

ST. JOSEPH'S ACADEMY, DEHRADUN
FIRST TERM EXAMINATION SEPTEMBER, 2024-25

SUBJECT: COMPUTER SCIENCE

CLASS: XII

M.M. :70 TIME : 3 HOURS

NAME OF THE STUDENT.....CLASS/SECTION.....ROLL NO.....

- **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 rest of the answer.**
- **The intended marks for questions or parts of questions are given in brackets [].**

PART- I [20 MARKS]
ANSWER ALL QUESTIONS.

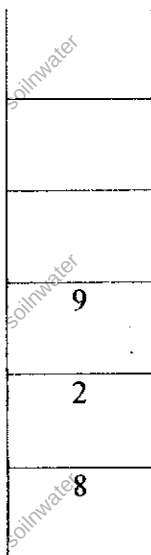
While answering questions in this Part, indicate briefly your working and reasoning, wherever required.

Question 1.

- a) State Involution law and prove it with the help of a truth table. [1]
- b) Show that $X \vee \sim (Y \wedge X)$ is a tautology. [1]
- c) Find the dual of $YX + X' + 1 = 1$ [1]
- d) Write the maxterm and minterm, when the inputs are $A = 0, B = 1, C = 1$ and $D = 0$. [1]
- e) Draw the logic circuit of a NAND gate using NOR gates only. [1]

Question 2.

- a) What is an interface? [2]
- b) Convert the following infix expression to prefix form: $P * (Q / R + (S + T) \% U) / V$ [2]
- c) From the diagram of a stack answer the questions that follow: [2]



- i) Show in diagram if we PUSH an element 10, in which cell would it come.
- ii) When will overflow take place?
- d) From the class declaration given below, state the nature of the identifiers A, B, C and D: [2]
class A extends B implements C, D

- e) What is a constructor? State one difference between a constructor and any other member function of a class. [2]

Question 3.

The following is a function of some class which sorts an integer array `a[ ]` in ascending order using selection sort technique. There are some places in the code marked by ?1?, ?2?, ?3?, ?4?, ?5? which may be replaced by a statement/expression so that the function works properly:

```
void selectsort(int [ ]a)
```

```
{
    int i, j, t, min, minpos;
    for(i=0; i<a.length; i++)
    {
        min=a[i];
        minpos = i;
        for(j=?2?; j<a.length; j++)
        {
            if(min>a[j])
            {
                ?3?=j;
                min = ?4?;
            }
            t=a[minpos];
            a[minpos]=a[i];
            a[i]= ?5?;
        }
        for(int k=0; k<a.length; k++)
            System.out.println(a[k]);
    }
}
```

- ✗ (i) What is the expression or statement at ?1?
(ii) What is the expression or statement at ?2?
(iii) What is the expression or statement at ?3?
(iv) What is the expression or statement at ?4?
(v) What is the expression or statement at ?5?

[1]
[1]
[1]
[1]
[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 4.

- (a) Given the Boolean function:
 $F(A, B, C, D) = \Sigma (4, 6, 7, 10, 11, 12, 14, 15).$

- (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 variables and their complements are available as inputs. [1]

(b) Given the Boolean function:

$$F(P, Q, R, S) = \prod(0, 5, 7, 8, 10, 12, 13, 14, 15)$$

(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 variables and their complements are available as inputs. [1]

Question 5.

A Government Institution intends to award a medal to a person who following criteria:
The person should have been an Indian citizen and had lost his/her completed 25 years of service.

OR

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

OR

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

The inputs are:

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

Output: X -- Denotes eligible for Medal [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 POS expression for X (A, B, C, D). [5]

(b) What is a half adder? Write the truth table, derive an SOP expression for sum, and carry for a half adder. [3]

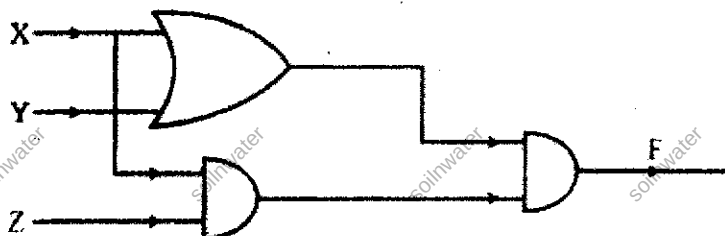
(c) Simplify the following expression, using Boolean laws: [2]

$$(X + Z).(X.Y + Y.Z') + X.Z + Y$$

Question 6.

(a) Write the truth table and draw the logic circuit diagram for a 3 to 8 decoder and explain its working. [5]

(b) From the logic circuit diagram given below, derive the Boolean expression and simplify it to show that it represents a logic gate. Name and draw the logic gate. [3]



(c) Using a truth table, state whether the following proposition is a Tautology, Contradiction or Contingency: [2]

$$\sim(P \Rightarrow Q) \Leftrightarrow (\sim P \vee Q)$$

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.

[10]

Question 7.

A class Adder has been defined to add any two accepted time.

Example:

Time A – 6 hours 35 minutes

Time B – 7 hours 45 minutes

Their sum is – 14 hours 20 minutes (where 60 minutes = 1 hour)

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

Class name: Adder

Data member/instance variable:

a[]: integer array to hold two elements (hours and minutes)

Member functions/methods:

Adder(): constructor to assign 0 to the array elements

void readtime(): to enter the elements of the array

void addtime (Adder X, Adder Y): adds the time of the two parameterized objects X and Y and stores the sum in the current calling object

void disptime(): displays the array elements with an appropriate message (i.e., hours= and minutes=)

Specify the class Adder giving details of the constructor(), void readtime(), void addtime(Adder, Adder) and void disptime(). Define the main() function to create objects and call the functions accordingly to enable the task.

Question 8.

A class SwapSort has been defined to perform string related operations on a word input. Some of the members of the class are as follows:

Class name: SwapSort

Data members/instance variables:

wrd: to store a word

len: integer to store the length of the word

swapwrd: to store the swapped word

sortwrd: to store the sorted word

Member functions/methods:

SwapSort(): default constructor to initialize data members with legal initial values

void readword(): to accept a word in UPPER CASE

void swapchar(): to interchange/swap the first and last characters of the word in 'wrd' and stores the new word in 'swapwrd'

void sortword(): sorts the characters of the original word in alphabetical order and stores it in 'sortwrd'

void display(): displays the original word, swapped word and the sorted word

Specify the class SwapSort, giving the details of the constructor(), void readword(), void swapchar(), void sortword() and void display(). Define the main() function to create an object and call the functions accordingly to enable the task.

[10]

Question 9.**[10]**

Two matrices are said to be equal if they have the same dimension and their corresponding elements are equal.

For example, the two matrices A and B is given below are equal:

Matrix A		
1	2	3
2	4	5
3	5	6

Matrix B		
1	2	3
2	4	5
3	5	6

Design a class EqMat to check if two matrices are equal or not. Assume that the two matrices have the same dimension.

Some of the members of the class are given below :

Class name: EqMat

Data members/instance variables:

a[][] : to store integer elements

m: to store the number of rows

n: to store the number of columns

Member functions/methods:

EqMat: parameterized constructor to initialise the data members m = mm and n = nn

void readArray(): to enter elements in the array

int check(EqMat P, EqMat Q): checks if the parameterized objects P and Q are equal and returns 1 if true, otherwise returns 0

void print(): displays the array elements

Define the class EqMat giving details of the constructor), void readarray(), int check(EqMat, EqMat) and void print(). Define the main() function to create objects and call the functions accordingly 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 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 10.

A superclass Product has been defined to store the details of a product sold by a wholesaler to a retailer. Define a subclass Sales to compute the total amount paid by the retailer with or without fine along with service tax.

[5]

Some of the members of both classes are given below:

Class name: Product

Data members/instance variables:

name: stores the name of the product

code: integer to store the product code

amount: stores the total sale amount of the product (in decimals)

Member functions/methods:

Product (String n, int c, double p): parameterized constructor to assign data members: name = n, code = c and amount = p

void show(): displays the details of the data members

Class name: Sales

Data members/instance variables:

day: stores number of days taken to pay the sale amount

tax: to store the service tax (in decimals)

total: to store the total amount (in decimals)

Member functions/methods:

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

void compute(): calculates the service tax @ 12.4% of the actual sale amount

calculates the fine @ 2.5% of the actual sale amount only if the amount paid by the retailer to the wholesaler exceeds 30 days calculates the total amount paid by the retailer as (actual sale amount + service tax + fine)

void show(): displays the data members of the superclass and the total amount

Assume that the superclass Product has been defined. Using the concept of inheritance, specify the class Sales giving the details of the constructor (...), void compute() and void show(). The superclass, main function and algorithm need NOT be written.

Question 11.

A doubly queue is a linear data structure which enables the user to add and remove integers from either ends, i.e. from front or rear. Define a class Dequeue with the following details: [5]

Class name: Dequeue

Data members/instance variables:

arr[]: array to hold up to 100 integer elements

lim: stores the limit of the dequeue

front: to point to the index of the front end

rear: to point to the index of the rear end

Member functions:

Dequeue(int 1): constructor to initialize the data members lim = 1; front = rear = 0

void addfront(int val): to add integer from the front if possible else display the message ("Overflow from front")

void addrear(int val): to add integer from the rear if possible else display the message ("Overflow from rear")

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

int poprear(): returns element from rear, if possible otherwise returns - 9999

Specify the class Dequeue giving details of the constructor (int), void addfront(int), void addrear (int), popfront () and int poprear (). The main function and algorithm need not be written.

Question 12.

Write the function to sort the array a[] passed as an argument in descending order using Bubble Sort Technique using the function declaration:

void bubblesort(int []a)

[5]