EASTERN UNIVERSITY, SRI LANKA

DEPARTMENT OF MATHEMATICS

FIRST YEAR EXAMINATION IN SCIENCE - 2016/ 2017

SECOND SEMESTER (March, 2019)

CS 106 – COMPUTER ORGANIZATION AND ARCHITECTURE

REPEAT

Answer all questions **Time allowed: Two Hours**

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1) Computer organization mainly deals with how a particular hardware works in a computer whereas computer architecture deals with how to design a circuit for such hardware.

   a) Briefly describe the tools which are provided by the principles of computer organization to create better designs.

   b) Write down three main features of the first electronic computer (ENIAC).

   c) Sketch a basic *Von Neumann* computer architecture by precisely identifying all the key components, and describe the basic function of each component.

   d) Describe the functions of the following registers in a typical Central Processing Unit (CPU):

      i. Program Counter (PC);

      ii. Memory Address Register (MAR);

      iii. Instruction Register (IR);

      iv. Accumulator.

2) Binary is the simplest kind of number system that uses only two digits of 0 and 1. By using these digits computational problems can be solved by machines easily.

   a) Give algebraic proof for the following questions by using the laws of boolean algebra:

      i. $(X + Y + Z)(\overline{X} + Y + Z) = Y + Z$;

      ii. $(A + \overline{B} + \overline{C})(A + \overline{B}C) = A + \overline{B}C$.

b) Convert the following hexadecimal numbers to octal numbers:

i. $DC7_{16}$;

ii. $A6.53_{16}$.

c) Briefly explain how a Full Adder works in a digital circuit to perform arithmetic operations.

d) What are the three common ways of representing signed numbers? Explain any two of them with the aid of examples.

e) Flip Flop is an electronic circuit which has two stable states and thereby is capable of serving as one bit of memory, bit 1 or bit 0. Briefly explain that how does a SR flip flop works.

3) Standardisation makes the evaluations and implementation of boolean expression much more systemic and easier.

a) What is meant by the term ***Standard "Product-of-Sum (POS)" form***?

b) Write down the rules which can be used for the conversion from *POS* to *Standard PO* with the aid of a simple example.

c) A **Karnaugh Map** (K-Map) is a two dimensional representation of boolean functio which uses to simplify boolean expressions easily.

i. Discuss the rules of simplification in the development of the K-Map.

ii. Find the minimum Product-of-Sum (POS) for the following function:

$$\mathbf{F\ (a, b, c, d) = \prod m\ (3, 5, 7, 8, 10, 11, 12, 13)}$$

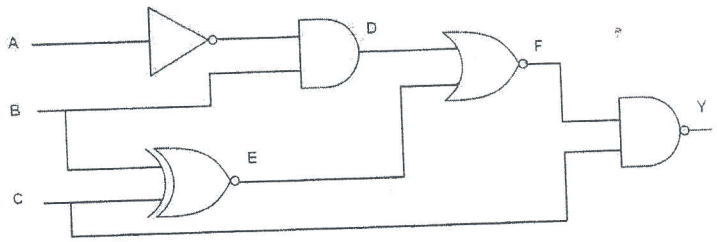
d) A famous restaurant orders a machine to dispense soft drink, fresh juice and coffee. A you are a designer, you need to design the machine which has a button for each choi and so that a customer can have at most one of the three choices.

i. Specify the input and output variables and two states of each.

ii. Construct the truth table for the above design and write down the sum of min term

iii. Diagram the circuit to ensure that the "at most one" condition is met.

e) Show the behaviour of the following circuit with a truth table:



4)

a) Machine language is a set of instructions executed directly by a computer's central processing unit. Consider the following pseudocode:

Set a to b /c

*Set r to s * t*

Then

*Set p to (a+ r)*r*

Write a piece of machine language for the above pseudocode by using the following memory location of each variables.

Variable	Memory Location
a	1111
b	3000
c	1200
r	9999
s	9998
t	9990
p	1110

b) Pipelining technique is the best method than sequentially processing each instruction.

i. Briefly describe the Instruction-Execution cycle with an aid of a diagram in pipelined execution.

ii. Explain with a suitable example that, how a normal pipeline execution can be disrupted.

c) Describe the key concepts behind the superscalar architecture. If a microprocessor needs to execute two instructions simultaneously, calculate the number of required cycles. (Assume that, there are five instruction execution stages)

d) Briefly explain three different types of pipeline hazards with suitable examples.

e) Distinguish between Reduced Instruction Set Computers (RISC) and Complex Instruction Set Computers (CISC).