Department

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University of Sri Jayewardenepura

B.Sc. (General) Degree First Year
First Semester Terminal Course Unit Examination – June, 2014

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

Answer all questions.

Question 01

(a) What are the functionalities of the special purpose registers: *Instruction Register* (IR) and *Program Counter* (PC)? With the help of these registers, briefly explain the major steps involved in execution of an instruction by a processor.

(b) Name and describe the purpose of two different types of buses in a processor.

(c) What is the role of ROM BIOS in a computer system? What is the functionality of bootstrap loader in ROM BIOS?

(d) What is a cache memory? Cache memories were not present in computers prior to 1990's. What is the main reason for introducing a cache memory into a computer system? Explain how it could increase the performance of a computer system.

[25 Points]

Question 02

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

(i) Addition of (-85) and (-98) with binary numbers in 16-bit registers taking signed-2's complement form.

(ii) Subtraction of (-564) from (+8715) with decimal numbers using signed-10's complement of the subtrahend.

(b) A scheme has been designed for representing positive and negative floating-point numbers in 32-bit registers. The numbers are represented in binary normalized form. A bit is reserved for the sign of the number, 11 bits for the exponent, and the rest is reserved for the fraction. There is no separate sign bit for the exponent, and hence, the value 1023 is used as the bias to represent both positive and negative exponents. All 0s and all 1s in the exponent field are reserved for a specific purpose. What are the smallest positive and the largest positive numbers that can be represented in the above scheme? Justify your answer.

[20 Points]

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Question 03

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

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

where a, b and c are Boolean variables.

(b) Redesign the circuit given in Fig 3.1 using **NOR** gates only.

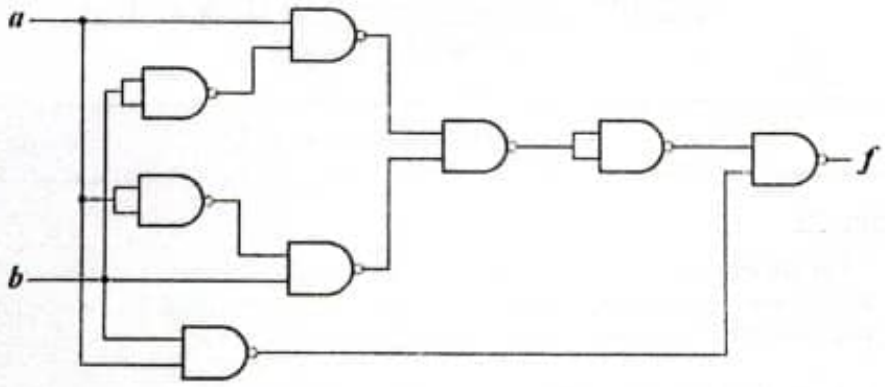

Fig 3.1

[25 Points]

Question 04

(a) What is a multiplexer circuit? Draw the block diagrams of two-input (2 by 1) and four-input (4 by 1) multiplexer circuits. Construct a 4 by 1 multiplexer circuit from three 2 by 1 multiplexers.

(b) A combinational counter is a combinational circuit that counts the number of 1s in an n-bit binary number. The output is represented in binary. In other words, the input to the circuit consists of n binary variables representing the n-bit binary number and the output consists of m binary variables representing the number of 1s in the input.

(i) How many binary variables are required in order to describe the output?

(ii) Obtain simplified algebraic expressions for the output variables in terms of input variables for $n = 4$.

[30 Points]

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