TA

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UNC Charlotte–ECGR4101/5101-Midterm Exam –10/14/09

Multiple Choice - Questions 1-10: Each of these multiple choice questions is worth 4 points for a correct answer, 0 points for an incorrect answer. Circle your answers on the bubble sheet.

1) Which of the following fully describes the outcome of the code at the right?
   a. Add all the numbers from 0 to 100 and put the result in sum.
   b. Add all the odd numbers from 0 to 100 and put the result in sum.
   c. Add all the even numbers from 0 to 100 and put the result in sum.
   d. Add all the odd numbers from N to 100 and put the result in sum.
   e. Add all the even numbers from N to 100 and put the result in sum.

```
int i,sum;
sum = 0;
i = 0;

for(i=N;i<100;i++){
  if((i % 2))
    sum += i;
}
```

2) MCU can run in three modes: single chip, memory expansion, microprocessor modes. If used in single-chip mode what areas in memory could be addressed.
   a. Only internal areas (SFR, internal RAM, internal ROM)
   b. Internal areas (SFR, internal RAM, internal ROM) and external memory areas
   c. SFR, internal RAM and external memory
   d. SFR, external memory
   e. Only external memory

3) What is the number of address bits required to address any byte in a memory that contains 65536 bytes?
   a. 2   b. 8   c. 12   d. 16   e. 20

4) If I used the MCU30262 instruction 'enter #2' at the beginning of a function, how many bytes does the corresponding 'exitd' instruction deallocate from the stack if no other enter, exitd, jsr, pop or push operations are performed within the function?
   a. 6   b. 7   c. 8   d. 9   e. 10

5) Which assembly language code below adds the value of global variable shoe to the value in R1 and stores the result in R1:
   a. add.w shoe, R1
   b. add.w R1, shoe
   c. add _shoe, R1
   d. add.w _shoe, R1
   e. add shoe + R1

6) How far apart in time can two interrupts be and still be considered as simultaneous (assume a 16 MHz clock)?
   a. 92 ns
   b. 62.5 ns
   c. 50 ns
   d. 40 ps
   e. None of the above

Consider the piece of C-code to the right for questions 7 and 8:

7) How is the char b in the code passed to the function choosechar(a,b)?
   a. Stack   d. R1H
   b. R1L   e. R2
   c. R1   f. None of the above

8) How is the int d passed in the function dothemath(c,d)?
   a. Stack   d. R1H
   b. R1L   e. R2
   c. R1   f. None of the above

```
main(){
    char a = 'x';
    char b = 'a';
    char new;
    int d = 5;
    float c = 3.14;
    float result;

    new = choosechar(a,b);
    result = dothemath(c,d);
}
```

9) The double word 0x AC35 FA34 is stored in memory addresses N through N+3. Which of the following represents storage using big endianness?

a.

N	43
N+1	AF
N+2	53
N+3	CA

c.

N	AC
N+1	35
N+2	FA
N+3	34

e.

N	34
N+1	FA
N+2	35
N+3	AC

b.

N	FA
N+1	34
N+2	AC
N+3	35

d.

N	FA
N+1	34
N+2	AC
N+3	35

10) According the ECGR4101/5101 programming standards, which of the following should be included in the header of a subroutine?
   a. Subroutine name
   b. Assumptions
   c. Inputs/Outputs
   d. Interfaces
   e. All of the above

Short Answer

11) You have several 1Ahr 1.2V batteries and a LED that has an average drain of 3.5mA at 4.8V.
   a. Draw the configuration of the minimum number of batteries needed to light the LED.(2 points)
   b. With your battery configuration how long would the LED stay lit? (3 points)

12) Given the following information of a particular analog to digital converter, determine the value of the digitally represented voltage and the step size of the converter. (10 points)
   - The device is a 10-bit ADC with a + reference voltage of 3.3 volts and a – reference voltage of -0 volts.
   - The digital representation is: 0100110010.

13) What are the benefits of a microprocessor/microcontroller-based embedded system over an FPGA-based embedded system? (10 points) (in three to five sentences)

14) Can you, the user, store a value at memory location 00CBCh? Why or why not? (5 points)

15) Write the code to set up an A/D conversion for the first four channels of P2, 10-bit sample-and-hold, one shot and store the data in four variables (unsigned *int sample0, sample1, sample2, sample3*). Include all set-up bytes needed. If you use any .h files, tell me which ones you use. (25 points)

16) A) Imagine you have an embedded system that uses your QSK board. The system will:
   - Req. 1: Use the C programming language.
   - Req. 2: Continually poll SW1. While it is pressed, light the LED1.
   - Req. 3: Continually poll SW2. While it is pressed, light the LED2.
   - Req. 4: Continually poll SW3. While it is pressed, light the LED3.
   - Req. 5: Two or three LEDs can be lit at the same time.
   - Req. 6: Continually have an ISR put an analog value on Port 0, bit 0 put it in the variable *printme*.
   - Req. 7: Continually print the value in *printme* on the LCD.
   - Req. 8: You may not use any string libraries.
   - Req. 9: Include a few comments, including headers.

   Identify the "architecture" of this problem, dividing he work into appropriate functions. Substantiate your design decisions. (20 points)

   B) Write the algorithms (general steps) which implements the above functionality of all functions. (35 points)

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11 a) Need to get up to 4.8v from 1.2v cells
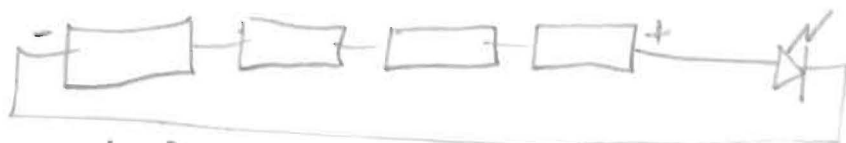
2pts
all or nothing

No need for a "doable bank" – I did not ask for a certain draw

11 b)   1 Ahr / 0.0035 A = 285.7 hr (11.9 days)

3pts all or nothing

12)   step size = $3.3v / 2^{10}$ = 3.22 mv

5 points
3 for concept
2 for correct answer

number 0100110010 = 306_{10}

306 * 3.22 mv = 0.985 v ± 0.005 v

5 points
3 for concept
2 for correct answer

13)   Notes, p1-11

Pros of Microcontroller-based system:
   Unit cost, Power Consumption
everything else is about the same or better on an FPGA

10 points
list two points correctly

14)   RAM Range x0400 to x7FFF, but
x07F7F to x07FFF is reserved.
Therefore xCBC is well within the allowed range of RAM

5 points,
all or nothing

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15) To do this:
  * Set up control registers
  * start single sweep
  * read each reg

Notes a "one shot" for several pins is a sweep —
— 8 if you did four one shots of individual pins

So

$$ADCONO = 0x B0;$$
$$or$$
$$0x 30$$

5 pts

```
/* CH0 = 0  ]
   CH1 = 0  ] Not used
   CH2 = 0  ]
   MD0 = 0  ]
   MD1 = 1  ] Single sweep
   TRG = 1
   ADST = 0  Not yet!
   CKS0 = any        */
```

$$ADCON1 = 0x 29;$$
$$or$$
$$0x 39$$

5 pts

```
/* SCAN0 = 1  ] AN0 to AN3
   SCAN1 = 0  ]
   MD2 = 0
   BITS = 1    10 bits
   CKS1 = any (0 or 1)
   VCUT = 1    Connect
   OPA0 = 0
   OPA1 = 0          */
```

$$ADCON 2 = 0x07;$$
$$or$$
$$0x17$$

5 pts

```
/* SMP =     1 = Sample/hold
   ADGSEL0 = 1 = Port2
   ADGSEL1 = 1
   b3      = 0
   CKS2    = any (0 or 1)
   b5      = 0
   b6        0
   b7        0          */
```

/ Now convert

10 pts
```
ADST = 1;
sample0 = AD0 & 0x03ff;
sample1 = AD1 & 0x03ff;
sample2 = AD2 & 0x03ff;
sample3 = AD3 & 0x03ff;
```

Setup SW&LED	Set up ADC	ADC-ISR	Convert_Value

Will run once
Sets up
direction
of SW &
LEDs

Set up ADC
to read
Correct port
and continuously
read

Reads ADC
register into
global var

Converts value
binary value
to ASCII value

Architecture - 4 pts each

Problem 16

Main

checks the
SW and
Converts value
and displays

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NOTE → I NEVER asked for code for this problem

```
// Setup_SW_LED
// Sets up SW as inputs, LEDs as output, turns LEDs off
    Set switches as inputs                          5 pts
    Set LEDs as outputs
    Turn off LEDs


// Setup_ADC
// Set up ADC to read bit 0 off port 0, continually read
    Configure ADCON0                                5 pts
    Configure ADCON1
    Configure ADCON2


// ADC-ISR
// Read bit 0 & save                                5 pts

    printme = ad0 & 0X03FF


// Convert value
// Convert the value to an ASCII string
    Convert thousands
    Convert hundreds                                10 pts
    Convert tens
    Convert ones
    display


// main
    setup-SW-LED                                    10 pts
    setup-ADC
    start ADC
    while (1) {
        if sw1 pressed, light LED1, else turn off LED1    These
        if sw2 pressed, light LED2, else turn off LED2    must allow
        if sw3 pressed, light LED3, else turn off LED3    all to
        Convert value                                      light
    }
```