ISC 2010
COMPUTER SCIENCE PAPER 1
THEORY

Question 1.

a) If X=A'BC + AB'C + ABC + A'BC' then find the value of X when A=1; B=0; C=1
b) Verify if, P.(~P+Q')=(P→Q) using truth table.
c) Draw the logic circuit of NOR using NAND gate only.
d) Convert the following function into its Canonical Sum-Of_products form:
   F(X,Y,Z)= ∑(0,1,5,7)
e) Show that the dual of P'QR' + PQ'R + P'Q'R is equal to the complement of PQ'R + Q(P'R' + PR')

[2 x 5 = 10]

Question 2.

a) State the difference between an interface and a class.
b) Convert the following infix notation to postfix notation.
   (A+B) / C * (D +E)
c) A character array B[7][6] has a base address 1046 at 0,0. Calculate the address at B[2][3] if the array is stored Column Major wise. Each character requires 2 bytes of storage.
d) State the use of exception handling. Name the two types of exceptions.
e) i) What is the worst-case complexity of the following code segment :

```
for(int i=0;i<N;i++)
{
        Sequence of statements
}
for(int j=0;j<M;j++)
{
        Sequence of statements
}
```

ii) How would the complexity change if the second loop went to N instead of M?

[2 x 5 = 10]

Question 3.

a) The following function numbers(int) and numbers1(int) are a part of some class. Answer the questions given below showing the dry run/working:

```
public void numbers(int n)
{
    if(n>0)
    {
        System.out.print(n+" ");
        numbers(n-2);
        System.out.print(n+" ");
    }
}
public String numbers1(int n)
{
    If(n<=0)
        return "";
    return(numbers(n-1)+n+" ";
}
```

i) What will be the output of the function numbers(int n) when n=5? **[2]**

ii) What will the function numbers1(int n) return when n=6? **[2]**

iii) State in one line what is the function numbers1(int) doing apart from recursion? **[1]**

b) The following function is a part of some class. It sorts the array a[] in ascending order using insertion sort technique. There are some places in the code marked by ?1?, ?2?, ?3?, ?4?, ?5? which must be replaced by expression/ statement so that the function works correctly.

```
void insertsort(int a[])
{
    int m= ?1?;
    int b,l,t;
    for(i=?2?;i<m;i++)
    {
        t=a[i];
        b=i-1;
        while(?3?>=0 && t<a[b])
        {
            a[b+1]= a[b];
            ?4?;
        }
        ?5?=t;
    }
}
```

i) What is the expression or statement at ?1? **[1]**

ii) What is the expression or statement at ?2? **[1]**

iii) What is the expression or statement at ?3? **[1]**

iv) What is the expression or statement at ?4? **[1]**

v) What is the expression or statement at ?5? **[1]**

Part II

Section A

Answer any three questions

Question 4.

a) Given F(P,Q,R,S)= ∑(0,2,5,7,8,10,11,13,14,15)
   i) Reduce the above expression by using 4- variable K-Map, showing the various groups (i.e. octals, quads and pairs).
   ii) Draw the logic gate diagram of the reduced expression using NAND gate only.

b) Given F(A,B,C,D)= (A+B+C+D).(A+B+C+D').(A+B+C'+D').(A+B+C'+D).(A+B'+C+D').(A+B'+C'+D').(A'+B+C+D).(A'+B+C'+D)
   i) Reduce the above expression by using 4- variable K-Map, showing the various groups (i.e. octals, quads and pairs).
   ii) Draw the logic gate diagram of the reduced expression using NOR gate only.

[5 x 2 =10]

Question 5.

A government institution intends to award a medal to a person who qualifies any one of the following criteria:

The person should have been an Indian citizen and had lost his/her life in a war but has not completed 25 years of service.

OR

The person must be an Indian citizen and has served the nation for a continuous period of 25 years or more but has not lost his/her life in a war.

OR

The person is not an Indian citizen but has taken active part in activities for the upliftment of the nation.

The inputs are:

INPUTS

A	The person is/was an Indian citizen
B	Has a continuous service of more than 25 years
C	Lost his/her life in a war
D	Taken part in activities for upliftment of the nation

Output

X	Denotes eligible for medal [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 POS expression for X(A,B,C,D)..
b) Reduce X(A,B,C,D) using Karnaugh's map.
   Draw the logic gate diagram for the reduced POS expression for X(A,B,C,D) using AND and OR gate. 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) What are Maxterms? Convert the following function as a Product of Maxterms:
F(P,Q,R)= (P+Q).(P'+R')

b) State whether the following expression is a Tautology or Contradiction with the help of a truth table:
(X↔Z). [(X→Y).(Y→Z)]

c) What is a Multiplexer? Draw the truth table and logic diagram of a 8:1 multiplexer.

[2+3+5=10]

Question 7.

a) Draw the circuit diagram for a 3 to 8 decoder.

b) Draw the truth table for a half adder. Also derive a POS expression for the half adder and draw its logic circuit.

c) Simplify the following expression and also draw the circuit for the reduced expression. [Show the step wise working along with the laws used.]
F= X. (Y+Z.(X.Y +X.Z)')

[3+3+4=10]

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.

The co-ordinates of a point P on a two-dimensional plane can be represented by P(x,y) with x as the x co-ordinate and y as the y co-ordinate. The co-ordinates of midpoint of two points P1(x1,y1) and P2(x2,y2) can be calculated as P(x,y) where:
x=x1+x2/2, y=y1+y2/2
Design a class Point with the following details:

Class name	:	Point
Data members		
x	:	stores the x co-ordinate
y	:	stores the y co-ordinate
Member functions:		
Point()	:	constructor to initialize x=0 and y=0
void readPoint()	:	accepts the co-ordinates x and y of a point
Point midpoint(Point A, Point B):		calculates and returns the midpoint of the two points A and B.
void displaypoint()	:	displays the co-ordinates of a point

Specify the class Point giving details of the constructor( ), member functions void readPoint(), Point midpoint(Point, Point) and void displaypoint() along with the main function to create an object and call the functions accordingly to calculate the midpoint between any two given points.

[10]

Question 9.

Input a word in uppercase and check for the position of the first occurring vowel and perform the following operation.

i) Words that begin with a vowel are concatenated with "Y" . For example, EUROPE becomes EUROPEY.

ii) Words that contain a vowel in between should have the first part from the position of the vowel till end, followed by the part of the string from beginning till position of the vowel and is concatenated by "C". For example PROJECT becomes OJECTPRC.

iii) Words which do not contain a vowel are concatenated with "N". For example, SKY becomes SKYN.

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

Class name	:	Rearrange
Data members		
Txt	:	to store a word
Cxt	:	to store the rearranged word
len	:	to store the length of the word
Member functions		
Rearrange()	:	constructor to initialize the instance variables
void readword()	:	to accept the word input in UPPERCASE
void convert()	:	converts the word into its changed form and stores it in string Txt
void display()	:	displays the original and the changed word

Specify the class Rearrange giving the details of the constructor(), void readword(), void convert() and void display(). Define a main function to create an object and call the function accordingly to enable the task.

[10]

Question 10.

Design a class Change to perform string related operations. The details of the class are given below:

Class name	:	Change
Data members		
str	:	stores the word
newstr	:	stores the changed word
len	:	stores the length of the word
Member functions		
Change()	:	default constructor
void inputword()	:	to accept a word
char caseconvert(char ch)	:	converts the case of the character and returns it
void recchange(int)	:	extracts characters using recursive technique and changes its case using caseconvert() and forms a new word
void display()	:	displays both the words

a) Specify the class Change, giving details of the constructor(), member functions void inputword(), char caseconvert(char ch), void recchange(int) and void display(). Define the main function to create an object and call the functions accordingly to enable the above change in the given word. **[8]**

b) Differentiate between finite and infinite recursion. **[2]**

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 super class Worker has been defined to store the details of a worker. Define a sub class Wages to compute the monthly wages for the worker. The details of both the classes are given below:

Class name	:	Worker
Data members	:	
Name	:	to store the name of the worker
Basic	:	to store the basic pay in decimal
Member functions		
Worker(….)	:	parameterized constructor to assign values to the instance variables
void display()	:	display worker details
class name	:	Wages
Data members		
hrs	:	stores the hours worked
rate	:	stores rate per hour
wage	:	stores the overall wage of the worker
Member functions		
Wages(….)	:	parameterized constructor to assign values to the instance variables of both classes
double overtime( )	:	calculates and returns the overtime amount as (hours * rate)
void display()	:	calculates the wage using the formula wage=overtime amount +basic pay and displays it along with other details

Specify the class Worker giving details of the constructor() and void display(). Using the concept of inheritance, specify the class Wages giving details of the constructor(), double overtime() and void display(). The main function need not be written.

[10]

Question 12.

Define a class Repeat which allows the user to add elements from one end (rear) and remove elements from one end (rear) and remove elements from the other end (front) only.

The following details of the class Repeat are given below:

Class name	:	Repeat
Data members		
st[]	:	an array to hold a maximum of 100 integer elements
cap	:	stores the capacity of the array
f	:	to point to the index of the front
r	:	to point to the index of the rear
Member functions		
Repeat(int m)	:	constructor to initialize the data members cap=m, f=0, r=0 and to create the integer array
void pushvalue(int v)	:	to add integers from the rear index if possible else display the message "overflow"
int popvalue()	:	to remove and return element from the front, if array is empty then return -9999
void disp()	:	displays the elements present in the list

a) Specify the class Repeat giving details of the constructor(int), member function void pushvalue(int), int popvalue() and void disp(). The main function need not be written. **[8]**

b) What is the common name of the entity described above? **[1]**

c) On what principle does this entity work? **[1]**

Question 13.

a) A linked list is formed from the objects of the class,

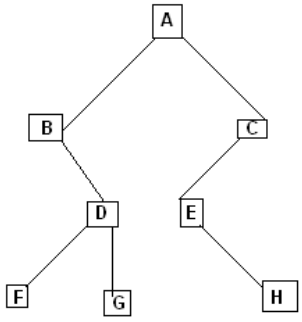
```
class ListNodes
{
        int item;
        ListNodes next;
}
```

Write a method OR an algorithm to compute and return the sum of all integers items stored in the linked list. The method declaration is specified below:

```
int listsum(ListNodes start);
```

b) What is Big 'O' notation? State its significance.

c) Answer the following from the diagram of a Binary tree given below:



i) Name the parent node of E. **[1]**

ii) Write the postorder tree traversal. **[1]**

iii) Write the internal nodes of the tree. **[1]**

iv) State the level of the root of the tree. **[1]**

COMPUTER SCIENCE

Paper – 2

(PRACTICAL)

(Reading Time: 15 minutes)

(Planning Session AND Examination Session: Three Hours)

The total time to be spent on the Planning and the Examination Session is Three hours.

After completing the Planning Session, the candidate may begin with the Examination Session.

A maximum of 90 minutes is permitted to begin the Examination Session.

However, if candidates finish earlier, they are to be permitted to begin the Examination Session.

(Maximum Marks: 80)

As it is a practical examination the candidate is expected to do the following:

1. Write an algorithm for the selected problem. **[10]**
   (Algorithm should be expressed clearly using any standard scheme such as pseudo code or in steps which are simple enough to be obviously computable.)
2. Write a program in **JAVA** language. The program should follow the algorithm and should be logically and syntactically correct. **[20]**
3. Document the program using mnemonic names / comments, identifying and clearly describing the choice of data types and meaning of variables. **[10]**
4. Code / Type the program on the computer and get a printout (hard copy). Typically, this should be a program that compiles and runs correctly. **[10]**
5. Test run the program on the computer using the given sample data and get a printout of the output in the format specified in the problem. **[20]**
6. Viva-Voce on the **Selected Problem.** **[20]**

*Solve any **one** of the following Problems:*

Question 1

A bank intends to design a program to display the denomination of an input amount, up to 5 digits. The available denomination with the bank are of rupees 1000 , 500 , 100 , 50 , 20 , 10 , 5 , 2 , and 1.

Design a program to accept the amount from the user and display the break-up in descending order of denomination. (i.e. preference should be given to the highest denomination available) along with the total number of notes. [Note: Only the denomination used should be displayed]. Also print the amount in words according to the digits.

Example 1

INPUT : 14856
OUTPUT : ONE FOUR EIGHT FIVE SIX

DENOMINATION :	1000	x	14	=	14000
	500	x	1	=	500
	100	x	3	=	300
	50	x	1	=	50
	5	x	1	=	5
	1	x	1	=	1
	TOTAL			=	14856
TOTAL NUMBER OF NOTES				=	21

Example 2

INPUT : 6043
OUTPUT : SIX ZERO FOUR THREE

DENOMINATION :	1000	x	6	=	6000
	20	x	2	=	40
	2	x	1	=	2
	1	x	1	=	1
	TOTAL			=	6043
TOTAL NUMBER OF NOTES				=	10

Example 3

INPUT : 235001

OUTPUT : INVALID AMOUNT

Question 2

A positive whole number 'n' that has 'd' number of digits is squared and split into two pieces, a right-hand piece that has 'd' digits and a left-hand piece that has remaining 'd' or 'd-1' digits. If the sum of the two pieces is equal to the number, then 'n' is a Kaprekar number. The first few Kaprekar numbers are: 9, 45, 297 ……..

Example 1:

9
9^2 = 81, right-hand piece of 81 = 1 and left hand piece of 81 = 8
Sum = 1 + 8 = 9, i.e. equal to the number.

Example 2:

45
45^2 = 2025, right-hand piece of 2025 = 25 and left hand piece of 2025 = 20
Sum = 25 + 20 = 45, i.e. equal to the number.

Example 3:

297
297^2 = 88209, right-hand piece of 88209 = 209 and left hand piece of 88209 = 88
Sum = 209 + 88 = 297, i.e. equal to the number.

Given the two positive integers *p* and *q*, where $p < q$, write a program to determine how many Kaprekar numbers are there in the range between *p* and *q* (both inclusive) and output them.

The input contains two positive integers *p* and *q*. Assume $p < 5000$ and $q < 5000$. You are to output the number of Kaprekar numbers in the specified range along with their values in the format specified below:

SAMPLE DATA:

INPUT:
p = 1
q = 1000

OUTPUT:

THE KAPREKAR NUMBERS ARE:-

1, 9, 45, 55, 99, 297, 703, 999

FREQUENCY OF KAPREKAR NUMBERS IS: 8

Question 3

Input a paragraph containing 'n' number of sentences where (1 = < n < 4). The words are to be separated with a single blank space and are in UPPERCASE. A sentence may be terminated either with a full stop '.' or a question mark '?' only. Any other character may be ignored. Perform the following operations:

i. Accept the number of sentences. If the number of sentences exceeds the limit, an appropriate error message must be displayed.
ii. Find the number of words in the whole paragraph
iii. Display the words in ascending order of their frequency. Words with same frequency may appear in any order.

Example 1

INPUT: Enter number of sentences.
1
Enter sentences.
TO BE OR NOT TO BE.

OUTPUT: Total number of words: 6

WORD	**FREQUENCY**
OR	1
NOT	1
TO	2
BE	2

Example 2

INPUT: Enter number of sentences
3
Enter sentences.
THIS IS A STRING PROGRAM.IS THIS EASY?YES,IT IS.

OUTPUT: Total number of words: 11

WORD	**FREQUENCY**
A	1
STRING	1
PROGRAM	1
EASY	1
YES	1
IT	1
THIS	2
IS	3

Example 3

INPUT: Enter number of sentences
5
OUTPUT: Invalid entry