Marks : 70 **Time: 3Hrs**

COMPUTER SCIENCE PAPER-I

THEORY

Maximum Marks: 70

Time Allowed: Three hours

(Candidates are allowed **additional 15 minutes** for **only** reading the paper.

*They must **NOT** start writing during this time)*

*Answer **all** questions in Part I (compulsory) and **six** questions from Part-II, choosing **two** questions from Section-A, **two** from Section-B and **two** from Section-C.*

All working, including rough work, should be done on the same sheet as the intended marks for questions or parts of questions are given in brackets [ ].

PART I (20 Marks)

Answer all questions.

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

QUESTION-1

(i) The reduced form of the Boolean equation (A+C)(A+AD)+(A.C+C) **[1]**

a. A+C
b. A+D
c. A+AD
d. None

(ii) Choose the correct form of canonical sum of minterms for the expression F=AB'+A

a. AB'+A'B'
b. A'B'+A'B
c. AB'+AB
d. AB+AA'

(iii) The dual of P'QR'+PQ'R+P'Q'R is equal to the complement of [1]

a. PQ'R+Q.(P'R'+PR)
b. PQ'R'+Q'.(P'R'+PR')
c. PQ'R+Q'+(PR'+P'R')
d. PQ'R+Q.(P'R'+PR')

(iv) The constructor of the base class can be inherited in the constructor of the derived class by using [1]

a. this
b. this()
c. extends
d. super()

(v) Write the canonical POS expression of F(P,Q)=∏ (0,2,3) [1]

(vi) Find the dual of (A'+B).(1+B')=A'+B [1]

(vii) Name the gate that is equivalent to (A'B+AB')' [1]

(viii) State the purpose of super keyword [1]

(ix) Explain about abstract classes with examples [1]

(x) Differentiate between Link list and arrays [1]

QUESTION-2

(i) A square matrix A[m*m] is stored in the memory with each element requiring 2 bytes of storage. If the base address A[1] [1] is 1098 and the address at A [4] [5] is 1144, determine the order of the matrix A[m × m] when the matrix is stored Column Major wise **[2]**

(ii) Convert the following infix notation to postfix form: **[2]**
A+(B-C*(D/E)*F)

(iii)

With reference to the code given, answer the questions that follow:

```
int P_26(int Onum)   {
    int g=0;
    for(int k = 1; k <= Onum; k++)
    {
    int c=0;
    for (int i = 2; i <= k/2; i++)
    if(k % i == 0)
    {
    c++;
    break;
    }
    if(c == 0 && k != 1 )
    g = g + k; }
    return g; }
```

(a) What will the method P_26() return when the value of Onum=30? [2]

(b) What is the method P_26() performing [1]

(iv)

The following function **quiz( )** is a part of some class. Assume 'n' is a positiv integer, greater than 0. Answer the given questions along with dry run / working.

```
int quiz( int n)
{
    if ( n <= 1 )
       return  n;
    else
        return  (--n % 2) + quiz(n/10);
```

(a) What will the function **quiz( )** return when the value of **n=36922**? **[2]**

(b) State in one line what does the function **quiz( )** do, apart from recursion? **[1]**

PART – II (50 Marks)

*Answer six questions in this part, choosing **two** questions from Section A, **two** from Section B and **two** from Section C.*

SECTION – A

Answer **any two** questions.

Question-3

(i) Given the Boolean function: F(A, B, C, D) = Σ (4,5,8,9,10,11,12,13,14,15).

a. Reduce the above expression by using 4-variable Karnaugh map, showing the various groups (i.e. octal, quads and pairs). **[4]**
b. Draw the logic gate diagram for the reduced expression. Assume that the variables and their complements are available as inputs. **[1]**

(ii) Given the Boolean function: F(A, B, C, D) = π (0,1,2,4,5,6,8,912,13,14).

a. Reduce the above expression by using 4-variable Karnaugh map, showing the various groups (i.e. octal, quads and pairs). **[4]**
b. Draw the logic gate diagram for the reduced expression**.** **[1]**
Assume that the variables and their complements are available as inputs.

Question-4

A job consultant searches jobs for applicants. The criteria for selecting the job are,
The Salary is less than 50 K but the firm takes care of the wellness of the employee and provides LTA or HRA

OR

HRA is provided as well as the firm takes care of the wellness of the employees.

OR

Salary is more than 50K, HRA and LTA is provided by the firm.

Inputs are S= Salary is more than 50K R = HRA is provided
W= Wellness of employees is taken care of. L= LTA is provided
Output F = Found
In all the cases, 1 indicates yes 0 indicates no.

(i) **Draw the truth table for the inputs and outputs given above and derive the POS expression for F(S,R,W,L)** **[5]**

(ii)

The POS expression of X from the truth table given below is:

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

[2]

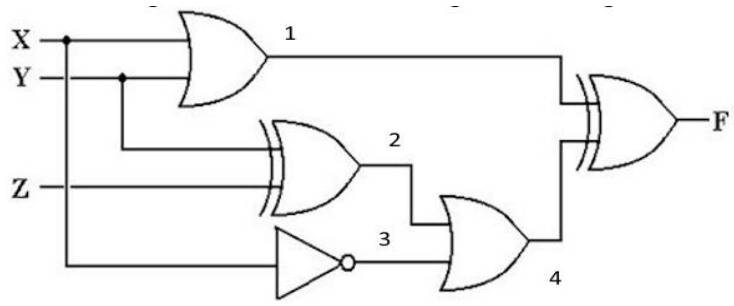
(iii) What are universal gates? Construct a logic circuit diagram using NAND gates only for the expression A.(B+C) **[3]**

Question-5

(i) What is a decoder? Draw the truth table and draw the logic circuit diagram for 3 to 8 decoder **[4]**

(ii) Convert the following expression into canonical POS form, F(A.,B)=(A+B).A' **[2]**

(iii)



Identify the expression for F **[4]**

SECTION – B

Answer any two questions.

Each program should be written in such a way that it clearly depicts the logic of the problem. This can be achieved by using mnemonic names and comments in the program.

(Flowcharts and Algorithms are **not** required.)

The programs must be written in Java.

Question-6

class **Checker** has been defined to check whether a number is palindrome or not. The details of the class are given below

Class Name : Checker

Data members/instance variables :

num	:	long integer variable to store number
rev	:	long integer variable to store reverse of number

Member functions/methods

Checker(long z)	:	Parameterized constructor to assign num=z
long ReverseNum(long q)	:	Using recursive technique reverse the number in the argument 'q' and store in 'rev' and returns it.
void display()	:	By invoking the recursive function decide whether num is a palindrome number or not and print the number along with the suitable message in both the cases

Specify the class **Checker** giving details of the constructor ,the functions long ReverseNum(long q) and void display() also ,define the main() function to create an object and call the methods accordingly to enable the task.

Question-7 **[10]**

A fraction is a combination of two integers a numerator and denominator .Design a class named Fraction whose details are as follows.

Class Name : Fraction

Data members/instance variables

n,d	:	Integer variable to store the value of numerator and denominator respectively

Member functions

Fraction(---)	:	Parameterized constructor to initialize the data member
void fnShow()	:	To show the member data as a fraction [ex: 35/77, 26/9 etc]
Fraction fnReduce(Fraction f1)	:	Reduce fraction f1 to its minimum using fnHCF() method for example 35/77 to become 5/11
int fnHCF(int a,int b)	:	To return the highest common factor of the arguments

Specify the class Fraction , giving the details of the above member and methods. Also write the main() method to create the object and call the other methods accordingly.

Question-8 **[10]**

The strength of the uppercase letters is measured as A=1, B=2-----Z=26, The potential of a word is measured by adding the strength of each alphabet in the word. For example

INPUT: BEST

Its potential =2+5+19+20=**46**

Design a class Strength with the following details:

Class Name : Strength

Data members/instance variables

St	:	Stores a string
Str	:	Stores the string in upper case

Member functions/methods

Strength()	:	Constructor to initialize the data members
void readStr()	:	To accept the sentence in St and store its Upper case form in Str.
void show()	:	To print the original and the uppercase sentence with the suitable message.
void potential()	:	To find and print the potential of each word of Str in two columns as per the given format below.

Example:

Input : BEST OF LUCK

WORD	**POTENTIAL**
BEST	46
OF	21
LUCK	47

Specify the class Strength giving the details of the constructor , functions void readStr(),void show() and void potential(). Define a main() function to create the object and call the methods accordingly

SECTION-C

Answer any two questions.

Each program should be written in such a way that it clearly depicts the logic of the problem stepwise.

This can be achieved by using comments in the program and mnemonic names or pseudo codes for algorithms. The programs must be written in Java and the algorithms must be written in general / standard form, wherever required / specified.

(Flowcharts are not required)

Question-9 **[5]**

An **interface StackOperations** is defined with methods **void push()** to push a character integer at the top index and **char pop()** to remove the element from the top i.e uses **LIFO** and **FIFO** principle.

Design a class **Stack** which implements interface **StackOperations.** The details of interface and class are as:

Interface name : StackOperations

Member functions /methods :

void push() : to perform push operation in the implementing stack.

char pop() : to return the popped character from the implementing Stack.

Class Name : Stack

Data members/instance variables:

st[]	:	Character array to store the elements
cap	:	Stores the maximum capacity of the array and stack.
top	:	to point the index of the topmost element of the stack

Member functions/methods

Stack(int n)	:	Parameterized constructor to initialize cap=n and top=-1
void push()	:	To accept a character and push into the stack at the top index if possible, otherwise display " not possible"
char pop()	:	returns character from the top index if possible otherwise, return'/'
void display()	:	Displays the elements of current stack if possible if stack is not empty, otherwise display a message "not possible"

Assume that the interface **StackOperation** has ,been defined.Specify the class Stack giving details of constructor and functions void push() ,char pop() only . Assume that the other functions have been defined.Do not write the main() function and the algorithm.

Question-10 **[5]**

A super class **Base** and a derived class **Derive** is defined to find the HCF and LCM of two numbers. The details of both the classes are given below:

Class Name : Base

Data members/Instance variables:

N1,N2	:	Integers whose lcm and lcm has to be defined.

Member functions/methods

Base(---)	:	Parameterized constructor to assign values to the data members
void accept()	:	to accept integers N1 and N2.
void display()	:	To display n1 and n2 with suitable messages

Class Name : Derive

Data members/Instance variable

HC,LC	:	Integers to store HCF and LCM

Members functions/methods

Derive(----)	:	Parameterized constructor to assign values to the data members of both

the classes

void swap() : To interchange values of **N1 and N2** if **N1<N2.**

void find_hcf(): To find and store HCF of N1 and N2 in HC

To find HCF Make use of the following steps

(i) Decide greater and smaller numbers out of two.
(ii) Divide the greater number by smaller number ,if remainder is zero(0),then the divisor would be the HCF,otherwise
(iii) Store divisor as dividend and remainder as divisor ,then repeat step-(ii)

void find_lcm(): To find and store LCM of N1 and N2 in LC by making use of HC variable , which has already been calculated

Hint: Product of two numbers = Product of their LCM and HCF

void display() : To display values of N1 and N2 and also print HCF and LCM along with suitable messages.

*Assume that the super class **Base** has been defined.* Using the concept of inheritance ,Specify the class **Derive** giving the details of the **constructor(---),void find_hcf(),void find_lcm and void display()**

The super class, main function and algorithm need NOT be written.

Question-11

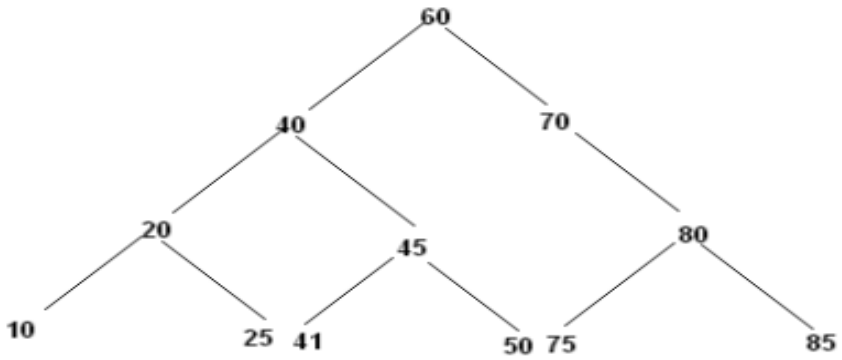
(i) A linked list is formed from the objects of the class Node. The class structure of the node is given below: **[2]**

```
class Node
{
        int num;
       Node link;
}
```

Write an *Algorithm* **OR** a *Method* to return the occurrence of nodes equal to N from an existing linked list.. The details of the method is as

int Node_frequency(Node start,int n)

(ii) Answer the following questions from the diagram of a Binary Tree given below



(a) Write the post order traversal of the tree **[1]**

(b) State the height of Node 50 **[1]**

(c) State the level of node 25 **[1]**