

THE SECOND COMPARATIVE EXAMINATION 2023-24
Class XII (ISC)
COMPUTER SCIENCE Paper – I (Theory)

Time: Three hours

Maximum marks:70

- * Answers to this paper must be written on the answer script provided separately.
- * You will not be allowed to write during the first 15 minutes. The time is to be spent in reading the question paper.
- * All subsections of each question must be answered in the correct order.
- * All working including rough work should be done on the same sheet as the rest of the answer.
- * Please do not write anything on your question paper except your name and roll number.
- * The intended marks for questions or parts of questions are given in the brackets [].
- * Do not copy the questions on your answer scripts. Copy the correct question number.
- * Answer all the questions from part I and six questions from part II choosing two questions from section A, two questions from section B and two questions from section C.

PART I [20 marks]

Attempt all questions from this part.

Question 1

- (i) Which among the following represents DeMorgan's law? [1]
- (a) $(A + B)' = A' \cdot B'$ (b) $(A')' = A$
(c) Both (a) and (b) (d) Neither (a) nor (b)
- (ii) Assertion: In Boolean algebra, canonical SOP and POS expressions are simplified because boolean operations are practically implemented in the form of gates. [1]
Reason: A canonical SOP or POS expression require less number of gates meaning simplified circuit.
Which of the following options is correct?
(a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.
(c) Assertion is true and Reason is false
(d) Assertion is false and Reason is true
- (iii) Which of the following is obtained after simplifying the expression: $X'YZ + XY'Z + XYZ' + XYZ$? [1]
- (a) $(Y \oplus Z) \cdot Y + Y \cdot Z$ (b) $(X \oplus Y) \cdot Z + XY$
(c) $(X \oplus Z) \cdot X + X \cdot Z$ (d) None of the above
- (iv) How many Boolean variables are reduced by an Octet in K-map? [1]
- (a) 1 (b) 2
(c) 3 (d) 4

- (v) $\sim A \vee \sim B$ is logically equivalent to? [1]
- (a) $\sim A \rightarrow \sim B$ (b) $\sim A \wedge \sim B$
- (c) $A \rightarrow \sim B$ (d) $B \vee A$
- (vi) Assertion: Product term and minterm in Boolean algebra are always the same. [1]
Reason: Minterm is the product of all the literals (with or without bar) within the logic system.
- (a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
- (b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.
- (c) Assertion is true and Reason is false.
- (d) Assertion is false and Reason is true.
- (vii) What is the significance of the keyword **this** in Java? [1]
- (viii) State any one advantage of using abstract method in Java. [1]
- (ix) Write one disadvantage of Recursion over Iteration. [1]
- (x) From the declaration of the class given below, state the nature of the identifiers A, B, C and D: [1]
class A extends B implements C, D

Question 2

- (i) Convert the following infix notation to its prefix form: [2]
 $(A + B / C) / D * (E - F / G)$.
- (ii) An array $ARR[-2 \dots 2, -1 \dots 5]$, stores elements in Column Major Wise, with the address of element $ARR[1][3]$ as 1292. If each element requires 4 bytes of storage, find the base address of the array. 1200 [2]
- (iii) The following functions are a part of some class: [2]
void display(int a, int b, int n)
{
 if(n >= 1)
 {
 System.out.println(a + " ");
 display(b, a + b, --n);
 }
}
- (a) What will be the output of display() when the value of a = 2, b = 3 and n = 6? [2]
- (b) Name the process performed by the given function apart from recursion. [1]

- (iv) The following function is a part of some class which displays prime factors of a number. For example if number is 84 it will display 2 2 3 7. There are some places in the code marked by ?1?, ?2?, ?3? which must be replaced by an expression / statement so that the function works correctly.

```
void disp_prime(int number)
{
    for (int i = 2; ?1? ; )
    {
        if (?2? == 0)
        {
            System.out.print(i + " ");
            number /= ?3? ;
        }
        else
        {
            i++;
        }
    }
}
```

- (a) What is the expression or statement at ?1? [1]
(b) What is the expression or statement at ?2? [1]
(c) What is the expression or statement at ?3? [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 [20 marks]

Answer any two questions.

Question 3

- (i) The inaugural function of the newly constructed flyover has been organised by the Public Works Department. Apart from a few special invitees, entry is permitted only if:

The person is an employee of PWD of class 1 category with more than 10 years of working experience.

OR

The person is an employee of any other government or authorized private organization either at the management level or with more than 10 years of working experience.

The inputs are:

INPUTS

- A The person is a class 1 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.

(In all the above cases, 1 indicates yes and 0 indicates no.)

OUTPUT X : Denotes eligible for entry [1 indicates Yes and 0 indicates No in all cases].

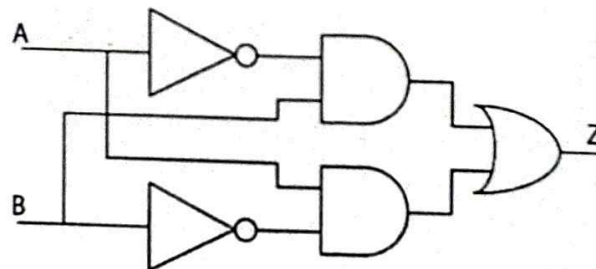
Draw the truth table for the inputs and outputs given above and write the SOP expression for X (A, B, C, D). [5]

- (ii) Reduce the above expression X (A, B, C, D) by using a 4- variable Karnaugh map, showing the various groups (i.e. octal, quads and pairs).

Draw the logic gate diagram for the reduced expression. Assume that the variables and their complements are available as inputs. [5]

Question 4

- (i) (a) Reduce the Boolean function $F(A, B, C, D) = \pi(0, 3, 4, 6, 8, 9, 10, 11, 12, 14)$ by using a 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) (a) From the logic circuit diagram given below derive the Boolean expression (Z) and draw the truth table for the derived boolean expression. Name the logic gate which is represented by the given logic circuit diagram. [4]



- (b) If $A = 1, B = 0$ and $C = 1$ then find the value of $A.B.C. + A.B.C' + A.B'.C$ [1]

Question 5

- (i) What is a decoder? State its application. Draw the truth table of a 2×4 decoder and draw its logic circuit diagram. [5]
- (ii) Verify using the truth table whether the following proposition is valid or not: [3]
 $(P \Rightarrow Q).(Q \Rightarrow R) \Rightarrow (P \Rightarrow R)$
- (iii) Using Boolean laws simplify the following Boolean expression. [2]
 $F = PQ + (P + Q).(P + PR) + Q$

SECTION B [20 marks]

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

A palindrome number (also known as numeral palindrome or a numeric palindrome) is a number (such as 16461) that remains the same when its digits are reversed.

Design a class Palindrome to check if a given number is a palindrome number or not. Some of the members of the class are given below:

Class name : **Palindrome**

Data members / instance variables:

- num : to store a positive number
- rev : to store the reverse of the number.

Methods / member functions:

- Palindrome() : default constructor to initialize the data members with legal initial value
- void getNum() : accepts a positive integer number
- int reverse(int n) : computes and returns the reverse of n using recursive technique
- void isPalin() : to check whether the given number is a palindrome number or not by invoking the function reverse() and to display the result with an appropriate message.

Specify the class Palindrome, giving details of the **constructor()**, **void getNum()**, **int reverse(int n)**, **void isPalin()**. Define the **main()** function to create an object of the class and call the functions accordingly to enable the task.

[10]

Question 7

A class Shift contains a two dimensional integer array of order (m × n) where the maximum values of both m and n is 20. Design a class Shift to shift elements of the matrix column wise such that each column is shifted towards one column left and first column is shifted to last as per the given example:

Input				Output			
1	2	3	4	2	3	4	1
8	5	6	7	5	6	7	8
91	10	11	22	10	11	22	91
13	34	15	16	34	15	16	13

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

Class name : **Shift**

Data members / instance variables:

arr[][] : integer array to store the numbers
m : integer to store the number of rows
n : integer to store the number of columns.

Methods / member functions:

Shift(int mm, int nn) : initializes the size of the matrix m = mm and n = nn
void fill() : accepts integers from the user and stores them in the matrix
void arrange() : shifts the elements of the matrix column wise such that each column is shifted towards one column left and first column is shifted to last without using another matrix
void display() : displays the array in matrix form.

Specify the class Shift, giving details of the **Shift(int, int)**, **void fill()**, **void arrange()** and **void display()**. Define the **main()** function to create an object of the class and call the functions accordingly to enable the task.

[10]

Question 8

A class **Vowels** has been defined to print all the words of the sentence having all the vowels along with the frequency of such words.

Example1:

Input: "The Higher Authorities of Automobile industries need good education"

Output: AUTHORITIES, AUTOMOBILES, EDUCATION

Frequency of words = 3

Some of the members of the class are given below:

Class name : **Vowels**

Data members / instance variables:

Str : to store a sentence in upper case
length : integer to store the length of the sentence.

Methods / member functions:

Vowels() : default constructor to initialize data members with legal initial values
void accept() : accepts a sentence and converts it into upper case
boolean check(String wrd) : checks wrd for presence of all vowels in the word and returns true if wrd contains all vowels otherwise returns false

void display()

: displays the original string, and the words containing all the vowels and also prints the frequency of words containing all vowels.

Specify the class **Vowels** giving details of the **constructor()**, **void accept()**, **boolean check(String)** and **void display()**. Define a **main()** function to create an object of the class and call the functions accordingly to enable the task. [10]

SECTION C [10 marks]

Attempt any two questions.

Each program 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 comments in the program and mnemonic names or pseudo codes for algorithms. The program must be written in Java.

(Flowcharts are not required.)

Question 9

Strange is an entity which can hold at the most 20 integers. The strange restriction is that an integer can only be added on the top or removed from the top. This is like a pile of china plates in which we add a plate to the pile on the top and remove a plate from the top only.

Define the class Strange with the following details:

Class name : **Strange**

Data members / instance variables:

ele[] : array to hold integer numbers
capacity : maximum capacity of the integer array
top : to point to the index of top most element.

Member functions / methods:

Strange(int cap) : constructor to initialize the data members capacity = cap, top = -1 and to create the integer array
void pushItem(int v) : adds the integer value v to the top of Strange if possible otherwise outputs the message "Overflow"
int popItem() : removes the integer from the top of Strange and returns it if Strange is not empty, otherwise outputs a message "Strange is empty" and returns -9999.

(i) Specify the class Strange giving details of the functions **void pushItem(int)** and **int popItem()**. Assume that the other functions have already been defined.

The main() function and algorithm need NOT be written. [4]

(b) Name the entity described above and state its principle. [1]

Question 10

A super class Account has been defined to represent details of the account holder.
A subclass Transaction has been defined to update the balance of the account.
The details of the members of both the classes are given below:

Class name : **Account**
Data members / instance variables:
accNo : stores the Account number of the customer
name : stores name of the customer.

Methods / Member functions:
Account (...)
void display()

: parameterized constructor to assign values to the data members

: to display the details of the account.

Class name

Transaction

Data member/instance variable:

balance

to store the account balance in decimals.

Methods / Member functions:

Transaction(.....)

: parameterized constructor to assign values to the data members of both the classes

void deposit(int amt)

: updates the balance by adding amt into balance

void withdraw(int amt)

: updates the balance by subtracting amt from balance if possible otherwise displays appropriate message. Minimum balance of Rs 500 must be maintained (i.e. in case after withdrawal balance is getting below Rs 500, no transaction shall take place)

void display()

: displays the details of the customer along with account balance.

Assume that the super class Account has already been defined. Using the concept of inheritance specify the class **Transaction** giving details of the **constructor(...)**, **void deposit(int)** and **void withdraw(int)**.

The super class, algorithm and main() function need not be written.

[5]

Question 11

(i) State one application of multiplexer.

[1]

(ii) What is the role of final keyword when used in function declaration?

[1]

(iii) What is the importance of base case in recursion?

[1]

(iv) Explain protected access specifier.

[1]

(v) How is an interface different from a class?

[1]