All the Best for ISC 2024

COMPUTER SCIENCE
Paper 1 – Theory

Class: XII
Marks: 70 **Time: 3hrs**

(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 questions from Section – B and two questions from Section – C
The intended marks for questions are given in brackets { }

Part I
Answer all questions.
While answering questions to this part, indicate briefly your working and reasoning, wherever required.

Question 1

(i)What is method overriding in Java?
a) Defining a method with the same name and different parameters in the same class
b) Defining a method with the same name, same parameters, and same return type in a subclass
c) Defining a method with a different name and parameters in a subclass
d) Defining a method with a different name but same parameters in a subclass

(ii) Which of the following statements is not true about abstract METHODS
a) Abstract methods have no method body.
b)Abstract methods are present in abstract class only
c)An abstract method can be declared as final
d) Abstract methods are generally defined in base class

Iii)Which of the following example does not relate to to big O- Notation equivalent to- O(1)
a) Pushing or popping an item on the top of a stack
b) Inserting an item in rear end or deleting an item from front end of queue
c) Popping an element from the queue
d) Bubble Sort

iv) When using the protected keyword in Java, which classes can access the protected members?
a) Only the class itself
b) Classes within the same package and its subclasses
c) Any class within the program
d) Classes in any package, but only if explicitly imported

v)Given $F(P,Q,R,S)=\sum(0,1,2,3,5,7,13,15)$, the reduced expression is
a) A'B'+BD+A'D b)A'B'+BD C) A'B+BD' d) (A+B)(B'+D')

Vi) The representation of the boolean function $F(A,B)=\Sigma(0,2)$ in canonical form is
a)(A+B)(A'+B) b) л (1,3) C) A'B'+AB' D)(A+B')(A'+B')

VII)The sum term of a half adder is equal to a two variable _____ gate
a)XNOR gate b)AND gate c) XOR gate d) OR gate

Viii) State one application of Multiplexer and Decoder

Ix) Write the working principle of a queue

X) What do you mean by balancing a binary tree?

Question-2

(i) Write the equivalent postfix expression of the given Infix Expression - E*(F/(G-H)*I)+J [2]

Ii) Given an array of integer elements arr[-1----8][-2----12] with base address as 1000 . [2]
Find the address of arr[8][6] ,when the elements are taken as row-major wise.

iii) a)If '1' ,'2','3','4' are added in a stack ,what will be the order of removal of the elements [2]
b)Mention the worst case complexity of Linear search

iv) [4]
The following functions are a part of some class which determines whether a given number is a narcissistic number or not.
// A narcissistic number is a number that is equal to the sum of its own digits raised to the power of the number of digits.

```
boolean isNarcissistic(int num)
 {
   int originalNum = num;
   int numDigits = countDigits(num);
   int sum = 0;

   while (?1?) {
      int digit = num % 10;
      sum += ?2?;
      num /= 10;
   }

   return sum == originalNum;
}

int countDigits(int num) {
   int count = 0;
   while (?3?) {
      count++;
      num /= 10;
   }
   return count;
}
```

// (a) What should be placed at ?1? to ensure the loop iterates until all digits of 'num' are processed?
// (b) What should be placed at ?2? to calculate the sum of digits raised to the power of the number of digits?
// (c) What should be placed at ?3? to ensure the loop in 'countDigits' iterates until all digits of 'num' are p

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) A car rental agency offers discounts to its customers based on the following criteria:

The customer is a member of a loyalty program and rents a luxury car.

(OR)

The customer rents a luxury car for more than 7 days.

(OR)

The customer is not a member of a loyalty program and rents a standard car for more than 7days.

The inputs are:

INPUTS	
l	Customer is a member of a loyalty program
R	Rental duration is more than 7 days
C	Customer rents a luxury car
S	Customer rents a standard car

D: 1 indicates a discount is awarded, 0 indicates no discount is awarded.

Create a truth table for the inputs and output and write the POS (Product of Sums) expression for D(L, R, C, S).

(ii) Reduce the above expression D(L,R,C,S) by using 4 variable kmap ,showing the various groups (ie octal,quads and pairs) Draw the logic gate diagram for the reduced expression.

Question-4

(i) Give the Boolean Function F[A,B,C,D)=∑(0,1,2,3,4,5,8,9,10,11,12,13,14) **[5m]**

Use 4 variable Kmap to reduce this function F showing the various groups., Draw the logic gate diagram of the reduced SOP expression using fundamental gates, consider that variables and their complements are available as input.

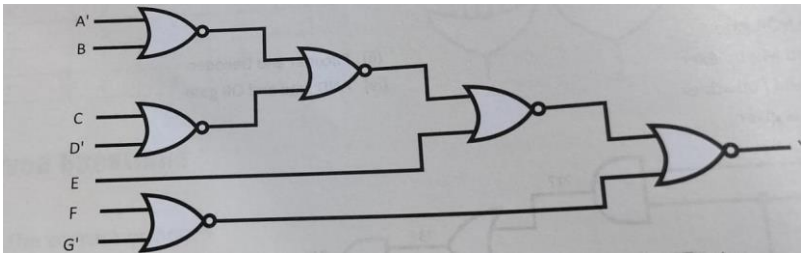
(ii)Verify if the following proposition is valid or not ~P0>Q=[~Q->(~P^~Q)

(iii) Define maxterms and minterms ,find the maxterm and minterm when P=0,Q=1,R=1 and S=0

Question-5

(i) Draw the logic circuit diargram to convert hexadecimal numbers A-F to its binary form. Also write the binary equivalents of the numbers

(ii) Derive a Boolean expression for the logic circuit and also reduce the derived expression



iii) Convert the following canonical SOP expression to Canonical POS form
AB'C+ABC'+A'BC+A'B'C'

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.

*(*Flow charts and algorithms are **not** required)

The programs must be written in JAVA.

Question-6

Design a class Amicable to check if two given numbers are Amicable or not[Two numbers are amicable if sum of its factors (excluding itself) of each is equal to the other number

Example 220 and 284

The proper divisors of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55, and 110.
The sum of these divisors is 1 + 2 + 4 + 5 + 10 + 11 + 20 + 22 + 44 + 55 + 110 = 284.

For 284:

The proper divisors of 284 are 1, 2, 4, 71, and 142.
The sum of these divisors is 1 + 2 + 4 + 71 + 142 = 220.

Some of the members of the class are given below
Class Name : Amicable

Data members/instance variables

x,y : To store the number

Amicable(int xx,int yy) : Parameterized constructor to initialize the data members x and y to xx and yy to y
int sumDivisor(int n,int d) : Returns the sum of the factors of number n(excluding itself) , (where d is used for the divisor using recursive technique)
void isAmicable() : Checks whether the given numbers are amicable numbers or not by invoking the function sumDivisor(int n,in i)and void isAmicable(),

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

Question-7

Design a class **NoRepeat** which checks whether a word has no repeated alphabets in it.

Example: COMPUTER has no repeated alphabets but SCIENCE has repeated alphabets.

The details of the class are given below:

Class name: NoRepeat

Data members/instance variables:

word : to store the word
len : to store the length of the word

Methods/Member functions:

NoRepeat(String wd) : parameterized constructor to initialize word = wd
boolean check() : checks whether a word has no repeated alphabets and returns true else returns false
void print() : displays the word along with an appropriate message

Specify the class NoRepeat, giving details of the constructor, boolean check() and void print(). Define the main() function to create an object and call the functions accordingly to enable the task.

Question-8

Design a class **SparseMatrix** to fill an array of order MxN (a matrix) and check if the matrix entered by the user is a sparse matrix or not. A matrix is considered sparse if the majority of its elements are zero.

Class Name: SparseMatrix

Data members/instance variables:

arr[][]: Two-dimensional array of integers to store the matrix.
M, N: Integers to store the number of rows and columns in the matrix.

Member functions/methods:

SparseMatrix(int m, int n) : Parameterized constructor to initialize M and N to m and n respectively.
void fill() : Method to accept MxN elements into the array (matrix).
void display() : Method to display the original array in matrix form and print whether the matrix is sparse or not by calling the checkSparse() method.
boolean checkSparse() : Method to check if the matrix is sparse or not.

Specify the class SparseMatrix by giving the details of the constructor and all the other functions. Also, write the main() function to create the object and call the methods accordingly.

SECTION-C
Answer any two questions

Question-9

You are tasked with implementing a stock management system for XYZ Retail Store using a stack data structure. The system should allow adding and removing items from the stock, and display the current stock

status.

Class Name: StockManagementSystem

Data Members/Instance Variables:

stockStack : A string array to store the names of items in the stock.
track (int) : An integer variable to keep track of the top item in the stack.
capacity (int) : To store the maximum capacity of the stock.

Member Functions:

StockManagementSystem(int n): Constructor to initialize capacity as n, and track as -1.
void addItem(String item) : Adds an item to the stock if there is space available in the stack, otherwise displays "Stock Full".
void sellItem() : Removes the top item from the stock if the stock is not empty, otherwise displays "Stock Empty".
void displayStock() : Displays all items currently in the stock.

Imagine you are developing a stock management system for a retail store. Specify the class StockManagementSystem giving information of the methods addItem() and sellItem(). You can assume that the class and the other methods are already written for you. You need not write the main method.

Question-10

A base class **Money** is defined to store an amount defined in rupees and Paisa . A derived class **AddMoney** is defined which stores another amount defined in rupees and Paisa and finds the total amount . The details of the classes are given below

Class Name: Money

Data Members

int rs1 : To store rupees
int ps1 : To store Paisa

Member Methods

Money(int d1,int m1) : Parameterized constructor to initialize data members of the base class

void show() : displays the first amount

Class Name : AddMoney

Data members

int rs2 : To Store rupees
int ps2 : To store Paisa
int totrs : To store the total rupees

int totps : To store the total paisa

Members Methods

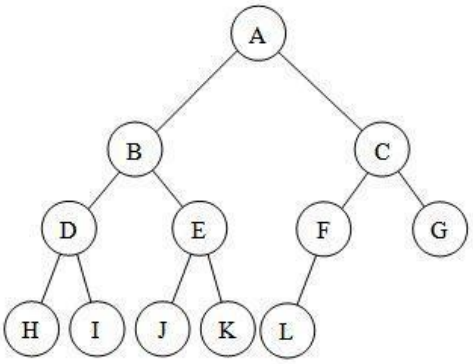
AddMoney(---) : Parameterized constructor to initialize amount of both the base class and the derived class
void addamt() : Adds the two amts
void show () : Displays the second amount and the sum amount

Using the concept of inheritance ,define AddMoney class in java giving details of the constructor ,methods void addamt() and void show(). The base class and the main() method need not be written

Question-11

(a) Write the Big(O) notation for the following
(i) Matrix multiplication
(ii) Selection Sort

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



(i) Mention the height of node (k)
(ii) Mention the depth of node H
(iii) Write the level of node H