COMPUTER SCIENCE, Practice Paper – 1 (THEORY)
PART I, Answer all questions

Question 1
(a) Verify using the truth table, if (X=>Y).(Y=>X) is a tautology, contradiction or contingency. [2]
(b) State the two Idempotence laws of Boolean Algebra. Verify any one of them using Truth Table. [2]
(c) Show how a NAND gate can be used to construct an OR gate. [2]
(d) Given, F (X, Y, Z) = (X+Y).(Y+Z) write the function in canonical product-of-sum form. [2]
(e) Given, the Boolean Function, F (X, Y, Z) = Σ (2, 3, 4, 6, 7). Reduce it using Karnaugh's Map and also find the complement of its result. [2]

Question 2
(a) State the difference between Function Overloading and Function Overriding. [2]
(b) What is a Binary Tree? What do you mean by Traversing a Tree? [2]
(c) Each element of an array A [-15….. 20, 20….. 45] requires 4 bytes for storage. [2]
Find the address of A [30][20] if the base address is 1000, in: (i) Row Major Wise (ii) Column Major Wise
(d) What do you mean by Complexity? What is the complexity of Binary Search? [2]
(e) Convert the following infix notation to its postfix form: [2] (A + (B * C)) / (C – (D * B))

Question 3
(a) Give output of the following function where x and y are arguments greater than 0. Show the dry run.

```
void confusing ( int x, int y )
{       if ( x > 1 ) // base case
        {       if ( x % y = = 0 )
                {       System.out.print( y + " " );
                        confusing ( x / y, y);
                } // end of inner if
                else
                confusing ( x , y+1);
        } //end of outer if
}
```

(i) What will the function confusing (24 , 2) return ? [2]
(ii) What will the function confusing (84 , 2) return ? [2]
(iii) In one line, state what the function is doing, apart from recursion. [1]
(b) The following function is a part of some class which prints whether a number is a Magic Number (Repeated sum of digits=1) or not. It returns the value 1 when the number is a Magic Number, otherwise it returns 0. There are some places in the code marked by ?1?, ?2?, ?3?, ?4?, ?5? which must be replaced by a statement /expression so that the function works properly:

```
int isMagic (int n)                          (i) What is the expression/value at ? 1 ? [1]
{       int dig = 0, s = n;                  (ii) What is the expression/value at ? 2 ? [1]
        while ( ? 1 ? )                      (iii) What is the expression/value at ? 3 ? [1]
        {       n = s, s = 0;                (iv) What is the expression/value at ? 4 ? [1]
                while (n > 0)                (v) What is the expression/value at ? 5 ? [1]
                {       dig = ? 2 ?;
                        s = s + ? 3 ?;
                        ? 4 ?;
                } //end of inner while
        } //end of outer while
        if ( ? 5 ? )
                return 1;
        else
                return 0;
}
```

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 (A,B,C,D) = Σ (0, 1, 2, 5, 8, 9, 10)
(i) Reduce the above expression by using 4 - variable K-Map, showing the various groups (i.e; octal , quads and pairs). [4]
(ii) Draw the Logic gate diagram of the reduced expression. Assume that the variable and their complements are available as inputs. [1]
(b) Given the Boolean function: F (A,B,C,D) = π (3, 4, 6, 7, 11, 12, 13, 14, 15)
(i) Reduce the above expression by using 4 - variable K-Map , showing the various groups (i.e; octal , quads and pairs). [4]
(ii) Draw the Logic gate diagram of the reduced expression. Assume that the variable and their complements are available as inputs. [1]

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 same department but passed out from the University in 1995 and has made a contribution of 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
C : The person contributes ` 1000
OUTPUT IS:
I : Denotes the Invitation Card is issued[1 indicates it is issued and 0 indicates it is not issued]
(a) Draw the truth table for the inputs and outputs given above and write the SOP expression for I (E, U, P, C).
(b) Reduce I (E, U, P, C) using Karnaugh's map.
(c) Draw the logic gate diagram for the reduced SOP expression for I(M, S, C, Y) using AND & OR gates. You may use gates with two or more inputs. Assume that variable and their complements are available as inputs.
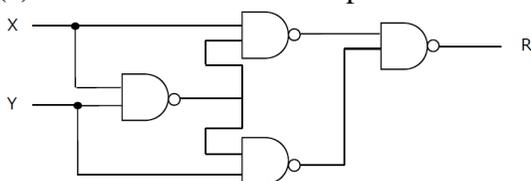
Question 6
(a) Draw the logic diagram and Truth Table to Encode the Hexadecimal lines (A – F). Briefly explain the working of the logic diagram. [5]
(b) Prove that the complement of A.(A + B).B.(B + C) is a Universal Gate. [3]
(c) Given : F (x, y, z) = π (2,3,6,7) Verify : F (x, y, z) = Σ (0,1,4,5) [2]

Question 7
(a) Find out the Boolean expression R from the following Logic diagram: [3]

Can you replace this by a single gate? If yes, draw that logic gate.
(b) State any one of the applications the following: (i) Multiplexer (ii) Half Adder [2]
(c) Using only NAND gates, draw a Logic circuit of the following function: F (X, Y, Z) = X.Y' + X'.Z [2]
(d) What are decoders? [2]
(e) How many select lines does an 8:1 multiplexer have? [1]

SECTION – B, Answer any two questions

Question 8

The Combination function C(n , k) gives the number of different (unordered) K – elements Subsets that can be found in a given set of n elements.

$$C(n,k) = \frac{n!}{k!(n-k)!}$$

The function can be computed from the formula:

Design a class Combination to implement this formula. Some of the data members and member functions are given below.

Class name: Combination

Data members/instance variables:

   n : integer number

   k : integer number

Member functions :

   Combination ( ) : to initialize the data members n = 0 and k = 0

   void read( ) : to accept the value of the data members

   int fact(int) : return the factorial of a number using Recursion Technique.

   void compute( ) : calculate and display the result

(a) Specify the class Combination, giving details of the Constructor and member functions void read( ), int fact(int) and void compute( ). Also write the main( ) function to create an object and call the member function accordingly in order to enable the task . [8]

(b) Give any two appropriate differences between recursion and iteration process. [2]

Question 9

A class MyArray contains an array of n integers (n<=100) that are already arranged in ascending order. The subscripts of the array elements vary from 0 to n-1. Some of the member functions of the class are given below:

Class name : MyArray

Data members/instance variables :

   arr : an array of n integers.

   n : size of the array

Member functions/methods :

   MyArray( ) : constructor to initialize 0 in each memory location of the array arr[ ]

   void readArray( ) : to read n integers that are arranged in ascending order.

   void displayArray( ) : to display the n integers of the array arr [ ]

   int binarySearch(int) : to search for the value taken as parameter in the array using the Binary Search Technique. It returns the subscript of the array element if the value is found, otherwise it returns -999.

(a) Specify the class MyArray giving the details of the void displayArray( ) and int binarySearch(int). You need not write the main function. [7]

(b) What changes would be necessary in the method binarySearch(int) if the given array was arranged in descending order. [2]

(c) When will binary search technique fail to work? [1]

Question 10

Design a class Palindrome which enables a word to be arranged in ascending order according to its alphabets and also finds the frequency of each alphabets present in the word. The details of the members of the class are given below:

Class name : Palindrome

Data members/instance variables :

   str : to store a word

   revword : to store the reverse of the word

Member functions/methods:

Palindrome( ) : constructor to initialize data members with initial values

void readWord( ) : to accept the inputted word

String rev(String, int) : to reverse the word using Recursive Technique

void disp( ) : to display the original word, and the reversed word

void isPalin( ) : to check whether the inputted word is a Palindrome or not by calling the rev( ) function.

Specify the class Palindrome giving details of the constructor and member functions void readWord(), String rev(String,int), void disp( ) and void isPalin( ). Define the main( ) function to create an object and call the member function according to enable the task . [10]

SECTION – C, Answer any two 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 library issues a book on rental basis at a 2% charge on the cost price of the book per day. As per the library, a book can be retained for 7 days without any fine. If the book is returned after 7 days, a fine will also be charged for the excess days as per the chart given below:

Number of excess days Fine per day (in ₹)

Number of excess days	Fine per day (in ₹)
1 to 5	₹ 2.00
6 to 10	₹3.00
Above 10 days	₹5.00

Design a class Library and another class Compute to perform the task. The classes details are as given:

Class name : Library

Data members/instance variables :

Name, author : string variables to store name of book and authors name

p : Price of the book in decimals.

Member functions/methods :

Library(String n,String a,double np) : parameterized constructor to assign the parameters n to name, a to author and np to p.

void show( ) : displays the book details

Class Name : Compute

Data members/instance variables :

d : number of days taken in returning the book

r : to store the fine.

Member functions/methods :

Compute (........) : parameterized constructor to assign values to data members of both the classes.

void fine( ) : calculates the fine for the excess days.

void display( ) : displays the book details along with the number of days, fine and total amount to be paid as fine. The Amount is calculated as : (2% of price of book * total no. of days) + fine

Specify the class Library giving the details of the constructor and void show( ). Using the concept of inheritance, specify the class Compute giving the details of constructor, void Fine( ) and void display( ) function. You do not need to write the main( ) function. [10]

Question 12

Rack is a kind of data structure which can store at the most 20 books. The rack restriction is that a book can be kept in to the rack or removed only at one end i.e. on the top. The class Rack has the following details:

Class name : Rack

Data members/ instance variables :

book[ ] : array of string of maximum 50 locations to store books.

name : string variable to store name of book.

Limit : integers as maximum capacity of the array

top : integer to indicate topmost book into the Rack.

Member functions/methods :

Rack( ) : a constructor to store blank in the array book[ ].

Rack(int nx) : a constructor to assign nx to limit and -1 to top.

void dispList( ) : to display list of books in the rack.

boolean ifEmpty( ) : returns true, if rack is empty, otherwise returns false.

void putTheBook( ) : input name of the book into variable name and adds it on the top into the array book[ ] if rack is empty otherwise prints a message "Rack overflow".

void removeBook( ) : removes a book form the top of the rack, if rack is not Empty and print the book name, otherwise outputs a Message "Rack underflow".

(a) Specify the class Rack giving details of constructors and the functions ifEmpty(), void putTheBook( ), void removeBook( ) only. Assume that other functions are already written for you. You do not need to write the main function. [9]

(b) Name the entity which is being used by the above class and also state the principle it uses. [1]

Question 13

(a) Link Lists are linear data structure. Create Algorithms for the following operations: [4]

(i) Insertion of a Node at the beginning in a Link List.

(ii) Deletion of the first Node in a Link list.

(iii) Insertion of a Node at the end of the List.

(iv) Deletion of the last Node in a Link list.

(b) Answer the questions below for the given binary tree: [4]
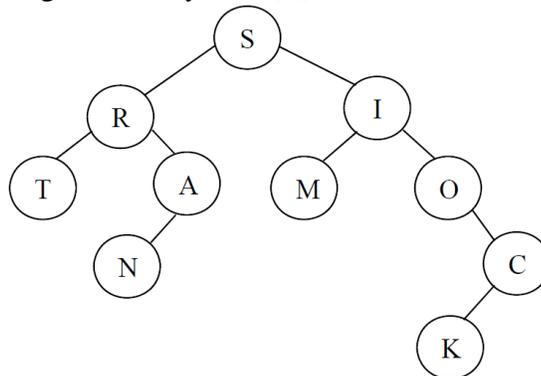
(i) State the Height of the Binary Tree

(ii) List the leaf nodes of the Binary Tree

(iii) Write In-order traversal of the Binary Tree

(iv)Write Preorder traversal of the Binary Tree

(c) State the Best Case and Worst Case complexity for the following algorithms : [2]

(i) Bubble Sort

(ii) Selection Sort

COMPUTER SCIENCE, Practice Paper – 2 (THEORY)
PART I, Answer all questions

Question 1

(a) Verify using the truth table, A + A = A. Also state the law. [2]

(b) If X → Y then write its: (i) Converse (ii) Contra positive [2]

(c) Show how a NAND gate can be used to construct an OR gate. [2]

(d) Given, F (X, Y, Z) = X.Y + Z', write the function in canonical sum-of-product form. [2]

(e) Given, the Boolean Function, F (X, Y, Z) = Σ (2, 3, 4, 6, 7). Reduce it using Karnaugh's Map. And also find the complement of its result. [2]

Question 2

(a) State the difference between linear and non-linear data structures. [2]

(b) What is an Abstract class? [2]

(c) A matrix B[10][7] is stored in the memory with each element requiring 2 bytes of storage. If the base address at B[X][1] is 1012 and the address at B[7][3] is 1060, determine the value 'X' where the matrix is stored in Column Major form. [2]

(d) What do you mean by Dominant term in Complexity? Give an example? [2]

(e) Convert the following infix notation to its postfix form: (A + B) * (B * C) / (C – D * B) [2]

Question 3

(a) Give output of the following function where a and b are arguments greater than 0. Show the dry run.

```
int somefun (int a, int b)
{       int an, s, k;
        if(a<b) {
                s   = a; k = b;
        }
        else {
                s = b; k = a;
        }
        an = k;
        while(an % s ! = 0)
                an + = k;
        return an;
}
```

(i) What will the function somefun (4 , 7) return ? [2]

(ii) What will the function somefun (7 , 5) return ? [2]

(iii) In one line, state what the function is doing, apart from recursion. [1]

(b) The following function is a part of some class which searches for a value (search) in an array arr[] using the Binary Search technique. (Assume that the array arr[] has been sorted in ascending order. It returns the value 1 when the search is successful, otherwise it returns 0. There are some places in the code marked by ?1?, ?2?, ?3?, ?4?, ?5? which must be replaced by a statement / expression so that the function works properly:

```
int binSearch (int arr[], int search)
{ int lb = 0, ub = arr.length-1, mid, flag=0;
 while ( ? 1 ? ) {
        mid = ? 2 ?;
        if (arr[mid] == search)
        {       ? 3 ?;
                break;
        }
        else if (search>arr[mid]) ? 4 ?;
        else ? 5 ?;
 } //end of while
if ( flag == 1 ) return 1;
else return 0;
}
```

(i) What is the expression/value at ? 1 ? [1]

(ii) What is the expression/value at ? 2 ? [1]

(iii) What is the expression/value at ? 3 ? [1]

(iv) What is the expression/value at ? 4 ? [1]

(v) What is the expression/value at ? 5 ? [1]

PART – II, SECTION – A, Answer any three questions

Question 4

(a) Given the Boolean function: F (A,B,C,D) = Σ (3, 4, 6, 7, 11, 12, 14, 15)

(i) Reduce the above expression by using 4 - variable K-Map, showing the various groups (i.e; octal , quads and pairs). [4]

(ii) Draw the Logic gate diagram of the reduced expression. Assume that the variable and their complements are available as inputs. [1]

(b) Given the Boolean function: F (A,B,C,D) = π (0, 8, 10, 12, 13, 14, 15)

(i) Reduce the above expression by using 4 - variable K-Map , showing the various groups (i.e; octal , quads and pairs). [4]

(ii) Draw the Logic gate diagram of the reduced expression. Assume that the variable and their complements are available as inputs. [1]

Question 5

A man goes to a placement agency to search for a lady receptionist. The office has information about 10,000ladies.

The man gives two conditions:-

○The lady must be a teacher or graduate.

○The lady must be 25 years or less and fluent in English.

THE INPUTS ARE:

G - The lady is a graduate (1 indicates yes and 0 indicates no)

T - The lady is a teacher (1 indicates yes and 0 indicates no)

A - The lady is 25 years or less (1 indicates yes and 0 indicates no)

B - The lady is fluent in English (1 indicates yes and 0 indicates no)

OUTPUT IS:

S : The lady is selected [1 indicates she is selected and 0 indicates she is rejected]

(a) Draw the truth table for the inputs and outputs given above and write the POS expression for S (G, T, A, B).

(b) Reduce S (G, T, A, B) using Karnaugh's map.

Draw the logic gate diagram for the reduced POS expression for S (G, T, A, B). You may use gates with two or more inputs. Assume that variable and their complements are available as inputs.

Question 6

(a) In the following truth table X and Y are inputs and B and D are outputs: [3]

X	Y	D	B
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

Answer the following questions: (i) Write the SOP expression for D. (ii) Write the POS expression for B.

(iii) Draw the logic diagram for SOP expression derived for D, using only NAND gates.

(b) Using truth table verify: (~p → q) ^ p = (p ^ ~q) v (p ^ q). [3]

(c) From the logic circuit diagram given below, name the outputs (1), (2) and (3). Finally derive the Boolean expression and simplify it to show that it represents a logic gate. Name and draw the logic gate. [4]
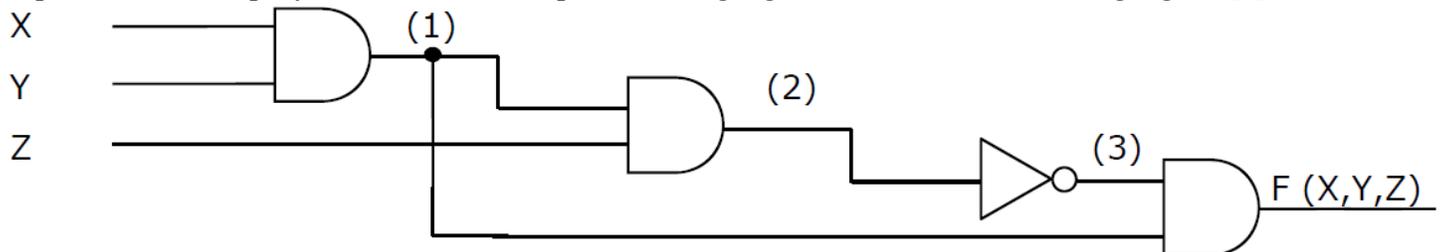
Question 7

(a) A combinational logic circuit with three inputs P, Q, R produces output 1 if and only if an odd number of 0's are inputs. [4]

(i) Draw its truth table (ii) Derive a canonical SOP expression for the above truth table.
(iii) Find the complement of the above derived expression using De Morgan's theorem and verify if it is equivalent to its POS expression.
(b) State a difference between multiplexers and decoders. Also state a use of each. [2]
(c) Draw the truth table and a logic gate diagram for a 4 : 1 multiplexer and briefly explain its working. [4]

SECTION – B, Answer any two questions
Question 8
A class called DigiNumber has been defined to find the frequency of each digit present in a number and the sum of the digits. Some of the members of the class DigiNumber are given below:
Class name : DigiNumber
Data members/instance variables :
        num : long integer for storing the number
Member functions :
        DigiNumber ( ) : constructor to assign 0 to num
        DigiNumber (long n) : parameterised constructor to assign n to num
        void digitfrequency( ) : find the frequency of each digit present in num and to display it
        long sumDigits(long N) : to return the sum of the digits of the number stored in num using Recursive
Technique
        void printsum( ) : print sum of digits of num by invoking sumDigits(…)
Specify the class DigiNumber, giving details of the two Constructor and functions void digitfrequency( ), long sumDigits(long) and void printsum( ). Also write the main( ) function to create an object and call the member function accordingly. [10]
Question 9
A class Collection contain ns an array of 100 integers. Using the following class description, create an array with common elements from two integer arrays. Some of the members of the class are given below:
Class name : Collection
Data members/instance variables:
        arr[] : an array of 100 integers.
        len : length of the array
Member functions/methods :
        Collection( ) : default constructor
        Collection(int) : parameterised constructor to assign the length of array
        void readArray( ) : to accept array elements.
        Collection common(Collection) : return the Collection containing the common elements of the current
Collection object and the Collection objet passed as Parameter
        void displayArray( ) : to display the array elements
Specify the class Collection giving the details of the constructors and the given. You need not write the main function. [10]
Question 10
Write a Java program to input a sentence from the user in lowercase and removes the first and the last characters of every word in it.
        Sample Input : i love java for school.
        Sample Ouptut : ov av o choo
Some of the data members and member functions are given below:
Class name : Remove
Data members/instance variables:
        sent : stores the sentence
        rem : to store the new sentence
        size : stores the length of the sentence
Member functions:

Remove() : default constructor

void readsentence() : to accept the sentence

void remfirstlast() : extract each word and remove the first and the last alphabet of the word and form a new sentence 'rem' using the changed words

void display() : display the original sentence along with the new changed sentence.

Specify the class Capitalize giving details of the constructor Remove (), void readsentence(), void remfirstlast() and void display(). Define the main() function to create an object and call the function accordingly to enable the task.

<div align="center">SECTION – C, Answer any two questions.</div>

Question 11 [10]

A class Salesman defines the personal data of a salesman while another class Sales defines the bill number, name of the item, number of items sold and price of the item. The details of classes are as:

Class name : Salesman

Data members/instance variables :

name : string variable to store name of salesman

address : string variable to store address.

Member functions/methods :

Salesman( ) : constructor to assign null ("") to name and address.

void readDetails(String n, String ad) : to assign 'n' to name and 'ad' to address.

void show( ) : to print values of name and address using suitable headings

Class Name : Sales

Data members/instance variables :

billno, qty : integer to store bill number and quantity

price, psales : double type to store price and previous sales amount.

pname : string variable to store name of product

Member functions/methods :

void readDetails(int b, int q, double p, : to assign 'b' to billno, 'q' to qty, 'p' to price,

double s, String pr) 's' to psales (previous sales) and 'pr' to pname

double calculate( ) : to calculate and return the total sales using the formula: $p * qty + psales$

void show( ) : to display values of pname, billno, qty, price, sales and total sales made by invoking suitable function.

Specify the class Salesman giving the details of the constructor, functions void readDetails(…) and void show(). Using the concept of inheritance, specify the class Sales giving the details of the functions void readDetails(…), double calculate() and void show( ) function. You do not need to write the main() function. [10]

Question 12

A circular queue is a linear data structure which enables the user to add integers from either ends, i.e. from front and rear, but allows removal only from the front end. Define a class Cqueue with the following details:

Class name : Cqueue

Data members/ instance variables :

que[ ] : array to hold up to 100 integer elements.

lim : stores the limit of the circular quque.

front : integer to point to the index of front end.

rear : integer to point to the index of the rear end.

Member functions/methods :

Cqueue(int l) : constructor to initialize the data members lim=l; front = rear = 0

void insert(int val) : to add integers to the circular queue from both the ends if possible else display a message ("Overflow")

int delete() : returns element from front if possible otherwise returns -9999

Specify the class Cqueue giving details of the constructor(int) and the functions void insert(int), int remove(). The main() function and algorithm need not be written. [10]

Question 13

(a) A linked list is formed from the objects of the class, [4]

```
class Node {
        int item;
        Node ptr;
}
```

Write an Algorithm Or a Method to find the sum of the values of all the elements in the linked list. The recursive method declaration is given below:

int sum(Node ptr_start)

(b) What is the worst case complexity of the following code segment: [2]

```
a = a + 1
for (i = 1 ; i <= N ; i++) {
m = m + 2;
}
for (i = 1 ; i <= M ; i++) {
for (i = 1 ; i <= N ; i++)
{
k = k +1;
}
}
```

(c) Answer the questions below for the given binary tree: [4]

A
B   C
D   E   F   G
H   I   J
K   L
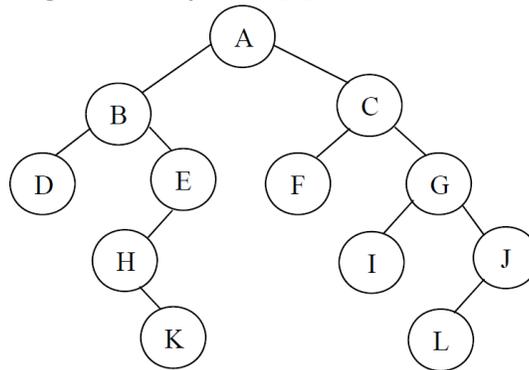
(i) List the internal nodes of the Binary tree
(ii) List the Leaf nodes of the Binary tree
(iii) Draw right sub-tree of Node C
(iv) Write Preorder traversal of the Binary Tree

COMPUTER SCIENCE, Practice Paper – 3 (THEORY)
PART I, Answer all questions

Question 1
(a) State and verify distributive law using the truth table. [2]
(b) Why NAND gate is regarded as the universal gate? Draw the logic gate symbol and make the truth table for the two input NAND gate. [2]
(c) Find the complement of F (a, b, c, d) using De Morgan's laws. Show the relevant reasoning. [2]
F(a, b, c, d) = a + {(b + c).(b' + d')}.
(d) Simplify using law of Boolean algebra. At each step state clearly the laws used for simplifications. [2]
F = x.y + x.z + x.y.z
(e) Given the Boolean function F(x, y, z) = Σ(0, 2, 4, 5, 6). Reduce it using Karnaugh's map. [2]

Question 2
(a) What is a (i) binary search tree? [1] (b) What do you understand by overflow? [1]
(c) What is an Interface? [2]
(d) Each element of an array D[-15….20, 20….45] requires 2 bytes of storage. If the array is stored in column major form and the base address of D[0][0] is 1200, Determine the location of D[1][40]. [2]
(e) Explain Worst Case Complexity of an algorithm. [2]
(f) Convert the following infix notation to its postfix form: A - B / (C ^ D) + (M * N)   [2]

Question 3
(a) The following functions show() and calling() are parts of some class. Assume that the parameter n is greater than 1 when the function is invoked. It returns value 1 when true otherwise returns 0. Show the dry run.

```
void calling()
{       int f = 2;
        show(n, f);
}
int show(int n, int f)
{       if(n == f) return 1;
        if(n % f ==0 || n==1) return 0;
        else return (show(n, f+1));
}
```

(i) What will the function show() returns when calling() is invoked with n = 11? [2]
(ii) What will the function show() returns when calling() is invoked with n = 27? [2]
(iii) In one line, state what the function show() is doing, apart from recursion. [1]

(b) The following is a function of some class.
It returns 1 if the number is a perfect number otherwise it returns 0.

```
/* A perfect number is a number which is equal to the
sum of its factors other than the number
itself.*/
int PerfectNo (int n)
{
        int?1?
        for(int j=1;?2?;j++)
        {
                if(?3?)
                        sum?4?;
        }
        if(?5?)
                return1;
        else
                return 0;
}
```

(i) What is the expression/value at ? 1 ? [1]
(ii) What is the expression/value at ? 2 ? [1]
(iii) What is the expression/value at ? 3 ? [1]
(iv) What is the expression/value at ? 4 ? [1]
(v) What is the expression/value at ? 5 ? [1]

PART – II, SECTION – A, Answer any three questions

Question 4

(a) Given the Boolean function: F (A,B,C,D) = Σ (0, 1, 2, 5, 8, 9, 10)

(i) Reduce the above expression by using 4 - variable K-Map , showing the various groups (i.e; octal , quads and pairs). [4]

(ii) Draw the Logic gate diagram of the reduced expression. Assume that the variable and their complements are available as inputs. [1]

(b) Given the Boolean function: F (A,B,C,D) = π (3, 4, 6, 7, 11, 12, 13, 14, 15)

(i) Reduce the above expression by using 4 - variable K-Map , showing the various groups (i.e; octal , quads and pairs). [4]

(ii) Draw the Logic gate diagram of the reduced expression. Assume that the variable and their complements are available as inputs. [1]

Question 5

For the selection in national level racing competition the selection committee has decided to select few candidates who satisfy at least one of the following conditions:

○ The candidate is a female not below 18 years of age and has won prize at the state level.

○ The candidate is a male of 18 years or above and has won the prize at the state level.

○ The candidate is a male who is a member of racing organization and also National level player.

○ The candidate is a female who has qualified in inter-school racing competition of a state.

THE INPUTS ARE:

A - The candidate is a male (1 indicates yes and 0 indicates no)

B - The candidate is 18 years and above (1 indicates yes and 0 indicates no)

C - The candidate belongs to racing organization or/and National level player (1 indicates yes and 0 indicates no)

D - The candidate is an inter-school state champion or state prize winner (1 indicates yes and 0 indicates no)

OUTPUT IS:

S : The candidate is selected [1 indicates she is selected and 0 indicates she is rejected]

(a) Draw the truth table for the inputs and outputs given above and write the SOP expression for S (A, B, C, D).

(b) Reduce S (A, B, C, D) using Karnaugh's map.

Draw the logic gate diagram for the reduced SOP expression for S (A, B, C, D).You may use gates with two or more inputs. Assume that variable and their complements are available as inputs. [10]

Question 6

(a) Draw a logic diagram for the following function using only NOR gates: [3]

F(A, B, C) = (A' + B') . (B + C')

(b) Convert the following expression into canonical Sum-Of-Product form: [3]

F(X, Y, Z) = X'.Y + X'.Y' + Y.Z'

(c) From the logic circuit diagram given below, name the outputs (1), (2) and (3). Finally derive the Boolean expression and simplify it. Name and draw the logic gate. [4]
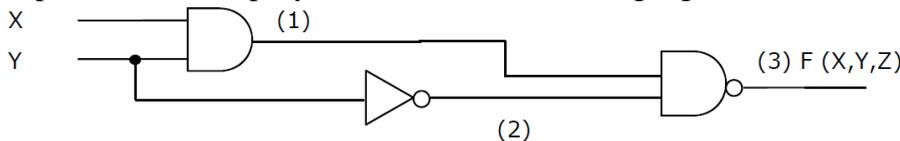
Question 7

(a) Draw the truth table to prove the following proportional expression: A <=> B = (A <=> B) ^ (B => A) [3]

(b) State a difference between a Tautology and Contradiction. [2]

(c) Draw the truth table and a logic gate diagram of Hexa-Decimal to Binary Encoder. [5]

SECTION – B, Answer any two questions

Question 8

A class called LCM has been defined to find the LCM of two integers. Some of the members of the class LCM are given below:

Class name : LCM

Data members/instance variables :

        n1, n2 : integers whose LCM is to be found.

        large, sm : integers to store the largest and the smallest from n1, n2

        lcm : integer to store the LCM of the n1 and n2

Member functions :

        LCM ( ) : constructor to assign initial values to the data members

        void acceptData() : to accept the value of n1 and n2

        int getLCM() : to return the LCM of n1 and n2 using the Recursive Technique and to store it in lcm.

        void printData( ) : to print the numbers n1, n2 and the LCM

Specify the class LCM, giving details of the two Constructor and functions void acceptData(), int getLCM() and void printData(). Also write the main( ) function to create an object and call the member function accordingly.

Question 9

The sum of angles is calculated as:

Let the first angle = 20 degrees 45 minutes

Let the second angle = 12 degrees 40 minutes

The sum of angles will be 33 degrees 25 minutes. (where 60 minutes = 1 degree)

Design a class Angle with the following details:

Class name : Angle

Data members/instance variables :

        deg : integer to store degrees.

        min : integer to store minutes.

Member functions/methods :

        Angle( ) : constructor to assign 0 to deg and min.

        void inputAngle() : to input values of deg and min.

        void dispAngle() : to print the values of deg and min with proper message.

        Angle sumAngle(Angle A, Angle B) : to find and return the sum of angles from objects A and B by using the above technique of adding angles Specify the class Angle giving the details of the constructors and all the functions. You need not write the main function.

Question 10

Write a Java program to input a sentence from the user in lowercase and capitalizes the first character of every word present in it.

Sample Input : i love java for school.   Sample Ouptut : I Love Java For School.

Some of the data members and member functions are given below:

Class name : Capitalize

Data members/instance variables :

        sent : stores the sentence

        cap : to store the new sentence

        size : stores the length of the sentence

Member functions:

        Capitalize() : default constructor

        void inpSentence() : to input the sentence

        void capChar() : capitalizes the first character of every word and form a new sentence 'cap'

        void display() : display the original sentence along with the new changed sentence.

Specify the class Capitalize giving details of the constructor Capitalize(), void inpSentence(), void capChar() and void display(). Define the main() function to create an object and call the function accordingly to enable the task.

SECTION – C, Answer any two questions.

Question 11

A class Student defines the personal data of a student while another class Marks defines to the roll number, name of subject and marks obtained by the student. The details of classes are as:

Class name : Student

Data members/instance variables :

      name, sex : string variables to store name and gender male/female

      age : integer variable to store age of the student.

Member functions/methods :

      Student( ) : constructor to assign initial values to the data members.

      void inputDetails() : to accept values for data members.

      void show( ) : to print personal data of student.

Class Name : Marks

      Data members/instance variables :

      rollno, marks : integers to store roll number and marks.

      subject : string variable to store name of subject

Member functions/methods :

      void readDetails() : to accept values for data members.

      int point() : to return the point obtained according to the following:

Marks	Point
>=90	1
70 - 89	2
50 – 69	3
40 – 49	4
< 40	5

void show( ) : to display name, sex, age, roll number, marks, subject and point of the student by invoking suitable function. Specify the class Student giving the details of the constructor, functions void inputDetails() and void show(). Using the concept of inheritance, specify the class Marks giving the details of the functions void readDetails(), int point() and void show( ) function. You do not need to write the main() function. [10]

Question 12

Define a class Repeat which allows the user to add elements from one end (rear) and remove elements from the other end (front) only. The details of the class Repeat is given below:

Class name : Repeat

Data members/ instance variables :

      st[ ] : array to hold up to 100 integer elements.

      cap : stores the capacity of the array.

      f : integer to point to the index of front end.

      r : integer to point to the index of the rear end.

Member functions/methods :

      Repeat(int nn) : constructor to initialize the data members cap=nn; 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 a_message ("Overflow")

      int popvalue() : to remove and return element from front if possible otherwise returns -9999

      void disp() : Displays the elements present in the list. If the array is empty then display a message ("Underflow")

(a) Specify the class Repeat giving details of the constructor() and functions void pushvalue(int), int popvalue() and void disp(). The main() function and algorithm need not be written.

(b) What is the common name of the entity described above?

(c) On what principle does this entity work?

Question 13

(a) A linked list is formed from the objects of the class, [4]

class Node
{
        int item;
        Node next;
}

Write an Algorithm OR a Method to search for a value in a linked list: (1) Iterative (2) Recursive The method declaration is given below:

void search(Node start, int value))

(b) Discuss with the help of an example why $O(N^2)$ complexity is better than $O(2^N)$? [2]

(c) Answer the questions below for the given binary tree: [4]
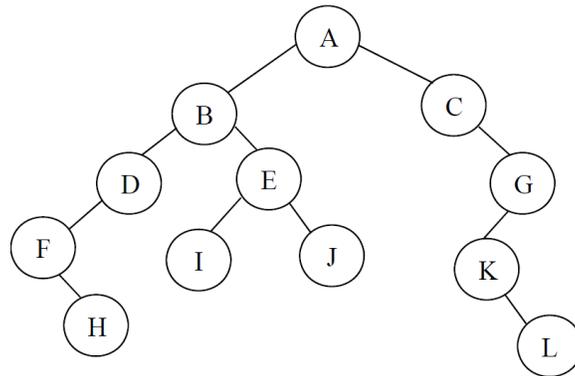
(i) What is the level of this Binary tree

(ii) List the number of pairs of siblings of this Binary tree

(iii) Draw right sub-tree of Node C

(iv) Write Postorder traversal of the Binary Tree. (Both function/algorithm and function.)

COMPUTER SCIENCE, Practice Paper – 4 (THEORY) ISC Specimen Question Paper 2013
PART I, Answer all questions

Question 1

(a) State the two distributive laws of Boolean Algebra. Prove any one of them with the help of Truth Table.[2]

(b) Draw the truth table to verify the expression: $p \rightarrow q$ is equivalent to $\sim q \rightarrow \sim p$ (Note: ($\sim q = q = q'$) [2]

(c) Find the complement of the following: [(xy)' • x] [(xy)' • y] [2]

(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) [2]

(e) Given F (x, y, z) = xz + xy + yz. Write the function in canonical sum of products form. [2]

Question 2

(a) What do LIFO and FIFO stand for? [2]

(b) For an array of real numbers x [− 6… 8 , -12… 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.[2]

(c) State the difference between an abstract class and an interface [2]

(d) Convert the following infix expression to its postfix form: b * [(a / d) - (c * (e - f))] [2]

(e) Define a binary tree. [2]

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./* An Armstrong number is a number which is equal to the sum of the cube of its individual digits */

int arms (int n)	(i) What is the expression/value at ? 1 ? [1]
{	(ii) What is the expression/value at ? 2 ? [1]
int digit = 0, sum = 0 ;	(iii) What is the expression/value at ? 3 ? [1]
int rem = n;	(iv) What is the expression/value at ? 4 ? [1]
while (? 1 ?)	(v) What is the expression/value at ? 5 ? [1]
{	
digit = ? 2 ?;	
sum = sum + ? 3 ? ;	
rem = ? 4 ? ;	
}	
if (? 5 ?)	
return 1 ;	
else	
return 0 ;	
}	

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

int strange (int x, int y)	(i) What will the function strange(20,5) return ? [2]
{	(ii) What will the function strange(15,6) return ? [2]
//Assuming x>0 and y>0	(iii) In one line, state what the function is doing. [1]
if(x>=y)	
{	
x = x-y;	
return strange(x , y);	
}	
else	
return x;	
}	

PART – II, Section – A
Question 4
(a) Given the Boolean function:

F (P, Q, R, S) = $\sqcup$ (0, 1, 3, 4, 5, 6, 7, 9, 10, 11, 13, 15)

Use Karnaugh's map to reduce the 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 variable and their complements are available as inputs. [5]

(b) Given the Boolean function :

X (P, Q, R, S) = $\lrcorner$ (3, 8, 10, 12, 13, 14, 15)

Use Karnaugh's map to reduce this function X using the given 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]

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 the three bank officials, excluding the chairman, must be entered.

The inputs are:
A : Denotes the Chairman's password.
B : Denotes the Regional Manager's password.
C : Denotes the Bank Manager's password.
D : Denotes the Head Casher's password.
Output:
X – Denotes that the safe can be opened. [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).
 (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 & OR gates. You may use gates with two or more inputs. Assume that the variables and their complements are available as inputs. [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) = $\prod$ (1,3,7) Verify : F(x, y, z) = $\sum$ (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

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: [10]

Class name : Perfect
Data members/instance variables
     n : stores an integer number
Member functions:
Perfect( ) : default constructor
Perfect(int) : parameterized constructor to assign a 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)
void sum_of() : to display all combinations of consecutive integers whose sum is equal to 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. ISC Specimen Question .

Question 9
A class RecFact defines a recursive function to find the factorial of a number. The details of the class are:
Class name : RecFact
Data members/instance variables
     n : stores the number whose factorial is required.
     r : stores an integer
Member functions
     RecFact( ) : default constructor
     void readnum( ) : to enter values for 'n' and 'r'
     int factorial(int) : returns the factorial of the number using the Recursive Technique.
     void factseries( ) : to calculate and display the value of $\dfrac{n!}{r!*(n-r)!}$
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.

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: [10]
Class name : Piglatin
Data members /instance variables :
     Txt : to store a word
     len : to store the length
Member functions :
     Piglatin( ) : constructor to initialize the data mrmbers
     void readstring( ) : to accept the word input in UPPER CASE
     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 the details of the constructor, void readstring( ), void convert( ) and void consonant( ). Also define the main function to create an object and call methods accordingly to enable the task.

SECTION – C, Answer any two questions.

Question 11

A class Author contains details of the author and another class Book List contains details of the books written by him. The details of the two classes are given below: [10]

Class name : Author

Data members

        authorno : stores the author's number

        name : stores the author's name

Member functions

        Author ( ) : default constructor

        Author (…) : parameterised constructor to assign values to author number and name

        void show( ) : to display the author's details

Class name : Booklist

Data members/instance variables

        bookno : Long type variable to the store book number

        bookname : stores the book name

        price : float variable to store the 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.

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 then the game is over. Define the class RingGame with the following details: [10]

Class name : RingGame

Data members/instance variables

        ring [ ] : array to hold rings (integer)

        max : integer to hold maximum capacity of ring array

        upper : integer to point to the upper most 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 the 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.

Question 13

(a) A Linked List is formed from the objects of the class,
Class Node
{
      int num;
      Node next;
}
Write the algorithm OR a method for swapping the first and the second node in the list. The method declaration is given below:
void swapnode(Node start) [4]

(b) State the complexity for the following algorithms: [3]
      (i) Linear Search (ii) Selection Sort
      (iii) Calculate the complexity of the following function

```
public static void patern(int lines)
   {   if(lines<=1)
         System.out.println("*");
      else
         for(int i=1; i<=lines; i++)
         {   for(int j=1; j<=i; j++)
            { System.out.print("*");
            }//j
            System.out.println();
         }//i
      }//pattern
```

(c) Mark/List the nodes in the tree given below using: [3]
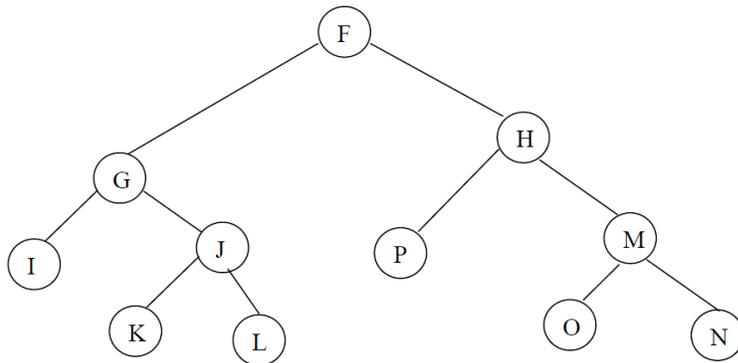
      (i) External Nodes
      (ii) Postorder Traversal
      (iii) Path

COMPUTER SCIENCE, Practice Paper – 5 (THEORY)
PART I, Answer all questions

Question 1

(a) Verify using the truth table, if $(X=>Y).(\sim Y=>\sim X)$ is a tautology, contradiction or contingency.   [2]

(b) State the two Indempotence laws of Boolean algebra. Verify any one of them using Truth Table.   [2]

(c) Show how a NOR gate can be used to construct an NAND gate.   [2]

(d) Given, F (X, Y, Z) = (X+Y).(Y+Z) write the function in cardinal canonical POS form.   [2]

(e) Given, the Boolean Function, F (X, Y, Z) = Σ (2, 3, 4, 6, 7). Reduce it using Karnaugh's Map.
    Also find the complement of its result.   [2]

Question 2

(a) State the difference between Function Overloading and Function Overriding.   [2]

(b) What is a (i) priority queue (ii) BST?   [2]

(c) Each element of an array A [-15….. 20, 20….. 45] requires 4 bytes for storage. Find the address of
A[10][20] in: (i) Row Major storage (ii) Column Major storage, if the address of the last element in 5000 [2]

(d) What do you mean by Complexity? What is the complexity of (i) Merge Sort and (ii) Quick Sort   [2]

(e) Convert the following infix notation to its postfix form: (A + (B * C)) / (C – (D * B))   [2]

Question 3

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

```
void test()
{
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) In the following function, strange( ) is a part of some class.

```
            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]

PART – II, SECTION – A, Answer any three questions

Question 4
(a) Given the Boolean function: F (A, B, C, D) = Σ (0, 1, 2, 5, 8, 9, 10)
    (i) Reduce the above expression by using 4 - variable K-Map, showing the various groups (i.e; octal ,
quads and pairs).   [4]
    (ii) Draw the Logic gate diagram of the reduced expression. Assume that the variable and their
complements are available as inputs.   [1]
(b) Given the Boolean function: F (A, B, C, D) = π (3, 4, 6, 7, 11, 12, 13, 14, 15)
    (i) Reduce the above expression by using 4 - variable K-Map , showing the various groups (i.e; octal ,
quads and pairs).   [4]
    (ii) Draw the Logic gate diagram of the reduced expression. Assume that the variable and their
complements are available as inputs.   [1]

Question 5
The inaugural function of a 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 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 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 eligible for entry. [1 indicates Yes and 0 indicates No in all cases]
(a)   Draw the truth tables 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 and draw a logic gate diagram for the same using NOR
gates only. You may use gates with two or more inputs. Assume that variable and their complements are
available as inputs.   [5+5]

Question 6
(a) Draw the logic diagram and Truth Table to Encode the Hexadecimal lines (A – F) only.
   Briefly explain the working of the logic diagram.   [3]
(b) Prove that the complement of A.(A + B).B.(B + C) is a Universal Gate and name the gate.   [3]
(c) Given: F (x, y, z) = π (2,3,6,7), Verify : F (x, y, z) = Σ (0,1,4,5)   [2]
(d) Make a block diagram for a full adder using 2 half adders and an OR gate.   [2]

Question 7
(a) Find out the Boolean expression R from the given
Logic diagram and reduce it.   [3]
(b) State any one of the applications the following:
(i) Multiplexer
(ii) Half Adder   [2]
(c) What are decoders?   [2]

(d) Using only NAND gates, draw a Logic circuit of the following function: F (X, Y, Z) = X.Y' + X'.Z [2]
(e) How many select lines does an 8:1 multiplexer have?   [1]

SECTION – B, Answer any two questions.
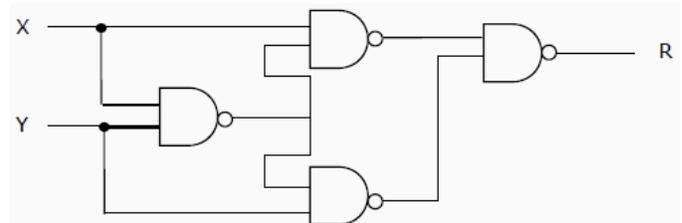
Question 8

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 genearatefibseries() : 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 9

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 functions
        Stringop() : constructor
        void readstring() : to accept the string
        char caseconvert(char letter): 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]

Question 10

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 and
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]

SECTION – C, Answer any two questions.

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

Rack is a kind of data structure which can store at the most 20 books. The rack restriction is that a book can be kept in to the rack or removed only at one end i.e. on the top. The class Rack has the following details :

Class name : Rack

Data members/instance variables: book[ ] : array of string of maximum 50 locations to store books.

       name : string variable to store name of book.

       Limit : integers as maximum capacity of the array

       top : integer to indicate topmost book into the Rack.

Member functions/methods :

       Rack( ) : a constructor to store blank in the array book[ ].

       Rack(int nx) : a constructor to assign nx to limit and -1 to top.

       void displList( ) : to display list of books in the rack.

       boolean ifEmpty( ) : returns true, if rack is empty, otherwise returns false.

       void putTheBook( ) : input name of the book into variable name and adds it on the top into the array book[ ] if rack is empty otherwise prints a message "Rack overflow".

       void removeBook( ) : removes a book form the top of the rack, if rack is not Empty and print the book name, otherwise outputs a Message "Rack underflow".

(a) Specify the class Rack giving details of constructors and the functions ifEmpty(), void putTheBook( ), void removeBook( ) only. Assume that other functions are already written for you. You do not need to write the main function.   [9]

(b) Name the entity which is being used by the above class and also state the principle it uses.   [1]

Question 13

(a) Link Lists are linear data structure. Create Algorithms for the following methods: [4]
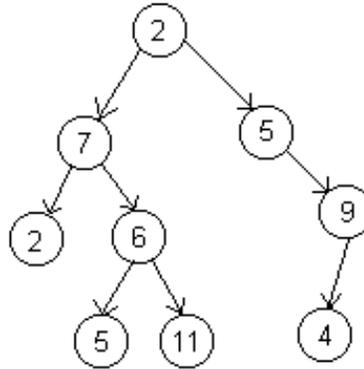
(i) Searching for a Node, when info(data) is provided.

    Boolean search(int item)

(ii) Merging 2 lists, L1 and L2 to one.

    NODE merge(NODE L1, NODE L2)

(b) Answer the following for the given binary tree: [4]

    (i) State the Height of the Binary Tree

    (ii) List the leaf nodes of the Binary Tree

    (iii) How many internal nodes are there in this tree?

    (iv) Write Preorder traversal of the Binary Tree

(c) Show the algorithm and the calculation of complexity for insertion sort.   [2]