UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 1999/2000

September 1999

CSI501 - Computer Organisation

Duration : [3 hours]

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **SIX** questions in **FIVE** printed pages before you start the examination.
- Answer any **FIVE (5)** questions.
- Please answer **Part A** in English only and you can choose to answer either in Bahasa Malaysia or English for **Part B**.

ENGLISH VERSION OF THE QUESTION PAPER

PART A

1. (a) Perform the following conversions (from one number system to the other):

(i) $(AB.C)_{16}$ = (?)$_{10}$

(ii) $(10.0625)_{10}$ = (?)$_{2}$

(iii) $(23.01)_{4}$ = (?)$_{10}$

(iv) $(43.1)_{16}$ = (?)$_{8}$

(v) $(1010.1)_{2}$ = (?)$_{BCD}$

(5 marks)

(b) Consider the binary numbers in the following addition problems to be in the 2's complement representation. Add the numbers using 2's complement arithmetic and check your results by converting the operands and the results to decimal representation:

(i) 010101

(ii) 110111

(iii) 101011

(iv) 111001

(4 marks)

(c) A 16 bit floating point register uses a sign bit and a six bit exponent and a nine bit mantissa. If the exponent is stored in sign-magnitude form and the mantissa is a normalized fraction,

(i) What is the decimal equivalent of the contents of the register when it is storing the binary number 1100011110000000?

(4 marks)

(ii) Find the range of positive numbers that can be stored in the register.

(4 marks)

(d) Construct the truth table for the following Boolean function without modifying the function:

A.B'.C+(B+C+D').(A+D'+C)

(3 marks)

2. (a) Find the complement of the function wx'+y'z'+w'yz' and express it in the sum of products form.

(5 marks)

(b) Simplify the following Boolean function f, using the don't cares given:

F(A, B, C, D) = (0,6,8,13,14)
d(A, B, C, D) = (2, 4, 10)

(5 marks)

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(c) Design and draw the logic diagram for half adder. (5 marks)

(d) Show that AND, OR and NOT operations can be realized using NAND gates only. (3 marks)

(e) What is the difference between a combinational circuit and a sequential circuit? (2 marks)

3. (a) Explain the role played by the following registers MAR, MDR, PC and IR in program execution. Use an example to explain your answer. (8 marks)

(b) Write programs using the following instruction formats to compute x multiplied by y and store the result in a location Z. Assume that the values of x and y are available in the locations X and Y respectively. Assume that Load, Store and Multiply instructions are available:

(i) Three address instruction format

(ii) Two address instruction format

(iii) Single address instruction format

(6 marks)

(c) Given the memory values below and a one-address machine with an accumulator, what values do the following instructions load into the accumulator?

word 20 contains 40
word 30 contains 50
word 40 contains 60
word 50 contains 70
Register 2 contains 25

(i) Load #20

(ii) Load 20

(iii) Load (20)

(iv) Load 30

(v) Load (30)

(vi) load 5(2)

(6 marks)

PART B

4. (a) Give the RTL statements that describe Figure 4 (a).

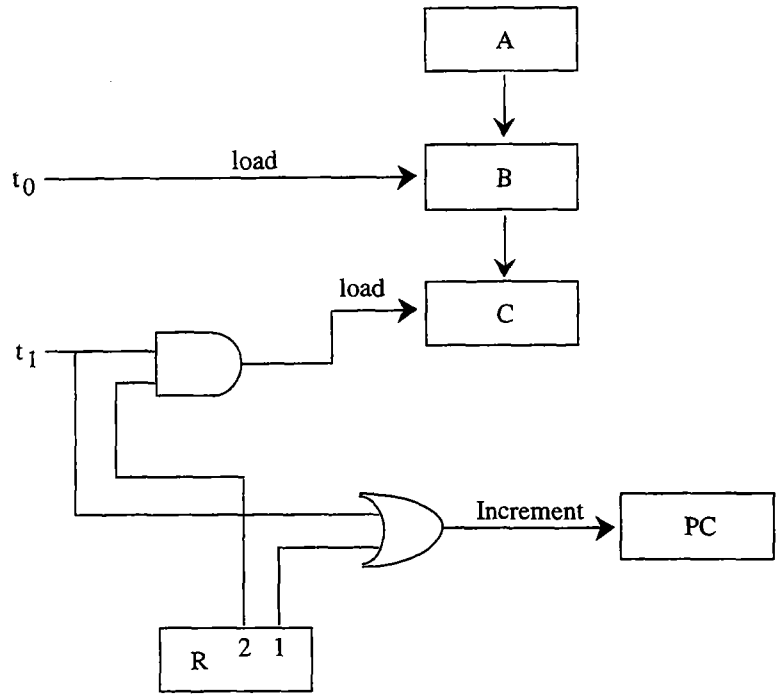

Figure 4 (a)

(5 marks)

(b) Draw a diagram like Figure 4 (a) for the following RTL statement:

$$F'E't_1 : MAR \leftarrow 0,\ PC \leftarrow 1$$
$$F'E't_2 : M[MAR] \leftarrow (MBR)$$

(5 marks)

(c) Consider a computer known as PDX that provides four addressing modes has 2^{10} word memory, includes 16 instructions and uses an accumulator for all arithmetic and logic operations. Explain your choice of an instruction format for the PDX.

(5 marks)

(d) Based on the register and memory contents specified in Figure 4 (d), what is the operand for each of the following:

(i) Register address mode; address in instruction = 2

(ii) Register indirect address mode; address in instruction = 1

(iii) Autoincrement address mode; address in instruction = 1

(iv) Relative address mode; address in instruction = 4

(v) Indirect address mode; address in instruction = 10

	Memory
10	12
11	24
12	26
13	25
14	11
15	12
16	10
17	15

R1	16
R2	12
PC	10

(5 marks)

5. (a) Explain in brief the three modes of basic I/O operation. Highlight their differences and their advantages and disadvantages.

(9 marks)

(b) Assume the existence of a machine with a vectored-interrupt capability, in which an I/O device supplies the starting address of the interrupt service routine at the time the interrupt is acknowledged. The processor status is saved on a memory stack. Describe (in point form) the sequence of events from the time the device requests an interrupt until execution of the interrupt-service routine is started.

(5 marks)

(c) An I/O device transfers characters at the rate of 1200 characters per second. When enabled, the device moves a character into a buffer register and set a DONE bit that can be tested by the program handling the device. The program is a loop containing two instructions, each of which takes 1.5 micro second to execute. How many times will the CPU go around the loop waiting for the DONE bit to be set?

(6 marks)

6. (a) Describe in detail the following memory types and then discuss the differences in their features. State also their advantages and disadvantages.

(i) stack memory

(ii) associative memory

(iii) cache memory

(12 marks)

(b) Explain the differences in the following pairs:

(i) memory access time and memory cycle time

(ii) memory address register and memory buffer register

(4 marks)

(c) Compare between segmentation and paging in the virtual memory management.

(4 marks)

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