Name-surname : **Signature:**
Student no :

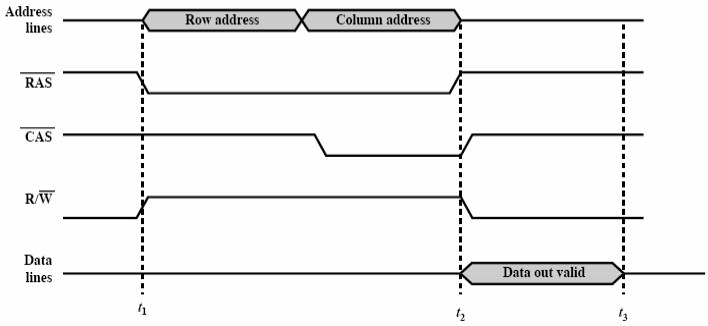
2nd Midterm Exam (15.12.2006)

____CSE2201(2204)- Computer Organization, SENG2201- Computing Systems ___

1(10). What are the major functions of an Input/Output module?

Control and timing.
Processor communication.
Device communication.
Data buffering.
Error detection.

2(15). Following figure shows a simplified timing diagram for a DRAM read operation over a bus. The access time is considered to last from t_1 to t_2. Then there is a recharge time, lasting from t_2 to t_3, during which DRAM chips will have to recharge before the processor can access them again.



a. Assume that the access time is 70 ns and the recharge time is 30 ns. What is the memory cycle time?

Memory cycle time = 70 + 30 = 100 ns.

b. What is the maximum data rate this DRAM can sustain, assuming a 1-bit output?

The maximum data rate is 1 bit every 100 ns. So, the data rate $=1/(100*10^{-9}) = 10^7 = 10$ Mbps.

c. Constructing a 16-bit wide memory system using these chips yields what data transfer rate in terms of Byte per second (B/s)?

1 Byte is 8 bits. So, Data rate =160 Mbps / 8 = 20 MB/s.

3(20). In a computer system, a small part of memory is given in the following table. What would be the contents of accumulator after running the following assembler code. All values are in hexadecimal. (LROTATE: left rotate; SHIFTR: logic shift right). Hint: Think in binary

Mem. Adress	Data
A0	15
A1	A3
A2	01
A3	3A
A4	11

LOAD INDIRECT A1
LROTATE
ADD DIRECT A4
OR IMMEDIATE A0
SHIFTR

LOAD INDIRECT A1	Acc = $(0011\ 1010)_2$	= $(3A)_{16}$
LROTATE	Acc = $(0111\ 0100)_2$	= $(74)_{16}$
ADD DIRECT A4	Acc = $(0111\ 0100 + 0001\ 0001)_2 = (1000\ 0101)_2$	= $(85)_{16}$
OR IMMEDIATE A0	Acc = $(1000\ 0101 \text{ OR } 1010\ 0000)_2 = (1010\ 0101)_2$	= $(A5)_{16}$
SHIFTR	Acc = $(0101\ 0010)_2$	= $(52)_{16}$

4(20).

a. What is the difference between SRAM and DRAM interms of application?

SRAM is used for cache memory (both on and off chip), and DRAM is used for main memory.

b. List the elements of an instruction.

Operation code (Op code), Source Operand reference, Result Operand reference, Next Instruction reference.

c. What type of instructions a processor have. Give one example for each type.

Data processing (add); Data storage (load); Data movement (I/O) (in); Program flow control (jump)

d. List the Input/Output techniques used in computers.

Program controlled I/O; Interrupt controlled I/O; Direct Memory Access (DMA)

5(15). A computer system has the following floating point format: (reminder: $N=(-1)^s \times 1.\text{fraction} \times 2^{(biased\ \exp - 2^{n-1})}$)

1 bit sign	5 bits biased exponent	10 bits mantissa

If the given floating number is "0101000010110000" ; Find

a. Corresponding binary number

s = 0

1.fraction = $(1.\ 0010110000)_2$

biased exp = $(10100)_2$

exp = $(10100\text{-}10000)_2 = (00100)_2$

Binary number = $(-1)^s \times 1.\text{fraction} \times 2^{(\exp)} = (-1)^0 \times 1.001011 \times 2^{(00100)} = (10010.11)_2$

b. Corresponding hexadecimal number

$(10010.11)_2 = (0001\ 0010.1100)_2 = (12.C)_{16}$

c. Corresponding decimal value?

$(10010.11)_2 = (18.75)_{10}$

6(20). Given x = 100 and y = 110 in twos complement notation, compute the product p = x × y with Booth's algorithm.

If Q = 100 and M = 110, then the solution:

	A	Q	Q_{-1}	M	Process
	000	100	0	110	Initial
Step 1	000	010	0	110	Shift
Step 2	000	001	0	110	Shift
Step 3	010	001	0	110	A ← A – M
	001	000	1	110	Shift

If Q = 110 and M = 100, then the solution:

	A	Q	Q_{-1}	M	Process
	000	110	0	100	Initial
Step 1	000	011	0	100	Shift
Step 2	100	011	0	100	A ← A – M
	110	001	1	100	Shift
Step 3	111	000	1	100	Shift

This is a special case, because twos complement of 100 is again 100 (in three bit twos complement number system)