CLASS 12 - COMPREHENSIVE TEST -2 - NOVEMBER 2022

COMPUTER SCIENCE
PAPER 1

(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.)

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

All working, including rough work, should be done on the same sheet as therest of the answer.

The intended marks for questions or parts of questions are given in brackets [ ].

PART I (20 Marks)

Answer **all** *questions.*

Question 1

1 The expression for Absorption law is given by [1]

(a) A + AB = A

(b) A + AB = B

(c) AB X1+ AA' = A

(d) A + B = B + A

2 The complement of the expression A'B + CD' [1]

(a) (A ' + B)(C' + D)

(b) (A + B')(C' + D)

(c) (A' + B)(C' + D)

(d) (A + B')(C + D')

3 The expression F1 = X.Y.Z' is in [1]

(a) Sum of products form

(b) Straight form

(c) Product of sums form

(d) Parallel form

4 The dual of the expression (B' + C).A [1]

(a) (B' . A) + C

(b) (B' . C) + A

(c) (B' . A) + A

(d) (B' . C') + A

5 The proposition (P => Q) ^ (Q => P) [1]

(a) Contradiction

(b) Negation

(c) Contingency

(d) Tautology

6 The device which converts an input into binary representation is [1]

7 Exclusive – OR gate is combination of _____ [1]

8 Write the purpose of super keyword. [1]

9 The expression A.B + (A.B) ' can be implemented by _____ gate [1]

10 What is linked list? [1]

Question 2

(i) Convert the following infix notation to prefix notation: A * (B + C / D) – E/F [2]

(ii) Each element of an array arr[15][20] requires 'W' bytes of storage. If the addresof arr[6][8] is 4440 and the Base Address at arr[1][1] is 4000 , find the width 'W' of each cell in the array arr[ ][ ] when the array is stored as Column Major Wise. [2]

(iii) With reference to the code below answer the questions that follow :

```
int test(int n)
{
  if(n==1)
     return 0;
for (int i=2;i<=(int)(Math.sqrt(n));i++)
    if( n%i==0)
return 0;
return 1;
}
```

What is the output of the function when the value of n = 9? [2]

What is the method printing ? [1]

(iv) With reference to the code below answer the questions that follow :

```
public void my_recursive_function(int n)
{
   if(n ! =  0)

   System.out.println ( n );
   my_recursive_function(n-1);
}
public static void  main()
{
   my_recursive_function(10);
   return 0;
}
```

What is the output of the above code? [2]

What is the output of the above code, the statement is *my_recursive_function(0)* ? [1]

PART – II (50 Marks)

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

SECTION - A

*Answer **any two** questions.*

Question 4

(a) Given the Boolean function **F(A, B, C, D) = (0, 2, 3, 6, 8, 10, 11, 14, 15)**

(i) Reduce the above expression by using 4-variable Karnaugh map, showing thevarious groups (i.e. octal, quads and pairs). **[4]**

(ii) Draw the logic gate diagram for the reduced expression. Assume that the variables and their complements are available as inputs. **[1]**

(b) Given the Boolean function **F(P,Q,R,S) = π (5, 7, 8, 10, 12, 14, 15)**

(i) Reduce the above expression by using 4-variable Karnaugh map, showing thevarious groups (i.e. octal, quads and pairs). **[4]**

(ii) Draw the logic gate diagram for the reduced expression. Assume that the variables and their complements are available as inputs. **[1]**

Question 5

(a) What is an Encoder? Draw the Encoder circuit to convert A-F Hexadecimal numbers to binary. **[5]**

(b) Simplify the following Boolean expression and draw the gate for the reduced expression: **[3]**

F= A'B + AB'C + A

(c) Define *Universal gates*. Give one example and show how it works as an OR gate. **[2]**

Question 6

(a) Draw a truth table with a 3 input combination which outputs 1 if there are odd number of 0's. Also derive an **SOP** expression for the output. Reduce the expression using Karnaugh Map. **[5]**

(b) Define *Proposition*. How does *tautology* differ from *contradiction*? **[3]**

(c) Draw the logic diagram of 4:1 Multiplexer. **[2]**

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 7 **[10]**

A class **Composite** contains a two dimensional array of order [m x n]. The maximum value possible for both 'm' and 'n' is 20. Design a class **Composite** to fill the array with the first 20 composite numbers. The details of the members of the class are given below:

Class name	:	**Composite**

Data members/instance variables:

arr[ ] [ ]	:	stores the composite numbers column wise
m	:	integer to store the number of rows
n	:	integer to store the number of columns

Member functions/methods:

Composite(int mm, int nn)	:	to initialize the size of the matrix m=mm and n=nn
void fill ( )	:	to fill the elements of the array with the first 20 composite numbers in column wise
void display( )	:	displays the array in a matrix form

Specify the class **Composite** giving details of the **constructor(int,int)**, **voidfill( )** and **void display( ).**

Define a **main( )** function to create an object and call the functions accordingly to enable the task.

Question 8 **[10]**

(i) Design a class **Arrange which** arranges the letters of the String such that all the upper-case characters follow the lower-case characters.

Example: Input : **Computer Science**

Output : **CSomputercience**

The details of the members of the class are given below:

Class name	:	**Arrange**

Data members/instance variables:

str	:	stores a String
word		stores the word formed.
len	:	to store the length of the word

Methods/Member functions:

Arrange( )	:	default constructor
void acceptString( )	:	to accept the String
void upperlower ( )	:	Arranges the String characters such that upper case characters follow lower case.
void display( )	:	displays the new String formed.

Specify the class **Arrange** giving details of the **constructor**, **void acceptString( ), void upperlower( )** and **void display( ).** Define the **main( )** function to create an object and call the functions accordingly to enable the task.

Question 9 **[10]**

A **Special** number is a number in which the sum of the factorial of its digits is equal to the number.

Example: 145 (1! + 4! + 5! = 145). Thus, 145 is a Special number.

Design a class **Special** to check if the given number is a Special number or not. Some of themembers of the class are given below:

Class name	:	**Special**

Data member/instance variable:

n	:	integer to store number

Member functions/methods:

Special( )	:	default constructor
void read( )	:	to accept the number
int factorial(int x)	:	return the factorial of a number using **recursivetechnique**
boolean isSpecial( )	:	checks for the special number by invoking the function factorial( ) and returns true if Special,otherwise returns false
void display( )	:	displays the result with an appropriate message

Specify the class **Special**, giving details of the **Constructor**, **void read( ), int factorial(int),boolean isSpecial( ) and void display( )**. Define the **main()** function to create an object andcall the member function according to enable the task.

SECTION – C

*Answer **any two** questions.*

Each Program should be written in such a way that it clearly depicts the logic of the problemstep wise. This can also be achieved by using comments in the program and mnemonic names or pseudocodes for algorithms. The program must be written in Java and the algorithms must be writtenin general / standard form, wherever required / specified.

(Flowcharts are **not** required.)

Question 10 **[5]**

An class **Shape** is defined with a method **area()** which returns the area of the implementing shape.

Create the classes **Circle** and **Rectangle** which inherit the class **Shape**. These classes have attributes which reflect their dimensions (radius for a circle, height and width for a rectangle) which are set by their constructors.

The details of the members of the class and both the classes are given below:

Class name : **Shape**

Member functions/methods:

double area()	:	returns the area of the implementing shape

Class name : **Circle**

Data members/instance variables:

radius	:	to store radius of the circle in decimal

Member functions/methods:

Circle(int r)	:	parameterized constructor to initialize radius=r
double area()	:	to calculate area of the circle [area of a circle is3.14*radius*radius]

Class name : **Rectangle**

Data members/instance variables:

length	:	to store length of the rectangle in decimal
breadth	:	to store breadth of the rectangle in decimal

Member functions / methods

Rectangle(int l, int b)	:	parameterized constructor to initialize length=l, breadth=b
double area()	:	to calculate area of the rectangle [area of arectangle is length*breadth]

*Assume that the parent class **Shape** has been defined*. Using the **concept of inheritance**, specifythe classes **Circle** and **Rectangle** giving details of their **constructor**s and **double area( )** respectively.

The parent class and the main function and algorithm need NOT be written.

Question 11 **[5]**

Queue is a linear data structure in which the operations are performed based on FIFO (First In First Out) principle

Define a class **Queue** with the following details:

Class name	:	**Queue**
Data member/instance variable:		
ele[ ]	:	array to hold the integer elements
cap	:	stores the maximum capacity of the array
front	:	to point the index of the front
rear	:	to point the index of the rear.
Member functions/methods:		
Queue(int max)	:	constructor to initialize the data member cap = max, front = rear = 0 and create the integer array
void insert(int v)	:	to add integers from the front index if possible else display the message("full from rear")
int delete( )	:	to remove and return elements from rear, if any,else returns -999
void display()	:	to display elements of queue

Specify the class **Queue** giving the details of **void insert(int)** and **int delete( )**. Assumethat the other functions have been defined.

The main( ) function and algorithm need NOT be written.

Question 12

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

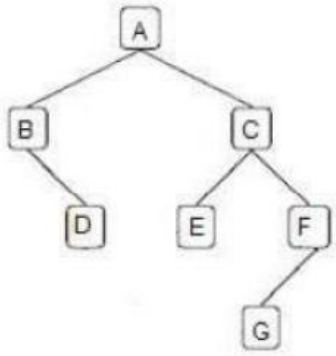
```
Class Node
{
    int num;
    Node
    next;
 }
```

Write an *Algorithm* **OR** a *Method* to insert a node at the beginning of an existinglinked list.

The method declaration is as follows:

void InsertNode(Node starPtr, int n)

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



(i) Name the Root and the leaves of the tree. **[1]**

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

(iii) Separate the Internal nodes and the External nodes of the tree. **[1]**