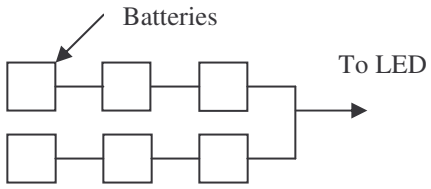
UNC Charlotte–ECGR4101/5101-Midterm Exam –10/8/08

Name: _____**Solution**_____ Mosaic User ID _____

Question	1	2	3	4	5	6	7	Total
Score	/5	/10	/10	/15	/10	/40	/60	/150

1. You have several 200mAh 1.5V batteries and a LED that has an average drain of 3.5mA at 4.5V. If you had the following battery configuration how long would the LED stay lit? (5 points)
Total: 400mAhr at 4.5v, 400mAhr/3.5mA = 114.3 hr
3pts for formula, 2 pts correct answer



2. Show how the C array **int a[5][3];**is laid out in memory for our Renesas board and compiler. Remember to pay attention to endianness, indicating which byte is located where. (10 points)

Address	Array Element	Which byte?
a	*a[0][0]*	*LSB*
a+1	*a[0][0]*	*MSB*
a+2	*a[0][1]*	*LSB*
a+3	*a[0][1]*	*MSB*
a+4	*a[0][2]*	*LSB*
a+5	*a[0][2]*	*MSB*
a+6	*a[1][0]*	*LSB*
a+7	*a[1][0]*	*MSB*
a+8	*a[1][1]*	*LSB*
a+9	*a[1][1]*	*MSB*
a+10	*a[1][2]*	*LSB*
a+11	*a[1][2]*	*MSB*
a+12	*a[2][0]*	*LSB*
a+13	*a[2][0]*	*MSB*
a+14	*a[2][1]*	*LSB*
a+15	*a[2][1]*	*MSB*

Address	Array Element	Which byte?
a+16	*a[2][2]*	*LSB*
a +17	*a[2][2]*	*MSB*
a +18	*a[3][0]*	*LSB*
a +19	*a[3][0]*	*MSB*
a +20	*a[3][1]*	*LSB*
a +21	*a[3][1]*	*MSB*
a +22	*a[3][2]*	*LSB*
a +23	*a[3][2]*	*MSB*
a +24	*a[4][0]*	*LSB*
a +25	*a[4][0]*	*MSB*
a +25	*a[4][1]*	*LSB*
a +27	*a[4][1]*	*MSB*
a +28	*a[4][2]*	*LSB*
a +29	*a[4][2]*	*MSB*
a +30		
a +31		

Points:
4pts: Correct order of row vs. column
2 pts: Correct number of cells used
2 pts: correct LSB vs. MSB
2 pts: Correct format of array

3. 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 8-bit ADC with a + reference voltage of 5 volts and a – reference voltage of -0 volts.
   - The digital representation is: 0011 0010.

Vref+ = 5V, vref- = 0V, step size = 5v/256 = 19.5mV ***= 4 points, all or nothing***
*00110010 = 0x22 = 50, 50 * 19.53mV = 0.98V* ***= 3pts formula, 3 points correct answer (note: the formula from the notes in class is also valid)***

4. Examine the assembly language code to the right. Assume that the variable x is stored in -6[FB] and variable y is stored in - 4[FB]. Write the C code for this Assembly Language code. (15 points)

```
mov.w – 6[FB], R0
cmp.w # 0001H, R0
jeq L8
cmp.w # 001fH, R0
jeq L9
jmp L10
L8:
add.w # 0003H, – 4[FB]
jmp L7
L9:
sub.w # 0011H, – 4[FB]
jmp L7
L10:
sub.w # 0001H, – 4[FB]
L7:
```

```
switch(x) {
      case 1:  y=y+3; break
      case31:  y=y-17; break
      default:  y--;
      }
```

OR

```
if(x==1) y=y+3;
else if (x==31) y=y-17;
else y--;
```

4 pts Identifying structure (switch or if/else)
4 pts correctly identify x is tested (=1, 31)
4 pts correctly set y to a value (y+3, y-17)
3 pts default condition (final else)

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

Question asked for the benefits of the micro solution, not benefits of ASIC. Include concepts like:

- **Lower up-front development costs**
- **Ability to change the system once delivered**
- **Able to use existing development tools**

Points: 4 pts clarity/not going beyond 5 sentences; 2 points for each of these listed concepts

6. Imagine you have an embedded system that uses your SKP board. The system will:
   - Req. 1: Use the C programming language.
   - Req. 2: Continually poll SW1. While it is pressed, light the green LED.
   - Req. 3: Continually poll SW2. While it is pressed, light the yellow LED.
   - Req. 4: Continually poll SW3. While it is pressed, light the red LED.
   - Req. 5: Two or three LEDs can be lit at the same time.
   - Req. 6: Include a few comments, including headers.

Write the algorithm (general steps) which implements the above functionality (40 points)

```
// Name: James Conrad – 10/8/08
// Function: when sw1 is pressed, turn the green LED on
// when sw2 is pressed, turn the yellow LED on
// when sw3 is pressed, turn the red LED on
// Inputs: sw1, 2, 3;   Outputs: LEDs
Setup switches (input)
Setup LEDs (output, turn off)
While (1) {
      If (sw1 pressed) Turn on the green LED
            Else turn off green LED;
      If (sw2 pressed) Turn on the yellow LED
            Else turn off green LED;
      If (sw3 pressed) Turn on the red LED
            Else turn off green LED;
      }
```

Problem 6 points:

5 points: header comments
5 points: set up switches
5 points: set up LEDs
5 points: While loop with testing values inside (continuously)
5 points: Handle green LED on/off
5 points: Handle yellow LED on/off
5 points: Handle red LED on /off
5 points: Nothing extra (i.e. did not copy previous test solution that asked for a bigger program)

7. In one main program, write the code for the algorithm from problem 6. Assume that the standard sfr62p.h file is available, attached. You do not need comments. (60 points)

```
include ``skp_bsp.h''
void main(void) {
      ENABLE_SWITCHES
      ENABLE_LEDS
      while (1) {
            if (!S1) GRN_LED=LED_ON;
                  else GRN_LED=LED_OFF;
            if (!S2) YLW_LED=LED_ON;
                  else YLW_LED=LED_OFF;
            if (!S3) RED_LED=LED_ON;
                  else RED_LED=LED_OFF;
      }
```

5 points: include skp_bsp.h
5 points: void main(void) { }
5 points: set up switches correctly
5 points: set up LEDs correctly
5 points: While loop forever
5 points: all switches are examined (no if-else structure)
5 points: Identify correct switch logic (!switch)
5 points: Handle green LED on/off
5 points: Handle yellow LED on/off
5 points: Handle red LED on /off
5 points: Nothing extra (i.e. did not copy previous test solution that asked for a bigger program)
5 points: Less than 14 lines total

Note: No points for comments