TUNKU ABDUL RAHMAN UNIVERSITY OF MANAGEMENT AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATION TECHNOLOGY

ACADEMIC YEAR 2022/2023

JANUARY EXAMINATION

COMPUTER SCIENCE BACS1113
COMPUTER ORGANISATION AND ARCHITECTURE

WEDNESDAY, 18 JANUARY 2023 TIME: 2.00 PM – 4.00 PM (2 HOURS)

BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN INFORMATION SECURITY
BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN INTERNET TECHNOLOGY
BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN SOFTWARE SYSTEMS DEVELOPMENT

Instructions to Candidates:

Answer **ALL** questions. All questions carry equal marks.

Question 1

a) Perform the following number conversions.
** You are required to show your conversion steps clearly.*

(i) 101010_8 to decimal number (2 marks)

(ii) $BACS1113_{16}$ to binary number (1 mark)

(iii) 123.4_{10} to hex number (2 marks)

(iv) 1011111.11010101_2 to octal number (2 marks)

b) The floating-point decimal numbers below are stored in the form of SEEMMMMM where the exponent is stored in excess-50 with the implied decimal point at the beginning of the mantissa. A 0 in the sign position indicates a positive number and a 1 indicates a negative number:

05351111
+ 14902222

(i) Add these two numbers. Show the result in sign-magnitude notation. (4 marks)

(ii) Divide these two numbers. Show the result in sign-magnitude notation. (4 marks)

c) Assuming a 8-bit system is used (i.e., the system uses 8 bits to represent an integer):

$$-34_{10} + 20_{10}$$

(i) Show how the above operation is solved using two's complement method. (3 marks)

(ii) Verify your answer by showing the answer in signed decimal value. (1 mark)

(iii) Does overflow occur? (1 mark)

d) Show how the binary number -10010001.00101_2 is stored in the computer's storage using IEEE754 32-bit single precision format. Assume "0" represents a positive sign and "1" represents a negative sign. Show your conversion steps clearly. (5 marks)

[Total: 25 marks]

Question 2

a) Discuss any **THREE (3)** disadvantages of Complex Instruction Set Computer (CISC). (6 marks)

b) Show the changes of contents in Instruction Register (IR), Program Counter (PC), Memory Address Register (MAR), Memory Data Register (MDR) and Accumulator (A) on the execution of machine code in memory locations $02BB_{16}$ and $02BC_{16}$.

Program counter: 02BA
Value in memory location $02BA_{16}$: 8191_{16} (LOAD)
Value in memory location $02BB_{16}$: $A192_{16}$ (ADD)
Value in memory location $02BC_{16}$: 9193_{16} (STORE)
:
Value in memory location 0191_{16}: 0001_{16}
Value in memory location 0192_{16}: 0003_{16}
Value in memory location 0193_{16}: 0009_{16}

(10 marks)

c) Define the following numeric values in data items named NAME1, NAME2, and NAME3.

Example: VAL BYTE 0005H

(i) A 8-bits item containing the hex equivalent to decimal 26 (1 mark)

(ii) A 2-byte item containing the hex equivalent to decimal 344 (1 mark)

(iii) An 8-byte item containing the ASCII value of text "BACS1113" (2 marks)

d) Given an 900 x 400 image, calculate the storage size, in bytes, required to store each of the following:

(i) 16 color bitmap, convert your result into kilobytes. (2 marks)

(ii) 64-bit bitmap, convert your result into megabytes. (3 marks)

[Total: 25 marks]

Question 3

ISA, PCI

a) Differentiate polled interrupt from vector interrupt. Give **ONE (1)** example of bus that implements polled interrupt and **ONE (1)** example of bus that implements vector interrupt. (4, 4 marks)

VME Bus.

b) Discuss **TWO (2)** advantages and **ONE (1)** disadvantage of cache memory. (6 marks)

c) Using only MOV, ADD, SUB, INC, DEC, and NEG instructions, translate the following high-level language assignment statements into assembly language. Assume that A, B, and C are word variables.

i) B = - (-A + C) (4 marks)

ii) C = 3 * A - 4 (4 marks)

d) What is the Memory Access Register **(MAR)**? One large modern computer has a 64-bit **MAR**. How much memory can this computer address? (1, 2 marks)

[Total: 25 marks]

2^{64}

$\approx 1.844 \times 10^{19}$

Question 4

a) Identify and discuss two different ways of configuring a multiprocessing system. Which configuration is more effective for general purpose computing? (10, 2 marks)

b) Table 4.1 shows a list of interrupting programs that has occurred consecutively one after the other, inclusive of the time duration of each interrupt should be handled and the time each interrupt started. In addition, priority is assigned to each interrupt.

	Time started	Duration Needed	Priority
Program A	8:00am	40 minutes	4 (lowest)
Interrupt X	8:10am	15 minutes	2
Interrupt Y	8:20am	20 minutes	1
Interrupt Z	8:30am	13 minutes	3

Table 4.1 interrupting programs

(i) Construct a diagram to show how these interrupts are handled by the CPU accordingly. (8 marks)

(ii) What is the time of completion for Interrupt A? (1 mark)

c) Refer to the table 4.2:

Code Segment (CS)	: 123AH
Data Segment (DS)	: 2B13H
Stack Segment (SS)	: B121H
Instruction Pointer (IP)	: 0232H
Base Pointer (BP)	: 0333H
Stack Pointer (SP)	: 0444H

4.2 Registers

(i) Calculate the absolute address for the location where the CPU is currently fetching instructions to execute. (2 marks)

(ii) Calculate the absolute address for the current location of data or address within the program stack. (2 marks)

[Total: 25 marks]