

**ISC SPECIMEN PAPER**  
**Computer Science**  
**Paper 1 (Theory)**  
**Part I**

While working questions in this part, indicate briefly your working and reasoning wherever required.

**Question 1.**

- a) State the two distributive laws of Boolean Algebra. Prove any one of them with the help of truth table.
- b) Draw the truth table to verify the expression:  $p \rightarrow q$  is equivalent to  $\sim q \rightarrow \sim p$ . ( $\sim q = q'$ )
- c) Find the complement of the following:  $[(xy)'.x][(xy)'.y]$
- d) Simplify the following Boolean expression using laws of Boolean Algebra. At each step, clearly state the law used for simplification.  $z(z+x).x(y+y')$
- e) Given  $F(x,y,z) = xz + xy + yz$  Write the function in canonical sum of product form.

**[ 2 x 5 = 10 ]**

**Question 2.**

- a) What do LIFO and FIFO stand for?
- b) For an array of real numbers  $x[-6 \dots 8, -12 \dots 20]$ , find the address of  $x[5][4]$ , if  $x[1][1]$  is stored in location 100 in the column major order. Assume that each element requires 4 bytes.
- c) State the difference between an abstract class and an interface.
- d) Convert the following infix expression to its postfix form.  $b * [(a/d) - (c * (e-f))]$
- e) Define a binary tree.

**[ 2 x 5 = 10 ]**

**Question 3.**

- a) The following function is a part of some class. It returns the value 1 when the number is an Armstrong number, otherwise it returns 0.

```
class Armstrong
{
    /* An armstrong number is a number which is equal to the sum of the cube of its individual digits*/
    int arms(int n)
    {
        int digit=0, sum=0;
        int rem=n;
        while(?1?)
        {
            digit=?2?;
            sum=sum+?3?;
            rem=?4?;
        }
        if(?5?)
            return 1;
        else
            return 0;
        }
    }
```

- i) What is the expression / value at ?1?
- ii) What is the expression / value at ?2?
- iii) What is the expression / value at ?3?
- iv) What is the expression / value at ?4?

v) What is the expression / value at ?5?

[ 1 x 5 = 5 ]

b) Give output of the following function where x and y are arguments greater than 0. Show the dry run/ working.

```
int strange(int x , int y)
{
    //Assuming x>0 y>0
    if(x>y)
    {
        x=x-y;
    }
    return strange(x,y);
}
else
return x;
}
```

i) What will the function strange(20,5) return ?

ii) What will the function strange(15,6) return ?

iii) In one line, state what the function is doing?

[ 2 + 2 + 1 = 5 ]

## Part II

Answer seven questions in this part, choosing three questions from Section A, two from Section B and two from Section C.

### Section A

Answer any three questions

#### Question 4.

a) Given the Boolean function  $F(P,Q,R,S) = \sum(0,1,3,4,5,6,7,9,10,11,13,15)$

Using Karnaugh' map to reduce the function F, using SOP form. Draw the logic gate diagram of the reduced SOP form. You may use gates with more than 2 inputs. Assume that the variables and their complements are available as inputs.

[ 4 + 1 = 5 ]

b) Given the Boolean function  $F(P,Q,R,S) = \pi(3,8,10,12,13,14,15)$

Using Karnaugh' map to reduce the function F, using POS form. Draw the logic gate diagram of the reduced POS form. You may use gates with more than 2 inputs. Assume that the variables and their complements are available as inputs.

[ 4 + 1 = 5 ]

#### Question 5.

The main safe in the nationalized bank can be opened by means of a unique password consisting of three parts. Different parts of the password are held by the chairman, Regional Manager, Bank Manager and Head Cashier of the bank, respectively.

In order to open the safe any one of the following conditions must be satisfied:

The password of the chairman, together with passwords of any two other officials, must be entered.

OR

The password of all three bank officials, excluding the chairman, must be entered.

The inputs are:

INPUTS

A Denotes the chairman's password

- B Denotes the Regional Manager's password
- C Denotes the Bank Manager's password
- D Denotes the Head Cashier's password

Output

X Denotes the safe can be opened[ 1 indicates YES ad 0 indicates NO in all cases]

- a) Draw the truth table for the inputs and outputs given above and write the SOP expression for  $X(A,B,C,D)$ .
- b) Reduce  $X(A,B,C,D)$  using Karnaugh's map, if possible.

Draw the logic gate diagram for the reduced SOP expression for  $X(A,B,C,D)$  using AND and OR gates. You may use gates with two or more inputs. Assume that the variable and their complements are available as inputs.

**[ 5 x 2 = 10]**

**Question 6.**

- a) Draw the truth table and logic circuit diagram for a Decimal to Binary Encoder. **[ 5 ]**
- b) Given  $F(X,Y,Z)=\Sigma(1,3,7)$  Verify :  $F(X,Y,Z)=\pi(0,2,4,5,6)$  **[ 2 ]**
- c) Simplify the following expression by using Boolean laws. Show the working and also mention the laws used:  $X'Y'Z' + XYZ' + XY'Z' + X'YZ'$  **[ 3 ]**

**Question 7.**

- a) Define cardinal form of an expression and canonical form of an expression. Give an example for each. **[ 3 ]**
- b) Which gate is equivalent to : (NOR) OR (XOR) **[ 3 ]**
- c) Define a Half Adder. Draw the truth table and logic diagram of a half adder. **[ 4 ]**

**Section B**

Answer any 2 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.

**Question 8.**

A perfect square is an integer which is the square of another integer. For example, 4,9,16... are perfect squares. Design a class Perfect with the following description:

Class Name	:	Perfect
Data members		
n	:	stores an integer number
Member functions		
Perfect()	:	default constructor
Perfect(int)	:	parameterized constructor to assign value to n
void perfect_sq()	:	to display the first 5 perfect squares larger than 'n' (if n=15, the next 3 perfect squares are 16,25,36).

voidsum\_of() : to display all combinations of consecutive integers whose sum is = n. (The number n=15 can be expressed as :  
 1 2 3 4 5  
 4 5 6  
 7 8

Specify the class Perfect giving details of the constructors, void perfect\_sq() and void sum\_of(). Also define the main function to create an object and call methods accordingly to enable the task.

[ 10 ]

**Question 9.**

A class RecFact defines a recursive function to find the factorial of a number. The details of the class are given below:

Class Name	:	RecFact
Data Members		
n	:	stores the number whose factorial is required.
r	:	stores an integer
Member functions		
RecFact()	:	default constructor
voidreadnum()	:	to enter values for n and r.
int factorial(int)	:	returns the factorial of the number using the recursive technique.
voidfactseries()	:	to calculate and display the value of n! ----- r! * (n-r)!

Specify the class RecFact giving the details of the constructor and member functions void readnum(), int factorial(int) and void factseries(). Also define the main function to create an object and call methods accordingly to enable the task.

[ 10 ]

**Question 10.**

In Piglatin a word such as KING is replaced by INGKAY, while TROUBLE becomes OUBLETRAY and so on. The first vowel of the original word becomes the start of the translation, any preceding letters being shifted towards the end and followed by AY.

Words that begin with a vowel or which do not contain any vowel are left unchanged.

Design a class Piglatin using the description of the data members and member functions given below:

Class name	:	PigLatin
Data members		
txt	:	to store a word
len	:	to store the length
Member functions		

PigLatin()	:	constructor to initialize data members
void readstring()	:	to accept the word input in uppercase
void convert()	:	converts the word into its piglatin form and displays the word. (changed or unchanged)
void consonant()	:	counts and displays the number of
consonants		present in the given word.

Specify the class Piglatin giving details of the constructor, void readstring(), void convert() and void consonant(). Also define a main function to create an object and call methods accordingly to enable the task.

[ 10 ]

### Section C

#### Answer any 2 questions.

Each program/algorithm should be written in such a way that it clearly depicts the logic of the problem step wise. This can also be achieved by using pseudo codes.  
(Flowcharts are not required)

**The programs must be written in Java.**

**The algorithm must be written in general standard form wherever required.**

#### Question 11.

A class Author contains details of the author and another class BookList contains details of the books written by him. The details of the 2 classes are given below:

Class name	:	Author
Data members		
authorno	:	stores the author's number
name	:	stores the author's name
Member functions		
Author()	:	default constructor
Author(.....)	:	parameterized constructor to assign values to author number and name.
void show()	:	to display the author's details.
Class name	:	Booklist
Data members		
bookno	:	long type variable to store the book number.
bookname	:	stores the book name
price	:	float variable to store price
edition	:	integer type variable to store the edition number
Member functions		
Booklist(.....)	:	parameterized constructor to assign values to data members of both the classes.
void show()	:	to display all the details.

Specify the class Author giving details of the constructors and member function void show(). Using the concept of inheritance, specify the class Booklist giving details of the constructor and the member function void show(). Also define the main function to create an object and call methods accordingly to enable the task.

[ 10 ]

**Question 12.**

In a computer game, a vertical column and a pile of rings are displayed. The objective of the game is to pile up rings on the column till it is full. It can hold 10 rings at the most. Once the column is full, the rings have to be removed from the top till the column is empty and the game is over. Define the class RingGame with the following details:

Class Name	:	RingGame
Data members		
ring[]	:	array to hold rings (integer)
max	:	integer to hold maximum capacity
of		
		ring array
upper	:	integer to point to the uppermost element
Member functions		
RingGame(int m)	:	constructor to initialize, max = m & upper to -1.
void jump-in(int)	:	adds a ring to the top of the column, if possible, otherwise, displays a message "Column full. Start removing rings".
void jump-out()	:	removes the ring from the top, if column is not empty, otherwise outputs a message, "Congratulations the game is over ".

Specify the class RingGame giving details of the constructor and functions void jump-in(int) and void jump-out(). Also define the main function to create an object and call methods accordingly to enable the task.

[ 10 ]

**Question 13.**

- a) A Linked List is formed from the objects of the class,  
class Node

```
{
    intnum;
    Node next;
}
```

Write an algorithm of a method for inserting a node in the end of a list. The method declaration is given below:

```
void insertnode(Node start) [ 4 ]
```

- b) State the complexity of the following algorithms:

- i) Linear Search
- ii) Binary search
- iii) Selection sort

[ 3 ]

- c) List the nodes in the tree given below using :
- i) Preorder Traversal
  - ii) Postorder Traversal
  - iii) Inorder Traversal

