EE 308 – Homework 2

1. Consider the following program:

```assembly
prog: equ $2000 ; Starting address from program
data: equ $1000 ; Starting address for data
org prog ; Set initial program counter value
ldx #1234 ;
ldab #235 ;
abx ;
stx result ;
swi

org data ; Put data starting at this location
resut: ds.w 1 ;
```

(a) Hand-assemble the program. That is, figure out what the op codes of the instructions are and where they will be located in memory, the addressing mode, number of cycles, and the status of the NVCZ bits.

(b) How many cycles will it take the MC9S12 to execute this program. (Do not include the swi instruction.)

(c) How long will it take an MC9S12 with a 24 MHz E clock to execute this program?

(d) What will be the contents of addresses $1000 and $1001 after the program executes?

2. Consider the following program:

; MC9S12 program to copy a table of data from one location to another
; The copied data is the negative of the original data

```assembly
prog: equ $2000 ; Starting address from program
data: equ $1000 ; Starting address for data
count: equ 8 ; 8 elements in the table
org prog ; Set initial program counter value
ldab #count ; ACCB keeps count of number to transfer
ldx #table_1 ; X points at table_1
ldy #table_2 ; Y points at table_2
repeat: ldab 1,X+ ; get data from table_1, X points to next element
```
nega
staa 1,Y+ ; save into table_2, Y points to next element
decb ; Decrement counter
bne repeat ; If not done, continue with next element
swi

; Initialize data in table

table_1: dc.b $44,$61,$74,$61,$20,$54,$61,$62

table_2: ds.b count ; Reserve count bytes of memory for results

(a) Hand-assemble the program. That is, figure out what the op codes of the instructions are, where they will be located in memory, and the addressing mode.

3. Write an instruction sequence to set the upper four bits of the number at address $0050 to 0, and leave the lower four bits unchanged.

4. Consider the following program fragment:

    ldy #5000
    loop1:
    ldx #5000
    loop2:
    dbne x,loop2
    dbne y,loop1
    swi

(a) Hand assemble the program. (Add an org assembler directive to put the program in memory starting at address 0x2000.)

(b) How many instruction cycles will it take the MC9S12 to execute the program? (Do not consider the swi instruction.)

(c) How many seconds will this take the MC9S12 with an 24 Mhz E-clock? (You should give the answer to the nearest millisecond.)

5. An MC9S12 has the following data in its memory:

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Determine the contents of the B and Y register after executing the following code fragments. (Before the first instruction, the Y register has $0000.) List the values in hexadecimal. Also, indicate what addressing mode is used, and what the effective address of the instruction is. (Assume that the first instruction is at address $2000, and that the instructions that follow are in subsequent locations - i.e., the instruction in the first row in the table shown below takes two bytes, so the instruction in the second row is at address $2002.)

<table>
<thead>
<tr>
<th>Addressing Mode</th>
<th>Address of Instruction</th>
<th>Y</th>
<th>B</th>
<th>Effective Address</th>
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<tbody>
<tr>
<td>ldab #21</td>
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<td>ldy $10E7</td>
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<td>ldy $10E0</td>
<td>ldab -2,Y</td>
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<tr>
<td>ldy #$10E0</td>
<td>ldab -2,Y</td>
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<tr>
<td>ldy #$10E0</td>
<td>ldab 2,+Y</td>
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<tr>
<td>ldy #$10E0</td>
<td>ldab 2,Y+</td>
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