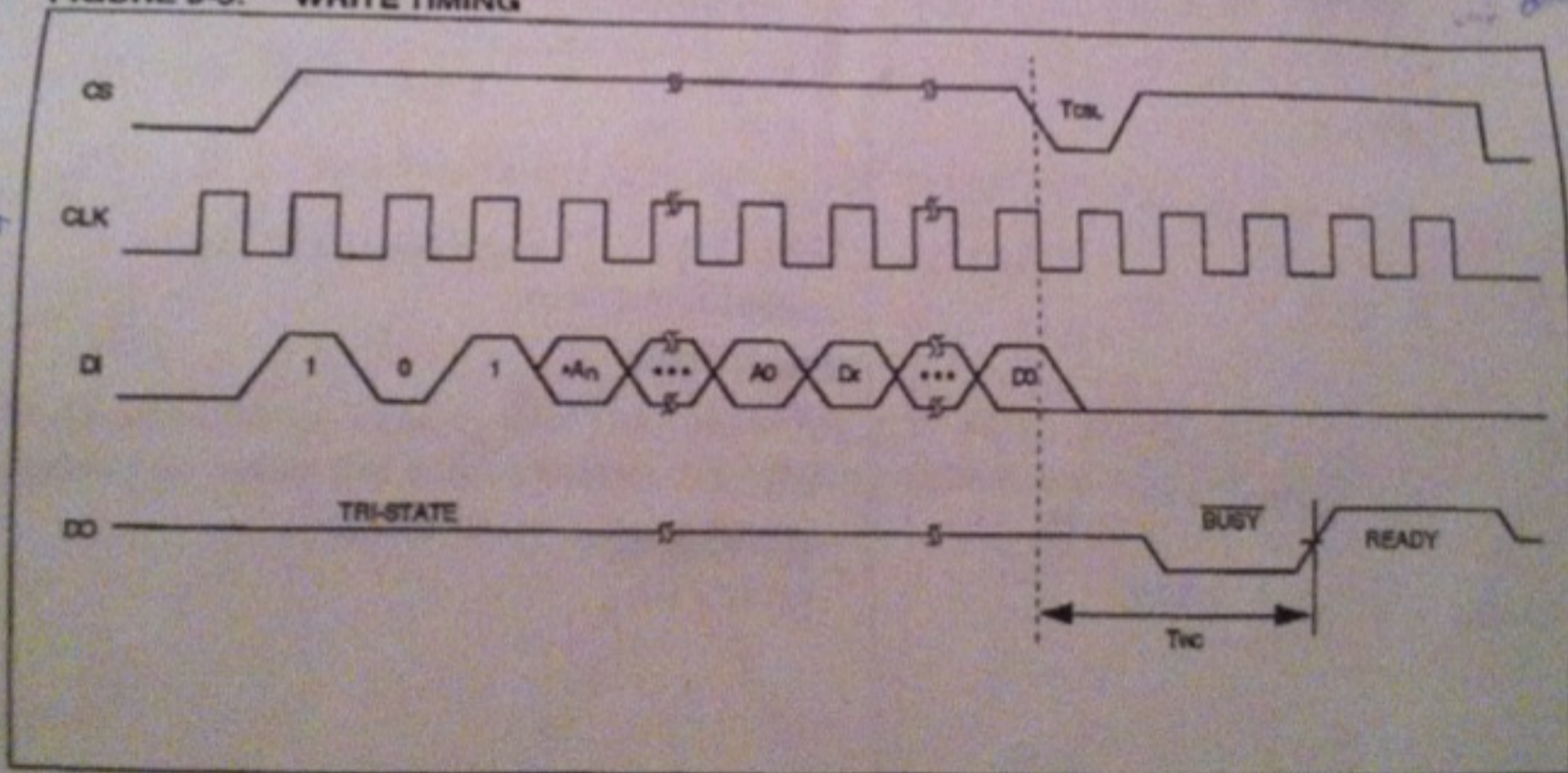
The EEPROM has a 3-wire Serial Interface. In order to control the EEPROM the cs, clk, Di, Do should be connected to the PIC (CS -> C0, CLK -> C1, Di -> C2, Do -> C3). In order to perform the write operation according to the timing diagram the write operation consist of the following

1. CS is set to 1
2. On each rising edge of the clock one bit of the sequence is set on DI
3. Then CS is set to 0 before the next rising edge
4. The function waits for Do to be 1 indicating the write operation is successful

C3 C2 C1 C0
1 0 0 0
08

The sequence for the write operation is 101<8 bit address A7 to A0><8 bit data D7 to D0>

FIGURE 9-5: WRITE TIMING



Write a function to write the value in W at the address 0x00 of the EEPROM

Processor 16F877
 -CONFIG 0x323
 INCLUDE "16F877A.INC"

Counter eq 0
 dk eq 0
 C1 eq 0
 C3 eq 0

ORG 0
 Goto Main

ORG 4
 Goto Main

Main:

BANKSEL TRISC
 MOVLW B'00001000'
 MOVWF TRISC

~~Bank~~ BANKSEL PORTC
 MOVLW B'00000001' ; C5=1
 MOVWF PORTC

Call Delay
 COMF CLK ; Complement the clock
 BTFSS Status, Z ; if clear

→ NOP

MOVLW B'00000011' ; rising edge of the clock
 MOVWF PORTC

BANKSEL TRISD
 CIRF TRISD ; output
 BANKSEL PORTD ?

movwf counter, w
 INCF counter → movwf D'10'
 goto G01 call movwf C3
 movwf PORTC, 2 DECF C3

G01:
 movwf counter, w
 ADDWF PCL, w

RETLW 1
 RETLW 0
 RETLW 1
 RETLW A9
 RETLW AB
 RETLW AC
 RETLW AD
 RETLW AE
 RETLW AF
 RETLW 90
 RETLW D3
 RETLW D6
 RETLW D6
 RETLW D4
 RETLW D3
 RETLW D2
 RETLW D1
 RETLW D0

X
 you should not assume address & data are static

Delays:
 movlw OFF
 movwf C1

loop:
 DECF C1, C1
 goto loop

Return

Call Delay
 COMF CLK
 CIRF PORTC, 1
 call delay
~~COMF CLK~~
~~movwf C3, C3~~
 BTFSS Status, Z
~~goto G02~~
 goto Ping

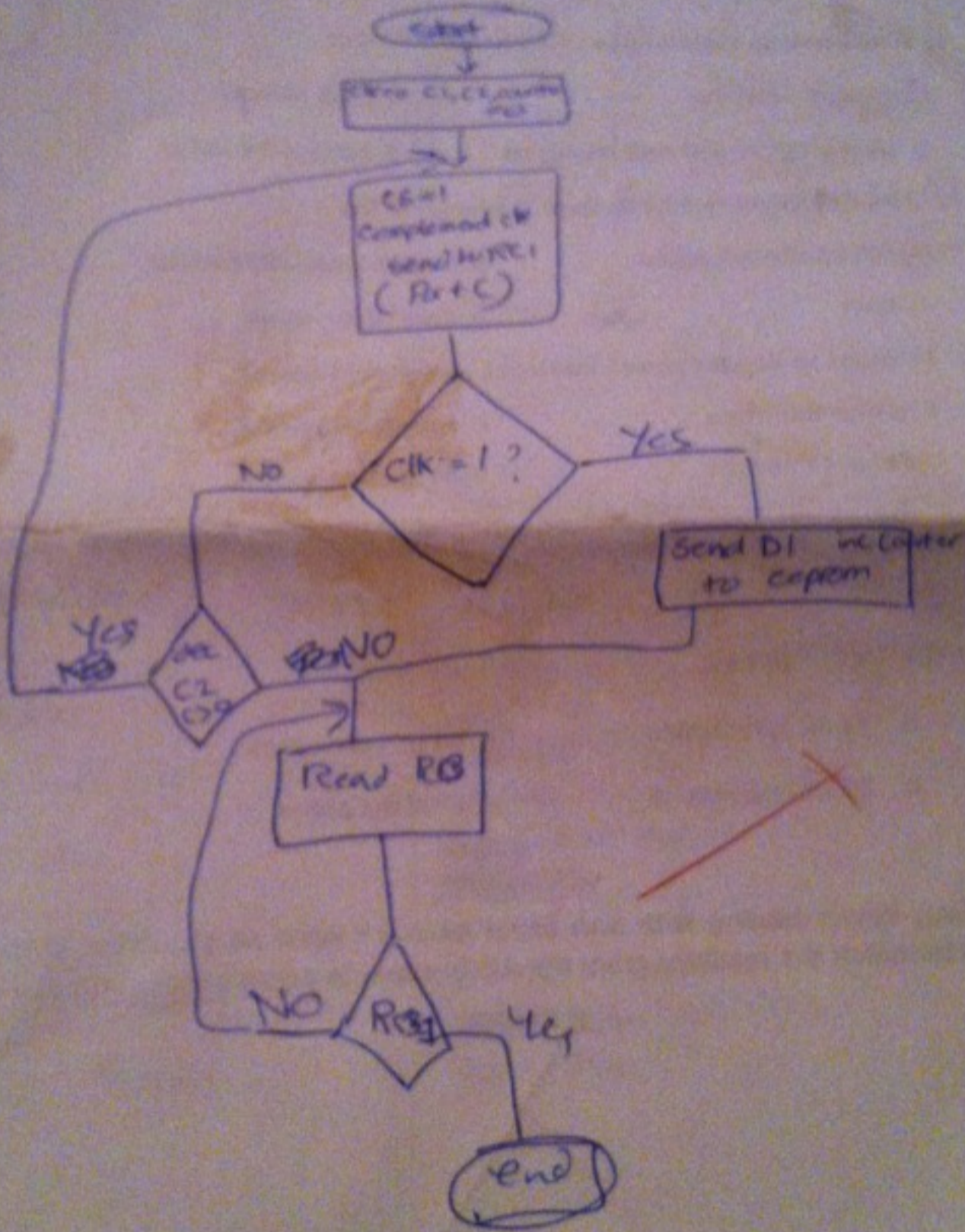
⇒
 call delay
 Ping

for
micro R03, w
BTFSS R03

goto ~~for~~

Call OR; Ready

OK =
Return
end;



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Q3. Select the most correct answer. Write down your final answers in the following table.
(25 points)

1	2	3	4	5
a	a	d	a	b

25

1) The Look up table can be used to store data in

- a. program memory
- b. data memory
- c. both program and data memories
- d. none of the above

2) The PIC memory architecture is based on the

- a. Harvard Architecture
- b. Von-Neuman Architecture
- c. both
- d. none of the above

3) In order to enable timer1 interrupt you should enable

- a. global interrupts
- b. peripheral interrupt
- c. Timer1 interrupt
- d. All of the above

4) If the external oscillator frequency is 4MHz most instructions on average will need

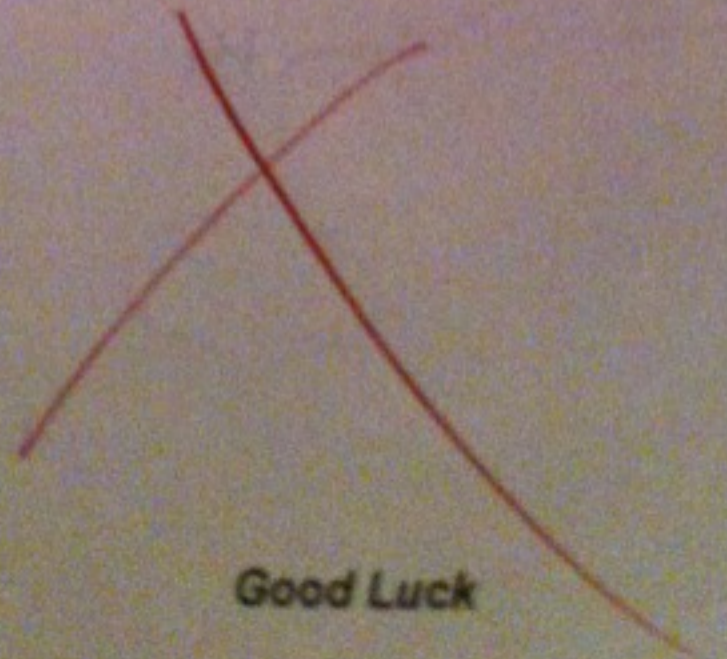
- a. 1 us
- b. 4 us
- c. 0.25 us
- d. 2 s

$\frac{1}{4} \rightarrow 1 \mu \rightarrow 1 \mu s$

5) The 16f877 uses a

- a. 12 bit instructions
- b. 14 bit instructions
- c. 16 bit instructions
- d. all of the above

Q4.(Bonus) When dealing with non linear sensor? What do you think is the best way (fastest) to match the readings from the ADC output to actual sensor output. (15 points)



Good Luck