

ISC 2005
COMPUTER SCIENCE PAPER 1
THEORY
PART I

Answer all questions in this part

Question 1.

- a) State the distributive law. Verify it using the truth table.
- b) What is the canonical form of Boolean expression? State the two types of canonical form.
- c) Using NOR gates only draw AND, OR and NOT gate.
- d) What is the application of Boolean Algebra in Computer Science?
- e) Reduce the following to its simplest form using laws of Boolean Algebra. At each step state the law used for simplification. $AB'+A'BC'+(AC)'+BC$

[2 X 5 = 10]

Question 2.

- a) What is data structure? What are the different types of data structure?
- b) With a suitable example state the difference between runtime and syntax error.
- c) State the different applications of stack.
- d) Convert the following into postfix: $(A+B/C) + B - C * D + C$
- e) An array ARR[10][5] is stored in memory with each element requiring 2 bytes of storage. If the first element ARR[0][0] is stored at the location 1250, calculate the location of ARR[5][6] when the array is stored row major wise.

[2 X 5 = 10]

Question 3.

- a) What will be the values stored in ar[] after the following program is executed.

```
public static void main(String args[])
{
    int i,j=1;
    int dividend=2,N=30;
    int ar[]={2,0,0,0,0,0,0,0,0,0};
    while(dividend<=N)
    {
        for(i=2;i<dividend; i++)
        {
            if(dividend%i==0)
            {
                break;
            }
            if(i==dividend-1)
            {
                ar[j++]=dividend;
            }
        }
        dividend++;
    }
}
```

- b) The following function is a function of some class. It computes the quotient and remainder of a division.

```

public void quotientrem()
{
    int dividend=13,divisor=2,quo=?1?;
    int rem;
    while(dividend>=?2?)
    {
        dividend-=?3?;
        rem=?4?;
        quo=?5?;
    }
    rem=dividend + divisor;
}

```

- 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?

[5 x 2 = 10]

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

$$F(A,B,C,D) = \sum(0,1,2,4,5,7,11,13,15)$$

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

- b) Now given

$$X(A,B,C,D) = \prod(2,3,4,7,9,10,11,12)$$

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

[5x 2 =10]

Question 5.

The Past Pupil Association of R.K. University Computer Science Department is organizing a reunion function at the campus. The invitation card is to be issued to a person if –

- The person is an ex – student of the department and had passed out in 1995.

OR

- The person is not an ex- student of the department but passed out from the university in 1995 and has made a contribution of Rs. 1000.

The inputs are :

E : The person is an ex student of the department.

U : The person is not an ex student of the department, but a student of the same

- university.
- P : The person passed out in 1995.
- S : The person contributes Rs. 1000.

[1 indicates yes and 0 indicates no in all cases]

Output:-

I : Denotes the invitation card is issued.

- Draw the truth tables for the inputs and outputs given above and write the SOP expression for $I(E,U,P,S)$.
- Reduce $I(E,U,P,S)$ USING Karnaugh's map.

Draw the logic gate diagram for the reduced expression for $I(E,U,P,S)$ using AND, OR gates. You may use gates with 2 or more inputs. Assume that variables and their complements are available as inputs.

[5 x 2 =10]

Question 6.

- What is an encoder? State its application. [2]
- Draw the truth table and logic circuit diagram for converting a decimal number to binary. Explain the working principle with an example. [6]
- Verify that :-
 $(Z+X).(Z+X'+Y) = (Z+X).(Z+Y)$ [2]

Question 7.

- State the difference between half adder and full adder circuit. [2]
- Draw the truth table and logic diagram of a full adder. [5]
- Using two half adder and an OR gate construct a full adder. [3]

Question 8.

- Prove that $F(A,B,C) = \prod(2,3,4,7) = \sum(0,1,5,6)$ [3]
- State the dual form of the following:
 $XY'(XY'Z+X+X'Z')$ [3]
- State the difference between encoder and multiplexer circuit. [2]
- Using NOR gates only draw a logic diagram to construct NAND gate. [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.

Question 9.

Sum = $1 + x/1! + x^3/2! + x^5/3! + \dots + x^{2n-1}/n!$

A class seriessum has been defined to calculate the sum of the above series. Some of the members of the class are given below:

Class name	:	seriessum
Data members		
x		
n	:	int
sum	:	double
Member functions		
sumseries()	:	constructor
int factorial(int n)	:	calculates and returns the factorial of n(n!) where $n!=1 \times 2 \times 3 \times 4 \times \dots \times n$.
double term(int p, int q):		Calculates and returns the value of $p/q!$ by making use of factorial(int).
void accept()	:	Inputs the value of member data x,n
void displaysum()	:	displays the value of member data sum.
double calsum()	:	calculates the sum of the given seriesusing the appropriate data and other member functions.

- Specify the class sumseries giving details of the constructor, int factorial(int), double term(int,int), void displaysum(). You may assume that other member functions are written for you. You do not need to write the main function. **[8]**
- What care do you need to take while designing double term(int, int). **[2]**

Question 10.

Class indexedarray contains the employee code of 100 employees. Some of the members are given below:-

Class name	:	indexedarray
Data member		
arr[]	:	int array
Member functions		
indexedarray()	:	to assign the code to 0.
void fillarray()	:	to input the code in the arr[].
void sortarr()	:	to sort the array variable using selection sort technique.
int binarysearch(int[],int)	:	to search and return 1 if an employee code is found in the array object otherwise returns 0.

Specify the class indexedarray giving details of the constructor, void sortarr(), int binarysearch(). You may assume that other member functions are written for you. You do not need to write the main function. **[10]**

Question 11.

A class quad contains the following data members and member functions to find the roots of a quadratic equation.

Class name	:	quad
Data members		
a		

b
 c
 x1
 x2 : float

Member functions

quad(float,float,float) : constructor to assign values to data members.
 float discriminant() : to return discriminant[b^2-4ac].
 void root_equal() : to display the root if both roots are equal.
 void imag() : to display the roots, if roots are imaginary.
 void root_real() : to display two real, unequal roots.
 void root() : to call other appropriate functions to find the solution of the problem.

If $ax^2 + bx + c = 0$ is the quadratic equation, then if $b^2 - 4ac > 0$ – roots are real, unequal

Where $x1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$

$$x2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

If $b^2 - 4ac = 0$ – roots are real, equal.

$$x1 = x2 = -b/2a$$

If $b^2 - 4ac < 0$ – roots are imaginary.

Specify the class quad giving the details of the functions:-

quad(float , float, float)
 float discriminant()
 void root_real()
 void root()

You may assume that the other functions are written for you. You need write the main function.

[10]

Question 12.

A class recursion has been defined to find the Fibonacci series upto a limit. Some of the members of the class are given below:

Class Name : recursion

Data Members

a

b

c

limit : int

Member functions

recursion() : constructor to assign a,b,c with appropriate values.

void input() : to accept the limit of the series.

int fib(int n) : to return the nth Fibonacci term using recursive technique.

void generatefibseries() : to generate the Fibonacci series upto the given limit.

- a) Specify the class recursion giving details of the constructor, int fib() , void generatefibseries(). You may assume other functions are written for you and you need not write the main function. **[8]**
- b) Why recursive functions result into slower execution of the program? **[2]**

Question 13.

A class Iscscores defines the scores of a candidate in six subjects and another class bestfour defines the best four subjects.

The details of both the classes are given below:-

Class name	:	Iscscores
Data members		
number[6][2]	:	int array to store marks of 6 subjects and subject code.
Member functions		
Iscscores()	:	constructor to accept the marks
int point()	:	to return the point in each subject according to the following:
		Marks>=90 1 point
		80-89 2 points
		70-79 3 points
		60-69 4 points
		50-59 5 points
		40-49 6 points
		-----accordingly

Class name	:	bestfour
Member functions		
void bestsubjects()	:	to display the total points and best four subject codes using the concept of inheritance.

Specify the class details of both the classes using the concept of inheritance. Specify the details of the constructor and all other functions. You may assume that all other functions are written for you.

[10]

Question 14.

A class stringop is designed to handle string related operations. Some members of the class are given below:

Date member		
txt	:	to store the given string of maximum length 100.
Member function		
stringop()	:	constructor
void readstring()	:	to accept the string
char caseconvert(int, int):		to convert the letter to other case
void circular decode() :		to decode the string by replacing each letter by converting it to opposite case and then by the next character in a circular way. Hence "AbZ" will decode "bCa".

Specify the class giving details of all member functions . You do not need to write function main().

[10]