

ISC 2007(R)
COMPUTER SCIENCE PAPER 1
THEORY
PART I

Answer all questions in this part

Question 1.

- a) Verify the following using truth table

$$A \oplus B \oplus C = (A \oplus B) \oplus C$$

- b) Find the complement of the following using De Morgan's Law

$$X'Y' + X' + XY$$

- c) Simplify and state the dual of the following expression:

$$XY'(XY'Z + X + X'Z)$$

- d) State the involution Law. Verify it using the truth table.

- e) Given $F(X, Y, Z) = (X + Y) \cdot (Y + Z)$ write the function in canonical product of sum form.

[2 X 5 = 10]

Question 2.

- a) What is a tree? Show diagrammatically a tree data structure marking its main parts.

- b) Convert the following into postfix form:

$$(A-B) * (C / D) + E$$

- c) Each element of an array Data[30][40] requires 4 bytes of storage. If the base address of Data[0][0] is 3000, determine the location of Data[10][10] when the array is stored as column major wise.

- d) Name any two recursive data structures.

- e) Explain the term static.

[2 x 5 = 10]

Question 3.

- a)

```
int recs(intnum)
{
    if(num==0)
        return 0;
    else
        return num+ recs(num-1);
}
void main()
{
    int r=0;
    for(int i=0;i<5;i++)
    {
        r=recs(i);
        System.out.println(" i = "+ i + " r= "+r);
    }
}
```

- b) `public static void main(String args[])`
{

```

int r;
char d='1';
for(int n=0;n<=9;n++)
{
    r = n++;
for(int a=0; a<=r; a++)
d++;
}
}
}

```

[5 x 2 = 10]

PartII

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 $F(X, Y, Z, W) = \sum(0,1,3,4,5,6,7,9,10,11,13,15)$
 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.
- a) Given $G(X,Y,Z,W) = \pi(0,2,4,6,8,9,10,11)$

Use Karnaugh's map to reduce the given function G 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 Panchayat Union of a particular village consists of 4 members- a president and three officers in charge. Any decision taken on developmental plans of the village can be implemented only if :

- The president and at least one officer vote a yes.
- OR
- All three officers vote a yes each.

The inputs are :

- | | | |
|---|---|------------------------------------|
| A | : | Denotes the President's vote. |
| B | : | Denotes the first officer's vote. |
| C | : | Denotes the second officer's vote. |
| D | : | Denotes the third officer's vote. |

Output:

X : Denotes that a plan can be implemented. [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 $X(A,B,C,D)$. [4]
- 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. [6]

Question 6.

- a) What is a multiplexer? Explain the working of a multiplexer. [3]
- b) Explain the following:-
 - i) canonical sum of products
 - ii) canonical product of sums [4]
- c) Draw the truth table for a 2-input NAND gate. Using NAND gates, draw AND & OR gates. [3]

Question 7.

- a) Differentiate between an encoder and a decoder. [2]
- b) Draw the truth table and logic circuit diagram for an octal to binary encoder. Briefly explain the working. [6]
- c) Verify if:-
 $(A+B).(A'+C)=(A+B+C).(A+B+C').(A'+B+C).(A'+B'+C)$ [2]

Question 8.

- a) Draw a logic gate diagram for the following function using NOR gates only.
 $F(A,B,C)= A'B+AB'+C$ [4]
- b) Simplify using laws of Boolean Algebra
 $(AB+X+Y+Z).(AB+X'Y'Z')$ [4]
- c) State whether the following is true or false:-
 $(X+Y).(Y+Z).(X+Z)= X(Y+Z) + YZ$ [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 **Numbers** contains the following data members and member functions to check for triangular numbers. [A triangular number is formed by the addition of a consecutive sequence of integers starting from 1.]

Eg.

$$1 + 2 = 3$$

$$1 + 2 + 3 = 6$$

$$1 + 2 + 3 + 4 = 10$$

$$1 + 2 + 3 + 4 + 5 = 15$$

Therefore 3,6,10,15 are triangular numbers.

Class name	:	Numbers
Data members		
n	:	integer to be checked whether it is triangular or not.
Member functions		
void getnum()	:	to accept integer n.
int check(int)	:	to check if n is triangular.
void dispnum()	:	to display message whether n is triangular or not.

Specify the class Numbers giving details of the functions void getnum(), int check(int) and void dispnum(). The main function need not be written.

[10]

Question 10.

Define a class **Duplicate** to pack an array of 10 integers which are sorted (to pack means to remove all duplicates from the array). For eg. If the given array has the following sorted numbers:

1 2 3 3 4 4 4 5 6 6

The resultant array should contain each element once. The output should be:

1 2 3 4 5 6

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

Class name	:	Duplicate
Data members		
num[]	:	integer array with 10 sorted integers.

Member functions:

void readList()	:	to enter elements of the array in sorted order.
void packList()	:	to remove duplicates from the array.
void dispList(int)	:	to display the array of integers without any duplicates.

Specify the class Duplicate giving the details of the functions void readList(), void packList() and void dispList(int). The main function need not be written.

[10]

Question 11.

Define a class **basePro** and a derived class **derivPro** to find the product of two numbers. The details of both classes are given below:

Class name : basePro
Data members
n1, n2 : float variables whose product is to be determined.

Member functions:

void enter() : to enter values for n1 and n2.
void show() : to display the values of n1 and n2.

Class name : derivPro
Data members :
result : float variable to store product

Member functions

void prod() : to accept values for n1 and n2 and to calculate their product using the concept of inheritance.
void disp() : to display the values of n1, n2 and their product.

- a) Specify the class **basePro** giving details of the function void enter() and void show().
- b) Using the concept of inheritance specify the class **derivPro**, giving details of the functions void prod() and void disp(). The main function need not be written.

[10]

Question 12.

A class **dec_Bin** has been defined to convert a decimal number into its equivalent binary number. Some of the members of the class are given below:

Class name : dec_Bin
Data members
n : integer to be converted to its binary equivalent.
s : binary equivalent number.
i : incremental value of power.

Member functions

dec_Bin() : constructor to assign initial value to the data members.
void getdata() : to accept the value of n.
void recursive(int) : to calculate the binary equivalent of n using the recursive technique.
void putdata() : to display the decimal number n and its binary equivalent.

- a) Specify the class `dec_Bin`, giving details of the constructor and the functions, `void getdata()`, `void recursive()` and `void putdata()`. The main function need not be written. [8]
- b) Give any two differences between the recursion and iteration process. [2]

Question 13.

A class **InsSort** contains an array of 50 integers. Some of the members of the class are given below:

Class name	:	InsSort
Data members		
<code>arr[]</code>	:	an array of 50 integers
Member functions		
<code>InsSort()</code>	:	default constructor
<code>void readarr()</code>	:	to input 50 integers
<code>void showarr()</code>	:	to display the list of sorted integers
<code>int smallarr()</code>	:	returns the index of the smallest integer in the array before sorting
<code>void sort()</code>	:	sorts the array in ascending order using the insertion sort technique

Specify the class `InsSort` giving the details of the constructor and the functions `void readarr()`, `void showarr()`, `intsmallarr()` and `void sort()`. The main function need not be written.

[10]

Question 14.

Define a class **modiString** with the following details:

Class name	:	modiString
Data members		
stra, strb, strc	:	to store three strings of maximum length 10.
ch	:	character which replaces first character of each string.
Member functions		
void getstr()	:	to accept the three strings.
void change()	:	to accept character ch and to replace the first character in each string with this character. (foreg. If 3 strings are :- sore, bunch, such and the accepted character is 'm' , then the display is : more , munch, much).
void next()	:	to change the original string by converting each character to its successive character. (foreg. If the three strings are sore, bunch, such , then the display is tpsf, cvodi, tvdi).
void print()	:	to display the changed strings calling both the functions change() and next().

Specify the class modiString giving the details of the functions void getstr(), void change(), void next() and void print(). The main function need not be written.

[10]