

ISC 2007
COMPUTER SCIENCE PAPER 1
THEORY
PART I

Answer all questions in this part

Question 1.

- a) Simplify the following Boolean expression using laws of Boolean Algebra. At each step state clearly the law used for simplification.
$$XY.(X.Y + Y.Z)$$
- b) State the DeMorgan's Laws. Verify any one of them using truth table.
- c) Convert the following Sum of Product expression into its corresponding Product of Sums form:
$$F(O,V,W)= O'V'W' + O'V'W+O'VW+OV'W$$
- d) Find the complement of
$$F(A,B,C,D)= [A + \{ (B+C) . (B'+ D')\}]$$
- e) Draw the logic gate diagram and truth table for XOR gate.

[2 x 5 = 10]

Question 2.

- a) Name the Universal gates.
- b) Convert the following infix expressions to its postfix form.
$$(A+ (B*C)) / (C-(D*B))$$
- c) Each element of an array X[-15...10,15...40] requires one byte of storage. If the array is stored in column major order with the beginning location 1500, determine the location of X[5,20].
- d) Explain any two standard ways of traversing a binary tree.
- e) What is meant by visibility mode in the definition of derived classes of Inheritance? Explain any two visibility modes available.

[2 x 5 = 10]

Question 3.

- a) In the following function strange is a part of some class. Assume that arguments x and y are greater than 0 when the function is invoked. Show the dry run/working.

```
public int strange(int x, int y)
{
    if(x>=y)
    {
        x=x-y;
        return strange(x,y);
    }
    else
    {
        return x;
    }
}
```

- i) What will the function strange(20,5) return? **[2]**
- ii) What will the function strange(15,6) return? **[2]**

iii) In one line state what the function strange(...) is doing? [1]

b) State the final value of q at the end of the following program segment: [5]

```
int m,n,p,q=0;
for(m=2;m<=3;++m)
{
for(n=1;n<=m;++n)
{
p=m+n-1;
if(p%3==0)
q+=p;
else
q+=p+4;
}
}
```

Part II

Answer any seven questions in this part, choosing three questions from Section A and four questions from Section B.

Section A

Answer any three questions.

Question 4.

a) Given the Boolean function $F(A,B,C,D) = \sum(0,2,3,4,6,7,9,13)$

Use Karnaugh's map to reduce the given function F, using the SOP form. Draw a logic gate diagram for the reduced SOP form. You may use gates with more than two inputs. Assume that the variables and their complements are available as inputs.

b) $X(A,B,C,D) = \pi(2,3,4,5,12,14)$

Use Karnaugh's map to reduce the given function X using the POS form. Draw a logic gate diagram for the reduced POS form. You may use gates with more than two inputs. Assume that the variables and their complements are available as inputs.

[5 x 2 = 10]

Question 5.

The inaugural function of the newly constructed flyover has been organized by the Public Works Department. Apart from a few special invitees, entry is permitted only if:-

- The person is an employee of the PWD of Class I category with more than 10 years of working experience.
- OR
- The person is an employee of any other government or authorized private organization either at the managerial level or with more than 10 years of working experience.

The inputs are:

A : The person is a Class I employee of PWD.

- B : The person is an employee of any other government or authorized private organization.
 C : The person has more than 10 years of working experience.
 D : The person is holding a managerial post.

Output:-

X : Denotes eligibility for entry. [1 indicates Yes and 0 indicates No in all cases]

- a) Draw the truth table for the inputs and outputs given above and write the SOP expression for $X(A,B,C,D)$. [5]
- b) Reduce $X(A,B,C,D)$ using Karnaugh's map. Draw the logic gate diagram for the reduced SOP expression for $X(A,B,C,D)$ using AND & OR gates. You may use gates with two or more inputs. Assume that the variables and their complements are available as inputs. [5]

Question 6.

A combinational circuit with 3 inputs A,B,C detects an error during transmission of code and gives the output D as 1 if any two of the inputs are low(0).

- i) Write the truth table with Inputs A,B,C and Outputs D. [2]
- ii) Write the SOP expression for $D(A,B,C)$ using minterms. Implement D using NAND gates only. [4]
- iii) Write the POS expression for $D(A,B,C)$ using maxterms. Implement D using NOR gates only. [4]

Question 7.

- a) Draw the truth table and logic circuit diagram for a Hexadecimal to Binary encoder. [6]
- b) Verify if $X'YZ+XY'Z+XYZ'+XYZ= XY+YZ+XZ$ [4]

Question 8.

- a) Using the truth table verify $PQ+ PQ' = P$ [2]
- b) What is full adder? Write the SOP expressions for Sum and Carry. Simplify the expressions algebraically using Boolean Algebra. [6]
- c) What is meant by a logic gate? State any one application of a logic gate circuit. [2]

Section B

Answer any 4 questions.

Each program should be written in such a way that it clearly depicts the logic of the problem. This can be achieved by using mnemonic names and comments in the program.

(Flowcharts and algorithms are not required)

The programs must be written in C++/Java

Question 9.

A class called EvenSeries has been defined to find the smallest value of integer, n, such that, $2 + 4/2! + 8/3! + 16/4! + \dots + 2^n/n! \geq S$, where $2.0 < S < 7.0$.

Some of the members of the class EvenSeries are given below:

Class name	:	EvenSeries
Data members:		
n	:	long integer type to store number of terms.
S	:	float variable where $2.0 < S < 7.0$.
k	:	float variable to store the value of series evaluated.
Member functions:		
EvenSeries()	:	constructor to initialize data members to 0.
void accept()	:	to accept value of data member S.
long fact(long x)	:	to compute and return factorial of x.
void disp()	:	calculates and displays the least value of n.

Specify the class EvenSeries giving details of the constructor and functions void accept(), long fact(long) and void disp(). The main function need not be written. **[10]**

Question 9.

Design a class change to convert a decimal number to its equivalent in base 16 and to convert it back to its decimal form. Eg.(i) The decimal number 35 is 23 in base 16. ii) The decimal number 107 is 6B in base 16.

Some of the members of the class are given below:

Class name	:	change
Data members		
a[]	:	integer type array.
n	:	integer to be converted to base 16.
Member functions		
change()	:	constructor to assign 0 to instance variables.
void input()	:	accepts integer to be converted to base 16.
void hexadeci(int)	:	to convert decimal integer to hexadecimal form.
void decihexa()	:	to convert hexadecimal number back to decimal form.

Specify the class change giving the details of the constructor and the functions void input(), void hexadeci(int) and void decihexa(). The main function need not be written.

[10]

Question 11.

A class Rearrange has been defined to insert an element and to delete an element from an array. Some of the members of the class are given below:

Class name	:	Rearrange
Data members		
a[]	:	integer type array
n	:	size of array (integer)
pos1	:	position of insertion (integer)
pos2	:	position of deletion
item	:	item to be inserted (integer)
Member functions		
void enter()	:	to enter size, array elements and to display the entered elements.
void insert()	:	to accept element (item) to be inserted, position of insertion and insert the element (item) at the position of insertion.
void disp1()	:	to display the array after item is inserted.
void disp2()	:	to display the array after item is deleted.
void remov()	:	to accept the position of deletion and delete element(item) at the position of deletion.

Specify the class Rearrange giving details of the functions void enter(), void insert(), void disp1(), void disp2() and void remov(). The main function need not be written.

[10]

Question 12.

Class Convert has been defined to express digits of an integer in words. The details of the class are given below:

Class name	:	Convert
Data members		
n	:	integer whose digits are to be expressed in words.
Member functions		
Convert()	:	constructor to assign 0 to n.
void innum()	:	to accept the value of n.
void extdigit(int)	:	to extract the digits of n using recursive technique.
void num_to_words(int)	:	to display the digits of an integer in words.

Specify the class Convert giving details of the constructor and function void innum(), void extdigit(int) and void num_to_words(int). The main function need not be written.

[10]

Question 13.

A class Student defines the personal data of a student while another class Marks defines the register number, name of subject and marks obtained by the student. The details of both the classes are given below:

Class name	:	Student
Data members		
name	:	string to store name.
sex	:	string to store sex
age	:	integer to store age
Member functions		
void inpdetails()	:	to accept values for data members.
void show()	:	to display personal data of student.
Class name	:	Marks
Data members		
regnum	:	int to store registration number.
marks	:	int to store marks.
subject	:	String to store subject name.
Member functions		
void inpdetails()	:	to accept values for data members.
void show()	:	to display exam and student details.

- Specify the class Student giving details of the functions void inpdetails() and void show().
- Specify the class Marks using the concept of inheritance giving details of the functions void inpdetails() and void show(). The main function need not be written.

[10]

Question 14.

A class Mystring has been defined for the following methods:

Class name	:	Mystring
Data members		
str	:	to store a string
len	:	length of the given string.
Member functions		
Mystring()	:	constructor
void readstring()	:	reads the given string from input.
int code(int index)	:	returns Unicode for character at position index.
void word()	:	displays the longest word in the string.

Specify the class Mystring giving details of the constructor and void readstring(), int code(int index), void word() only. The main function need not be written.