THE FIRST 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
Choose the correct answer and write the correct option:

(i) The Boolean expression which holds true for Commutative law is: [1]

(a) $A \oplus B = B \oplus A$

(b) $(A + B) + C = A + (B + C)$

(c) $(A \oplus B) \oplus C = A \oplus (B \oplus C)$

(d) $A . (B + C) = (A + B) . C$

(ii) Dual of $(A' + 0) . (B' + 1) = A'$ is: [1]

(a) $(A'.0) + (B'.1) = A'$

(b) $(A.1) + (B.0) = A'$

(c) $(A'. 1) + (B'.0) = A'$

(d) $A'+1 + B'.0 = A'$

(iii) The complement of the Boolean expression $\overline{(P.Q)' + R'}$ is: [1]

(a) $(P + Q).R$

(b) PQR

(c) $(P' + Q'). R'$

(d) $(P' + Q').R$

(iv) If $(X \Rightarrow \sim Y)$ then, its converse will be: [1]

(a) $X \Rightarrow Y$

(b) $\sim Y \Rightarrow X$

(c) $Y \Rightarrow X$

(d) $\sim X \Rightarrow Y$

This paper consists of Eight printed pages.   Turn over

B – 6

(v) The given truth table represents an: [1]

X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	1

(a) Inclusive-OR (b) Exclusive-OR

(c) Exclusive-NOR (d) Inclusive-NOR

(vi) Write the canonical sum of product form of the function Y (A, B) = A + B. [1]

(vii) Complete the relation $(A + B . C)' =$ _____. [1]

(viii) State the difference between the functions nextToken() and hasMoreTokens(). [1]

(ix) What is the significance of keyword 'new' in Java? [1]

(x) Give one disadvantage of type casting. [1]

Question 2

(i) Explain the term 'Map Rolling' in a Karnaugh map. [2]

(ii) Mention any two properties of 'static' variable in Java. [2]

(iii) With reference to the code given below answer the questions that follow with dry run/working:

```
int solve(int p, int q)
{
    for(int r = 0; p > 0; r = q % p, q = p, p = r);
    return (p == 0 ? q : -1);
}
```

(a) What will the function solve() return when the value of p = 12 and q = 8? [2]

(b) What is the function solve() computing? [1]

(iv) The following function play() is a part of some class. Assume 'y' is a positive integer, greater than 0. Answer the given questions along with dry run/working.

```
void play(int y)
{
    int b = 0;
    for(int a = 1; y > 0; b + = (y % 2) * a, a *= 10, y /= 2);
    System.out.println(b);
}
```

(a) What will be the output of the function play() if y = 11? [2]

(b) What is the function play() performing? [1]

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)   Given the Boolean function $F(A, B, C, D) = \Sigma(1, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15)$.

    (a)   Reduce the above expression in SOP form using K-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 $F(P, Q, R, S) = \pi(0, 1, 2, 8, 9, 11, 13, 15)$.

    (a)   Reduce the above expression in POS form using K-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]

Question 4

(i)   A company intends to develop a device to show the high status power load for a household invertor depending on the criteria given below:

- If Air conditioner and Geyser are ON.

- If Air conditioner is OFF, but Geyser and Refrigerator are ON.

- If Geyser is OFF, but Air conditioner and Water purifier are ON.

- When all are ON.

The inputs are:

INPUTS	
A:	Air conditioner is ON
G:	Geyser is ON
R:	Refrigerator is ON
W:	Water purifier is ON

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

OUTPUT X: (1 indicates high power, 0 indicates low power)

Draw the truth table for the given inputs and outputs and write the SOP expression for X(A, G, R, W) [5]

(ii) Minimize the following expression using Boolean laws: [3]

Q. (Q' + P). R. (Q + R)

(iii) Draw circuit diagram of a two input XOR gate with the help of NOR gates only. [2]

Question 5

(i) State an application of a multiplexer. Draw the logic circuit for an octal to binary encoder and explain its working when a particular digit is pressed. [5]

(ii) Using a truth table, verify if the following proposition is valid or invalid: [3]

$(a \Rightarrow b) \wedge (b \Rightarrow c) = (a \Rightarrow c)$

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

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

Design a class ArrMix to arrange two single dimensional array into one single dimensional array, such that the perfect squares from both the arrays are at the beginning followed by the non-square numbers.

Example: Array 1: {2, 13, 64, 19, 25, 11, 4}

Array 2: {7, 81, 38, 17, 256, 49}

Arranged Array = {64, 25, 4, 81, 256, 49, 2, 13, 19, 11, 7, 38, 17}

Some of the members of the class are given below:

Class name   : **ArrMix**

Data members / instance variables:

a1[]   : first array to store integers

a2[]   : second array to store integers

arranged[]	: stores the arranged numbers as per the given criteria
sizel	: integer to store the size of the first array
size2	: integer to store the size of the second array.

Methods / member functions:

ArrMix(int m, int n)	: parameterized constructor to assign m to *sizel* and n to *size2* and to create the three arrays
void fillarray()	: to enter integer elements in the arrays *a1* and *a2*
void arrange()	: stores the perfect squares from the two arrays *a1* and *a2* in array *arranged* followed by the non-square numbers from the two arrays
void display()	: displays the elements of the arranged array.

Specify the class ArrMix, giving details of the constructor and methods. Also define the main( ) method to create object of the class and call the functions accordingly to enable the task. [10]

Question 7

Design a class MidDigit to find the middle digit number. The middle digit number of a number is the one which is exactly in the mid of a given number. Some examples are:

Example 1: If number is 86596, then 5 is the middle digit number because there are two digits both on the left and right of 5.

Example 2: If number is 41789036, then 89 is the middle digit number because there are three digits both on the left and right of 89.

Some of the members of the class are given below:

| Class name | : **MidDigit** |

Data members / instance variables:

| num | : to store a positive integer |
| midnum | : to store the middle digit number. |

Methods / member functions:

| MidDigit(int nn) | : parameterized constructor to initialize num = nn and midnum = 0 |
| int numLen(int p) | : returns the number of digits in p |

| void midDigit() | : finds the middle digit number using appropriate method(s) |
| void display() | : displays the original number and the middle digit number. |

Specify the class MidDigit, giving details of the constructor and methods. Define the main( ) function to create an object and call the functions accordingly to enable the task.

[10]

Question 8

A class Encrypt has been defined to replace only the vowels in a word by the next corresponding vowel to form a new word. i.e. A → E, E → I, I → O, O → U and U → A:

Example: COMPUTER becomes CUMPATIR

Some of the members of the class are:

Class name : **Encrypt**

Data members / instance variables:

| wrd | : to store a word |
| len | : integer to store the length of the word. |

Methods / member functions:

Encrypt()	: default constructor to initialize data members
void acceptword( )	: to accept the word in UPPER case
void freqvowcon()	: finds the frequency of the vowels and consonants in the word stored in 'wrd' and displays them with an appropriate message
void nextVowel( )	: replaces only the vowels present in the word stored in 'wrd' by the next corresponding vowel leaving the remaining characters unchanged
void display( )	: displays the original word along with the encrypted word using appropriate methods.

Specify the class Encrypt, giving details of the constructor and methods. Define the main( ) function to create an object and call the functions accordingly to enable the tasks.

[10]

*Attempt any **two** questions.*

Each program / algorithm 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 and the algorithm must be written in general / standard form, wherever required / specified.

(Flowcharts are **not** required)

Question 9

Design a class LeadNum to check if a given number is a lead number or not. A lead number is one whose sum of even digits is equal to the sum of its odd digits.

For example, 6369, 1452, 1964, 29634 and so on.

The details of the class are:

Class name   : **LeadNum**

Data member / instance variable:

    n   : to store the number.

Member functions / methods:

    LeadNum(…)   : parameterized constructor to initialize n

    boolean isLead()   : returns true if 'n' is a lead number and false otherwise

    void display()   : displays the number and prints whether it is a lead number or not.

Specify the class LeadNum giving details of the constructor and methods. The main() function and algorithm need not be written.   [5]

Question 10

A class Alpha enables the characters of a string to be arranged in alphabetical order. Some of the members of the class are:

Class name   : **Alpha**

Data member / instance variable:

    str   : to store a word.

Member functions / methods:

Alpha()	: default constructor
void readString()	: to accept a word in UPPER case
void arrange()	: arranges the letters of the word in alphabetical order without using any sorting technique and print it.

Specify the class Alpha giving details of the constructor and member functions. The main() function and algorithm need not be written.   [5]

Question 11

Write an Algorithm or a Method to search a value 'val' in an array A[] using binary search technique. Assume that A[] is sorted in ascending order. The method declaration is as follows:

void bsearch(int A[], int val)   [5]