EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE 2002/2003 (Repeat)

FIRST SEMESTER (June/July, 2003)

CS 106 Computer Organization and Architecture

Answer all Questions

Time allowed: 2 Hours

Q1 State and prove De Morgon's Theorem.

(a) Prove that $(A+B).\overline{(AB)} = A.\overline{B} + \overline{A}.B$

(b) Simplify the following expressions

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

ii. $\overline{\overline{A+B.\overline{C}} + D.\overline{(E+F)}}$

(c) State the characteristics of a flip-flop.
Construct RS flip-flop using NOR gates and describe its function.

Q2 Answer all parts

(a) Describe, with the aid of examples, the properties of 2's complement numbers. What is the range of two's complement numbers in **n** bits and what will happen if we violate this range? Provide examples.

(b) Explain why floating point representation is used in a computer.

A particular computer allocates 16-bits to represent a floating-point number, using 6-bits exponent in **excess-32** and 10-bits two's complement **normalised mantissa**. Explain the meaning of the bolded terms.

Perform the following calculations:

i.
```
  123.5
+113.4
=======
```

ii.
```
  123.5
- 112.8
=======
```

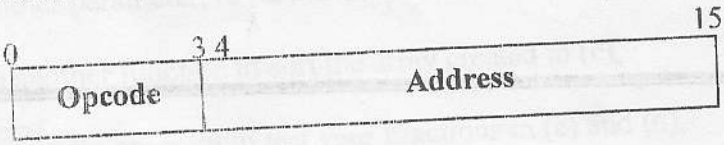
In each case show how the numbers would be stored in the computer.

Q3 Answer all parts

(A) Describe the function of the following registers in a computer:

(i) Instruction Register (IR)
(ii) Program Counter (PC)
(iii) Memory Data Register (MDR)
(iv) Accumulator (ACC)
(v) Memory Address Register (MAR)

Consider a computer with the following instruction format:



(i) What is the length of the instruction register?
(ii) How many bits are there in the PC register?
(iii) How many words can be directly addressed?

(B) Suppose you are given a computer with 7 single address instructions.

The instructions are

```
LDA  A     //Load accumulator
STO  A     //Store accumulator
ADD  A     //Add
SUB  A     //Subtract
IN   A     //Read from an input unit and store at the address A
OUT  A     //Output the content of A to an output unit
HALT       //Stop the execution
```

Write a program to this computer to do the following tasks:

(a) read three numbers A, B, and C
(b) compute P=A – B –C
(c) output P.

Q4 Answer all parts

(a) Describe the different bus systems in a computer.

(b) Illustrate, with the aid of a diagram, the use of a **Cache** memory in alleviating the speed mismatch of memory and processors. Explain the terms **spatial locality** and **temporal locality** of reference of instructions in programs.

(c) Draw a schematic diagram for a DMA transfer from input to memory and describe the steps involved in the DMA transfer of one word.

What is cycle stealing?

Briefly describe the procedure involved in transferring a block of data from a high-speed device such as a disk drive.