University of Sri Jayewardenepura

B.Sc. (General) Degree First Year
First Semester Terminal Course Unit Examination – June, 2015

CSC 106 1.5 Computer System Organization
(Time: 1½ hours)

This paper consists of four (4) questions on two (2) pages.
Answer all questions.

Question 01

(a) Explain the difference between system software and application software. Provide two examples for each category.

(b) What are the factors affecting performance of a hard disk? Name two advantages of solid state drives over hard disk drives.

(c) Consider the following specifications pertaining to a single core processor.

Data I/O bus: 64 bits wide and running at the speed of 1066 MHz
Internal registers: 32 bits wide
Address bus: 36 bits wide

(i) How much of information can be processed within the processor at a time?
(ii) How much of information can be transferred in and out of the processor per second?
(iii) What is the maximum amount of memory the processor can handle?

[25 Points]

Question 02

(a) Suppose you have 8-bit registers to store integers. What are the minimum and the maximum number that can be stored using each of the following forms?

(i) Unsigned form
(ii) Signed-magnitude form
(iii) Two's complement form

(b) Perform the following arithmetic operations with the given numbers.

(i) Addition of (+43) and (-58) with binary numbers in 10-bit registers taking signed-2's complement form.
(ii) Subtraction of (+56) from (-87) with binary numbers using signed-2's complement of the subtrahend.

[15 Points]

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Question 03

(a) Using the rules of Boolean algebra, show that

$$b(a \oplus c) + a'(b \oplus c) + b(a + c) + a(b' + c) = a + b + c$$

where a, b and c are Boolean variables.

(b) Suppose that 18 bits are used to represent positive and negative floating point numbers in binary. A bit is reserved for the sign of the number, but there is no sign bit to represent the sign of the exponent. The exponent field consists of 7 bits with a bias of 63. Remaining bits are allocated for the fraction. All 0s and all 1s in the exponent field are reserved for a special purpose.

(i) Show the bit configuration when -0.0000101101 is represented using the above scheme.

(ii) What are smallest and largest positive numbers that can be represented? Provide their bit configurations.

[20 Points]

Question 04

(a) What is a multiplexer circuit? Draw the block diagram of an 8 by 1 multiplexer circuit.

(b) The block diagram of a 256 x 4 bits (1-Kilobit) memory is shown in Fig 4.1. Suppose you are required to extend it to a 32-Gigabit memory with the word size of 8-bits. Draw the block diagram of 32-Gigabit memory.

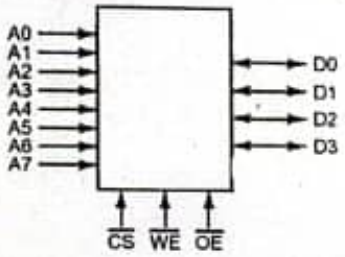

Fig 4.1 – 256 x 4 bits memory

(c) A kid is going on a nature picnic. Her enjoyment of the picnic depends on various factors. She enjoys her picnic on sunny days that have no ants. She also enjoys her picnic on any day she sees a hummingbird, as well as on days where there are ants and ladybugs.

(i) Using Karnaugh maps, obtain a simplified expression for her enjoyment (E) in terms of sunny days, ants, hummingbird and ladybugs; and draw the logic diagram of it.

(ii) Implement E using an 8 by 1 multiplexer circuit (use the block diagram in part (a)).

[40 Points]

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