Assignment # 4 - CSI 2111

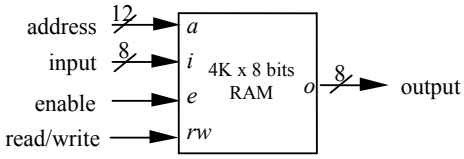
Due Thursday **December 1, 2005** by 16:00,
in box marked CSI2111 (#31) in 1st floor of SITE building.
This assignment should be done in teams of two people.

Clearly identify all the steps for each question.

Q1. You are asked to design a 3-bit synchronous counter that starts at 1 and cycles through prime numbers (i.e., number divisible by 1 or itself). The counter counts up when the mode M = 1 and down when M = 0.

a) Design the counter using JK flipflops, transitioning on positive edge. Show all the steps. (15)
b) Is the counter self-correcting? Justify your answer. (5)

Q2. Using the following 4K x 8 bits RAM chip (the *enable* input is also called *chip select*):



a) Describe the circuits necessary by filling out the blanks as shown below for the realization of a 1M x 64 bits RAM. (5)

_____ 4K x 8 bits RAM chips
_____ OR gates with ____ inputs
One ____to____ decoder with *enable* input

b) Implement a 12K x 24 bits RAM. Clearly show the inputs/outputs of your RAM blocks and decoders, and show connections clearly (with different colors). For the OR gates, you can simply draw some of them and explain how the others would be connected. (10)

Q3. Given the contents of the following memory addresses and registers (available before each of the following **MC68000** instructions), determine for each instruction, *when possible*, the contents of the modified memory addresses and registers. (15)

Some registers:

```
[A0] = $0000 2002
[A1] = $0000 2006
[D0] = $0000 0010
[D1] = $ABCD 5432
[D2] = $0001 0002
[D3] = $0000 2002
```

Memory ([address] = content):

```
[$002000] = $B020
[$002002] = $BBBB
[$002004] = $8000
[$002006] = $1111
[$002008] = $7000
[$00200A] = $1234
```

a) `MOVE.L  A0,D3`
b) `MOVE.L  #80,D1`
c) `MOVEA.W  D1,A1`
d) `MOVE.W  (A1),A1`
e) `MOVEA.B  (A1),D0`
f) `MOVE.L  D1,(A1)`
g) `MOVE.W  -(A1),(A0)+`
h) `MOVE.B  D2,-(A1)`
i) `MOVE.L  $FFFC(A1), D0`
j) `MOVE.B  $4(A1),D1`
k) `ADDA.W  -(A1),A0`
l) `ADD.B  D1,D1`
m) `MULU  D0,D2`
n) `DIVS  D0,D2`
o) `ROR.W  $#5, D2`

Q4. Consider an array of **N** bytes located in memory at the address **B**. Write a program in Sim68K assembly language ("maximum.68a") which will find the largest and the second-largest value in this array and store them in the locations **First** and **Second**, respectively. Your program should also display the values of **First** and **Second** in the end. Test your program using an array of at least 10 elements. (Suggestion: You can put **N** and **B** at the end of your program after the `HLT.B`) (15)

Q5. Here is a binary **Sim68k** program. Decode it and provide the corresponding **Sim68k** assembly language program. You can check your answer by translating your assembly program… (15)

```
/ ;    Assembler Language       OpCode  Oper1   Oper2 /
/ ;                            MSB LSB MSB LSB MSL LSB /
/ ;------------------------------------------------- /
/                           ; / $E0 $60 $00 $2C
/                           ; / $CC $21
/                           ; / $3C $00
/                           ; / $C1 $60 $00 $2C
/                           ; / $81 $10
/                           ; / $BA $60 $00 $26
/                           ; / $2D $10
/                           ; / $5B $00
/                           ; / $8C $00
/                           ; / $A2 $60 $00 $22
/                           ; / $08 $11
/                           ; / $92 $60 $00 $06
/                           ; / $C8 $16 $00 $2D
/                           ; / $E8 $60 $00 $2D
/                           ; / $F8 $00
/                           ; / $00
/                           ; / $00
```

(b) Can you guess what this program does? (Bonus 5)