October 4th, 2011

COE/BME - 538 Quiz

Name: _____ Student #: _____ Time: 50 min.

Notes:

1. Closed book.
2. Write the answers in the space provided.
3. Show the process that is used to derive your answers.
4. No question during the quiz; state your assumptions.

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1. Fill in the rest of the instruction (below) that loads accumulator D with the contents of the memory location at an address lower than the contents of Y by 4.
   Show the contents of accumulator D after execution of this instruction, given the following memory contents: **[2 marks]**

$AB	← Y-4
$68	← Y-3
$00	← Y-2
$F0	← Y-1
$74	← Y

ldd __- 4__ , __Y__ **;**
offset **index reg.**

The content of accumulator D = __$AB68__ .

2. Assuming that the E-Clock period is 10 ns, how long does it take to execute the following set of instructions? **[3 marks]**

```
first   ldab   #02          1E    ; load 2 in register B
out_lp  ldx    #0004        2E    ; load 4 in register X
in_lp   nop                 1E    ; no operation
        dbne   x,in_lp      3E    ; decrement reg. x and branch if not equal (Z=0)
        dbne   b,out_lp     3E    ; decrement reg. b and branch if not equal (Z=0)
last    nop                 1E
```

Notes: the **ldab** instruction with immediate addressing mode requires 1 E-clock cycle
the **ldx** instruction with immediate addressing mode requires 2 E-clock cycles
the **nop** instruction requires 1 E-clock cycle
the **branch** instruction requires 3 E-clock cycles (if taken or not)

Show calculations here:

1E + [2E + (1E+3E)×4 + 3E]×2 + 1E = 44E = 44 × 10 = 440 ns

Execution time (from *"first"* to *"last"*) = __**440**__ nsec.

3. What will be the content of registers A and B, after the following program has been executed? Show all numbers in binary representation. **[4 marks]**

```
        ldab    #5          ; load reg. B
        ldaa    array       ; load reg. A
        ldx     #array      ; load index reg. X
        cmpa    2,x         ; compare content of reg. A with content of memory
        bhs     next        ; unsigned branch to "next" if higher or the same
        ldab    #7          ; load reg. B
next    incb                ; increment reg. B
stop    bra     stop        ; stop here (branch to itself forever)
array   dc.b    16,3,15     ; define constants in memory starting from address "array"
```

Content of reg. A (1 Byte) = **0001 0000** **;**

Content of reg. B (1 Byte) = **0000 0110** **.**

4. Given the program below, trace the results for each instruction from *start* to *stop.* Use the table provided below to indicate the values stored in registers A, B, X, and memory locations at $5004 and $5005 after the execution of each instruction. Show all numbers in hexadecimal representation. **[6 marks]**

```
        org     $5000
data    dc.b    $44, $FA, $A1, $33, $22, $12   ; define constants starting at org address
        clra                                   ; clear reg. A
        clrb                                   ; clear reg. B
start   ldx     #data                          ; load reg. X
        ldd     2,+x                           ; load reg. D in preincrement addr. mode
        lsla                                   ; logical shift left acc. A (via Carry bit)
stop    std     2,+x                           ; store reg. D in preincrement addr. mode
```

Note: Accumulator D consists of reg. A (most significant) and reg. B (least significant).

Instructions	A	B	X	[$5004]	[$5005]
ldx #data	**00**	**00**	**5000**	**22**	**12**
ldd 2,+x	**A1**	**33**	**5002**	**22**	**12**
lsla	**42**	**33**	**5002**	**22**	**12**
std 2,+x	**42**	**33**	**5004**	**42**	**33**