BACS1113 COMPUTER ORGANISATION AND ARCHITECTURE

Question 1

a) Perform the following operations and show the answers in the respective number base. You are required to show your working steps clearly.

(i) $323.2_5 + 41.4_5$ (2 marks)

(ii) $56_{16} \times BB_{16}$ (3 marks)

(iii) $1100001_2 - 11111_2$ (2 marks)

b) Perform the following conversions. (Show your conversion steps clearly)

(i) 10100101111100_2 to hexadecimal number (2 marks)

(ii) 126_5 to base-10 number. (2 marks)

(iii) 605.3_8 to binary (2 marks)

c) Assume that:

- An Excess-52 notation is applied.
- The implied decimal point is at the beginning of the mantissa.
- A "0" is used to represent a positive number and a "1" is used to represent a negative number.

(i) Given that 15555555 is presented in SEEMMMMM format. Convert it to a decimal number. (2 marks)

(ii) Solve the subtraction problem below. Present your result in SEEMMMMM format. (4 marks)

$$\begin{array}{r} 05345678 \\ -\ 15278654 \end{array}$$

d) Assume that W contains 00011001_2, X contains 01110001_2 and Y=01010101_2. Determine the result generated by the following operations. You are required to show your working steps clearly.

(i) W ***AND*** X ***OR NOT*** Y (3 marks)

(ii) ***NOT***(W ***XOR*** Y) (3 marks)

[Total: 25 marks]

Question 3

a) Assume a hypothetical computer model is applied. The contents are stored in 3-digit format. The instructions have the following format. The first digit represents the opcode, while the following two digits represent the memory location.

Program Counter: 90
Value stored in memory location 55: 058_{16}
Value stored in memory location 56: 059_{16}
Value stored in memory location 57: 060_{16}
...
...
Value stored in memory location 90: 555_{16} *(LOAD instruction)*
Value stored in memory location 91: 256_{16} *(SUB instruction)*
Value stored in memory location 92: 357_{16} *(STORE instruction)*

Visualise in words the progressive changes of the contents for *Instruction Registers (IR), Program Counter (PC), Memory Address Register (MAR), Memory Data Register (MDR) and Accumulator (A)* respectively immediately after the execution of the following instructions:

(i) Memory location 90 (5 marks)

(ii) Memory location 91 (5 marks)

(iii) Memory location 92 (5 marks)

b) Using the information in the table below, calculate the physical address for the function parameter where it is saved on of the top of the stack.
(You are required to show your calculation steps clearly.) (4 marks)

Code Segment (CS): 14C3H Data Segment (DS): 56D4 H Stack Segment (SS): 4ED3H Instruction Pointer (IP): 0004H Base Pointer (BP): 0123H Stack Pointer (SP): 034FH

c) Briefly explain **THREE (3)** types of memory segments. (6 marks)

[Total: 25 marks]

Question 4

a) Assume that a bus has 32 data lines and requires 8 cycles of 150 nanoseconds **each** to transfer data. Calculate the bandwidth (in **Megabytes/seconds**) of the bus. (5 marks)

b) (i) State the **TWO (2)** methods used by CPUs to identify interrupts and execute their corresponding Interrupt Service Routines (ISRs). (2 marks)

(ii) Distinguish the two interrupts handling methods in Question 4 b) (i) with the aid of diagrams. (8 marks)

c) (i) What is the master -slave multiprocessing? (2 marks)

(ii) Briefly explain any **TWO (2)** advantages and **TWO (2)** disadvantages of the master -slave multiprocessing. (8 marks)

[Total: 25 marks]

8 * 150 = 1200 nanoseconds

32/8 = 4 bytes

= 4/1200 * 10^{-9}

= 4.8 Megabytes/sec