



COMPUTER SCIENCE PAPER 1 (THEORY)

Maximum Marks: 70

Time Allotted: Three Hours

Reading Time: Additional Fifteen minutes

Instructions to Candidates

1. You are allowed an **additional fifteen minutes** for **only** reading the question paper.
2. You must **NOT** start writing during reading time.
3. This question paper has **10 printed pages**.
4. It is divided into **two parts: Part I and Part II**.
5. It has **eleven questions** in all.
6. **Part I** is compulsory and has **two** questions.
7. While answering **Multiple Choice Questions** in **Part I**, you are required to **write only ONE option as the correct answer**.
8. **Part II** is divided into three sections: **A, B and C**.
9. **Each section in Part II** has **three questions**. **Any two** questions have to be attempted from each section.
10. The intended marks for questions are given in brackets [].

Instruction to Supervising Examiner

Kindly read **aloud** the Instructions given above to all the candidates present in the examination hall.

Note: The Specimen Question Paper in the subject provides a realistic format of the Board Examination Question Paper and should be used as a practice tool. The questions for the Board Examination can be set from any part of the syllabus, though the format of the Board Examination Question Paper will remain the same as that of the Specimen Question Paper. The weightage allocated to various topics, as given in the syllabus, will be strictly adhered to.

PART I – 20 MARKS

Answer all questions.

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

Question 1

- (i) The hexadecimal equivalent of $(349 \cdot 75)_{10}$ is: **(Apply)** [1]
- (a) 16D·7
 - (b) 15D·C
 - (c) 15B·C
 - (d) 5DC·B
- (ii) Given below are two statements marked, Assertion and Reason. Read the two statements carefully and choose the correct option. **[1]**
- Assertion:** In Python, loop with the else clause executes only in the case of normal termination of the loop.
- Reason:** In Python, break statement in the body of the loop results in unnatural exit from the loop. **(Analyse)**
- (a) Both Assertion and Reason are true, and Reason is the correct explanation for the Assertion.
 - (b) Both Assertion and Reason are true, but Reason is not the correct explanation for the Assertion.
 - (c) Assertion is true and Reason is false.
 - (d) Both Assertion and Reason are false.
- (iii) Which of the following is an example of open-source software? **(Recall)** [1]
- (a) Linux
 - (b) MS Word
 - (c) Photoshop
 - (d) Windows OS
- (iv) The proposition $(X \vee \sim X) \wedge 1$ will be equal to: **(Apply)** [1]
- (a) 1
 - (b) 0
 - (c) X
 - (d) $\sim X$

- (v) The logic gate represented by the Boolean Expression $(A' + B') \cdot (A + B)$ is: [1]
(Analyse)
- (a) OR
(b) AND
(c) XOR
(d) XNOR
- (vi) Consider the following statement written in Java class *Kinetic* where *g* is its data member. [1]
static final double g = 9.8;
Which of the following statements are valid for *g*?
- I. It contains a common value for all objects class *Kinetic*.
II. Its value is non-changeable.
III. At a time two access modifiers static and final, cannot be applied to a single data member *g*. (Understand)
- (a) Only I and II
(b) Only II and III
(c) Only I and III
(d) Only III
- (vii) Given below are two statements marked, Assertion and Reason. Read the two statements carefully and choose the correct option. [1]
Assertion: $(p \wedge q)$ is a satisfiable proposition.
Reason: A satisfiable formula is true for all possible truth assignments. (Apply)
- (a) Both Assertion and Reason are true, and Reason is the correct explanation for the Assertion.
(b) Both Assertion and Reason are true, but Reason is not the correct explanation for the Assertion.
(c) Assertion is true and Reason is false.
(d) Both Assertion and Reason are false.
- (viii) Name the File Stream Class in Java to perform the following operations: (Recall) [1]
(a) to write data into a text file
(b) to read data from a binary file
- (ix) If, [1]
• E denotes "The exam is difficult"
• S denotes "Students pass the exam"
then express the following statements in symbolic form:
"If students do not pass the exam, then the exam was difficult." (Apply)
- (x) State the use of Python keywords *pass* and *continue* with respect to loops. [1]
(Understand)

Question 2

- (i) Convert the following arithmetic expression into Java statement: [2]

$$s = (a^4 + b^r) / \sqrt{ab} \quad \text{(Apply)}$$

- (ii) Define the term *conjunction* in propositional logic. Give *one* example. (Recall) [2]

- (iii) The following function *puzzle()* is a part of some Java class. Assume '*p*' and '*q*' are parameters to the function. Answer the questions given below along with dry run / working.

```
double puzzle ( double p , int q )
{
    double r = 1 ;
    int c = ( q < 0 ) ? -q : q ;
    if ( q == 0 )
        return 1 ;
    else
    {
        for ( int i = 1 ; i <= c ; r = r * p , i ++ );
        return ( q > 0 ) ? r : 1 / r ;
    }
}
```

- (a) What does the function **puzzle()** perform ? (Analyse) [1]
- (b) What will the function **puzzle()** return when the value of **p = 2** and **q = -3**? (Apply) [2]
- (iv) Given below is the Python code and its output. There are some places in the code marked by **?1?**, **?2?**, **?3?** which may be replaced by a statement / expression so that it gives the following output:

```
Hello  mike check 1
        mike check 2
Hello  mike check 1
        mike check 2
Hello  mike check 1
        mike check 2
```

Code

```
str1="Hello"
str2="mike check"
for i in range(1,6,?1?):
    print(str1,end=" ")
    for j in range(1,?2?):
        print("\t",str2,?3?)
```

- What are the expressions or statements at **?1?**, **?2?** and **?3?** (Analyse) [3]

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

Perform the following conversions / operations:

(Apply)

- (i) $(10111010 \cdot 101)_2 = (?)_8$ [2]
- (ii) $(5B3 \cdot C)_{16} - (2F \cdot 19)_{16}$ [2]
- (iii) $(5273)_8 \times (23)_8$ [2]
- (iv) $(1011010)_2 - (0110111)_2$ (using 1's complement) [2]
- (v) $(110111 \cdot 10)_2 + (1010 \cdot 01)_2$ [2]

Question 4

- (i) A Research Grant Committee includes a Director (D), Scientist (S), and Auditor (A). A research grant is sanctioned only if: [5]

- The Director and either Scientist or Auditor agrees

OR

- All three agree

The inputs are:

INPUTS	
D	Denotes the Director's vote
S	Denotes the Scientist's vote
A	Denotes the Auditor's vote

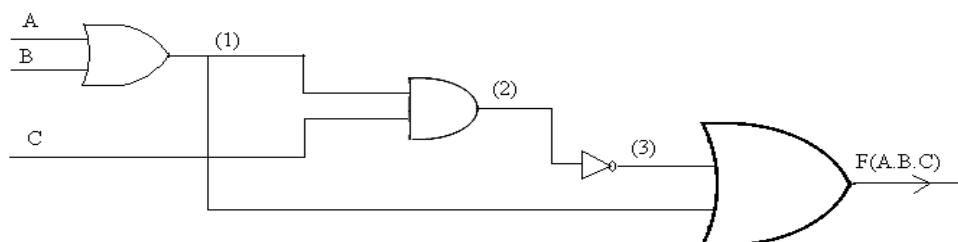
(In all the above cases, 1 indicated YES and 0 indicates NO)

Output: **X** - Denotes sanction

(1 = sanctioned and 0 = not sanctioned)

Draw the truth table for the inputs and outputs given above. Also, write the Boolean expression for **X(D,S,A)** with disjunctive operators for each of the **false** values (0's) from the output column of the truth table. (Analyse)

- (ii) From the logic gate diagram given below, derive the Boolean expression for (1) and (3). Also, derive the Boolean expression for $F(A,B,C)$. [3]
(Analyse)



- (iii) What are *Universal gates*? How can an OR gate be constructed using only NAND gates? [2]
(Understand)

Question 5

- (i) (a) Explain the concept of a Half Adder in the context of binary addition. How does a Half Adder differ from a Full Adder? [2]
(Understand)
- (b) Derive the Boolean expressions for the Sum and Carry outputs of a Half Adder and construct the logic gate diagram of a Half Adder using appropriate logic gates. [3]
(Recall)
- (ii) Draw a truth table to verify the following proposition. [3]
 $(Y \Rightarrow X) \vee (X \Rightarrow Y) = 1$ (Apply)
- (iii) Study the logic gate given below and answer the questions that follow:



- (a) What is the output of the above gate if input $A=1$ and input $B=0$? [1]
(Understand)
- (b) What should be the input values of A and B to obtain an output of 1? [1]
(Understand)

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 6

[10]

Design a class **FileAlpha** to arrange the names in alphabetical order by reading from a text file “Student.txt” assuming the file contains names of 50 students.

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

Class name : **FileAlpha**

Data members / instance variables:

str[] : to store the names

n : to store the maximum size of the array

Member functions/methods:

FileAlpha(int nn) : default constructor to initialise data member n=nn and to declare the array

void readFile() : to read the names from the file “Student.txt” and store it in str[]

void alphabetic() : to sort the names in str[] alphabetically

void show() : to display the names in alphabetical order

Define the class **FileAlpha** giving details of the **constructor()**, **void readFile()**, **void alphabetic()** and **void show()**. Define the **main()** function to create an object and call the functions accordingly to enable the task. **(Create)**

Question 7**[10]**

A class **SpyNumGen** has been defined to generate all Spy numbers between a specific range.

[A **Spy number** is a positive integer where the sum of its digits equals the product of its digits.]

Example: 1124

$$\text{Sum} = 1+1+2+4 = 8 \quad \text{Product} = 1 \times 1 \times 2 \times 4 = 8$$

Hence, 1124 is a Spy number

Some of the members of the class are given below:

Class name : **SpyNumGen**

Data members/instance variables:

start : to store the start of range

end : to store the end of range

Methods/Member functions:

SpyNumGen(int a, int b) : parameterised constructor to initialise the data members start=a and end=b

int sum_digits(int n) : returns the sum of the digits of the number 'n'

int prod_digits(int n) : returns the product of the digits of the number 'n'

void generate() : generates all Spy numbers between start and end by invoking the functions *sum_digits()* and *prod_digits()*

Specify the class **SpyNumGen** giving details of the **constructor()**, **int sum_digits(int)**, **int prod_digits(int)** and **void generate()**. Define the **main()** function to create an object and call the functions accordingly to enable the task. **(Create)**

Question 8**[10]**

A class **ColMin** contains a square matrix which finds the smallest element in a given column.

Example: if array size is [3][3] and elements are:

17	2	19
13	17	5
7	34	8

Given, column = 0, then the smallest element is 7 at row 2 and column 0

Some of the members of the class are given below:

Class name : **ColMin**

Data member/instance variable:

mat[][] : array to store integer elements

m : to store the order of the matrix

Member functions/methods:

ColMin(int mm) : parameterised constructor to initialise the data member m=mm and to declare the array

void accept() : to accept the array elements

void small_col(int n) : to find and display the smallest element in the 'n'th column along with row index and column index

void display() : to display the array elements in matrix form

Specify the class **ColMin**, giving the details of the **constructor()**, **void accept()**, **void small_col(int)** and **void display()**. Define the **main()** function to create an object and call the functions accordingly to enable the task. **(Create)**

SECTION – C

Answer **any two** questions.

[Based on **PYTHON** Programming / Trends in Computing and Ethical issues]
Each program should be written in such a way that it clearly depicts the logic of the problem.
(Flowcharts and Algorithms are **not** required.)

Question 9

- (i) A school has introduced a health programme for all its students which aims at promoting holistic physical development. As a part of the programme, the school wants to calculate BMI (Body Mass Index) of each student. [3]

Write a program to input the name, weight in kilograms and height in meters of the students and to calculate the BMI based on the formula $BMI = \text{weight} / \text{height}^2$.

The output should display the name, BMI value and status of the student based on WHO criteria as per the chart given below.

Status of the student	WHO criteria for BMI
Underweight	<18.5
Normal	between 18.5 to 24.9
Overweight	Between 25 to 29.9
Obese	≥ 30

(Create)

- (ii) What will be the output for the following part of code? Show the working. [2]

```
x,y,z=4, -6,2
result=-(x+z)<y or x**z<10
print(result)
```

(Analyse)

Question 10

- (i) Write a program to input an integer. Check and display if it is a prime palindrome number or not. [4]

[Prime number is a number which is exactly divisible only by itself and by number one. Palindrome number is a number which remains the same on reversing its digits. Prime palindrome is a number which is prime as well as palindrome.]

E.g. 101, 131, 313

(Create)

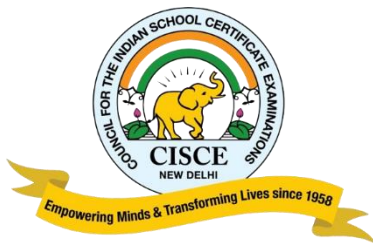
- (ii) Construct a for loop statement which will generate multiples of 5 in descending order from 50 to 5, in a single line. [1]

(Apply)

Question 11

Answer the following questions:

- (i) State *one* advantage and *one* challenge of IoT. (Recall) [1]
- (ii) Explain Natural Language Processing (NLP). (Recall) [1]
- (iii) Give *one* example each of non-malicious spamming and malicious spamming. (Understand) [1]
- (iv) What is *Open-Source Software (OSS)*? (Recall) [1]
- (v) Write the full form of GPL and explain its main feature. (Recall) [1]



COMPUTER SCIENCE

PAPER 1

(THEORY)

ANSWER KEY

PART I – 20 MARKS

Question 1

- (i) (b) 15D·C [1]
- (ii) (a) Both Assertion and Reason are true, and Reason is the correct explanation of the Assertion. [1]
- (iii) (a) Linux [1]
- (iv) (a) 1 [1]
- (v) (c) XOR [1]
- (vi) (a) Only I and II [1]
- (vii) (c) Assertion is true and Reason is false. [1]
- (viii) (a) FileWriter [½]
- (b) FileInputStream [½]
- (ix) $\sim S \Rightarrow \sim E$ [1]
- (x) The statement *pass* does nothing but acts as a placeholder in the loop. It is a Null operation. [1]

The statement *continue* skips the statements in the current iteration and moves to the next iteration. It returns the control to the beginning of the loop.

(½ mark each)

Question 2

- (i) `double s = (Math.pow(a, 4) + Math.pow(b, r)) / Math.sqrt(a * b);` [2]
- (ii) Conjunction in propositional logic is a logical connective that combines two propositions using the word *and*. It is true only when both propositions are true and is represented by the symbol $\wedge$. [2]
Ex: If, P: It is raining and Q: It is cold
Then the conjunction is: $P \wedge Q$: It is raining and it is cold.
- (iii) (a) Function *puzzle()* is calculating p raised to the power q (p^q) [1]
(b) Given $p = 2$ and $q = -3$ [2]
Now $p^q = 2^{-3}$
 $= \frac{1}{8} = 0.125$

- (iv) $?1? = 2$ [3]
 $?2? = 3$
 $?3? = j$

PART II - 50 MARKS

SECTION - A

Question 3

- (i) For binary $\rightarrow$ octal, group the bits in **3s** from the decimal point. [2]

10111010·1012

010 111 010 · 101

Now convert each group:

$010_2 = 2$, $111_2 = 7$, $010_2 = 2$, $101_2 = 5$

Therefore,

$(10111010·101)_2 = (272·5)_8$

- (ii) $5B3 \cdot C0$ [2]

$- 02F \cdot 19$

583 · A7

Since $C0_{16} < 19_{16}$, borrow 1 from the integer part:

$5B3 \cdot C0 = 5B2 + 1C0$

Now subtract the fractional parts:

$1C0_{16} - 19_{16} = A7_{16}$

Subtract the integer parts:

$5B2_{16} - 02F_{16} = 583_{16}$

Therefore,

$(5B3 \cdot C)_{16} - (2F \cdot 19)_{16} = (583 \cdot A7)_{16}$

- (iii) Multiply in octal: [2]

5273

$\times 23$

16145

125660

145025

Therefore,

$(5273)_8 \times (23)_8 = (145025)_8$

(iv) Given: [2]

1011010₂

– 0110111₂

Step 1: Find the 1's complement of the subtrahend

0110111 then 1's complement will be: 1001000

Step 2: Add it to the minuend

1011010
+1001000

10100010

There is an end-around carry:

0100010 + 1 = 0100011

Therefore, (1011010)₂ – (0110111)₂ = **(0100011)₂**

(v) Align the binary points: [2]

110111.10
+ 001010.01

1000001.11

Therefore,

(110111.10)₂ + (1010.01)₂ = **(1000001.11)₂**

Question 4

(i) [5]

D	S	A	X
Director's vote	Scientist's vote	Auditor's vote	OUTPUT
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$$X(D,S,A) = (D \vee S \vee A) \wedge (D \vee S \vee \sim A) \wedge (D \vee \sim S \vee A) \wedge (D \vee \sim S \vee \sim A) \wedge (\sim D \vee S \vee A)$$

OR

$$X(D,S,A) = (D+S+A) \cdot (D+S+A') \cdot (D+S'+A) \cdot (D+S'+A') \cdot (D'+S+A)$$

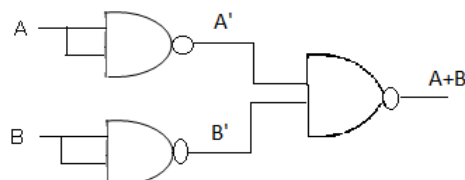
(ii) Expression at (1) = $A+B$ [3]

Expression at (3) = $[(A+B) \cdot C]'$

Derived expression = $[(A+B) \cdot C]' + (A+B)$

(iii) **NAND** and **NOR** gates are called Universal Gates because they can be used to construct any other basic logic gate like AND, OR, and NOT. [2]

OR gate using only NAND gates:



Question 5

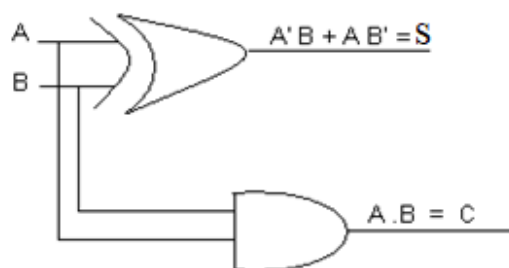
(i) (a) Half Adder is a combinational circuit which adds two input binary digits and outputs (SUM and CARRY). [2]

Half adders add two binary bits whereas, Full adder add three binary bits.

(b) Expression for SUM: $A'B + AB'$ or $A \oplus B$ [3]

Expression for CARRY: $A \cdot B$

Logic circuit diagram of a Half adder:



(ii) [3]

X	Y	$Y \Rightarrow X$	$X \Rightarrow Y$	$(Y \Rightarrow X) \vee (X \Rightarrow Y)$
0	0	1	1	1
0	1	0	1	1
1	0	1	0	1
1	1	1	1	1

Verified that $(Y \Rightarrow X) \vee (X \Rightarrow Y) = 1$ is true.

(iii) (a) 0 [1]

(b) $A=0, B=0$ [1]

SECTION – B

Question 6

[10]

```
import java.io.*;
class FileAlpha
{
    String str[];
    int n;
    FileAlpha(int nn)
    {
        n = nn;
        str = new String[n];
    }
    void readFile() throws Exception
    {
        BufferedReader br = new BufferedReader(new FileReader("Student.txt"));
        for(int i=0;i<n;i++)
            str[i] = br.readLine();
        br.close();
    }
    void alphabetic()
    {
        for(int i=0;i<n-1;i++)
            for(int j=i+1;j<n;j++)
                if(str[i].compareTo(str[j])>0)
                {
                    String t=str[i];
                    str[i]=str[j];
                    str[j]=t;
                }
    }
    void show()
    {
        for(int i=0;i<n;i++)
            System.out.println(str[i]);
    }
    public static void main(String args[]) throws Exception
    {
        FileAlpha ob=new FileAlpha(50);
        ob.readFile();
        ob.alphabetic();
        ob.show();
    }
}
```

Question 7**[10]**

```
class SpyNumGen
{
    int start,end;
    SpyNumGen(int a,int b)
    {
        start=a;
        end=b;
    }
    int sum_digits(int n)
    {
        int s=0;
        while(n>0)
        {
            s+=n%10;
            n/=10;
        }
        return s;
    }
    int prod_digits(int n)
    {
        int p=1;
        while(n>0)
        {
            p*=n%10;
            n/=10;
        }
        return p;
    }
    void generate()
    {
        for(int i=start;i<=end;i++)
            if(sum_digits(i)==prod_digits(i))
                System.out.println(i);
    }

    public static void main(String args[])
    {
        SpyNumGen ob=new SpyNumGen(1,500);
        ob.generate();
    }
}
```

Question 8**[10]**

```
import java.util.*;
class ColMin
{
    int mat[][];
    int m;
    ColMin(int mm)
    {
        m=mm;
        mat=new int[m][m];
    }
    void accept()
    {
        Scanner sc=new Scanner(System.in);
        for(int i=0;i<m;i++)
            for(int j=0;j<m;j++)
                mat[i][j]=sc.nextInt();
    }
    void small_col(int n)
    {
        int min=mat[0][n];
        int row=0;
        for(int i=1;i<m;i++)
            if(mat[i][n]<min)
            {
                min=mat[i][n];
                row=i;
            }
        System.out.println("Smallest = "+min);
        System.out.println("Row = "+row+" Column = "+n);
    }
    void display()
    {
        for(int i=0;i<m;i++)
        {
            for(int j=0;j<m;j++)
                System.out.print(mat[i][j]+" ");
            System.out.println();
        }
    }
    public static void main(String args[])
    {
        ColMin ob=new ColMin(3);
        ob.accept();
        ob.display();
        ob.small_col(0);
    }
}
```

SECTION – C

Question 9

- (i) `name=input("Enter your name:")` [3]
`weight=float(input("Enter your weight in kilograms:"))`
`height=float(input("Enter your height in meters:"))`
`bmi=weight/height**2`
`print(name," your BMI is ",bmi,"Status ",end=" ")`
`if bmi<18.5:`
 `print("...Underweight")`
`elif bmi<25:`
 `print("...Normal")`
`elif bmi<30:`
 `print("...Overweight")`
`else:`
 `print("...Obese")`
- (ii) $-(4+2) < -6$ or $4^2 < 10$ [2]
 $-6 < -6$ or $16 < 10$
False or False

Output - False

Question 10

- (i) `no=int(input("Enter a number"))` [4]
`for i in range(2,no//2+1):`
 `if(no%i==0):`
 `flag=False`
 `break`
`else:`
 `flag=True` # to check for prime
`n=no` # duplication of original value
`rev=0`
`while(n>0):`
 `dig=n%10`
`n=n//10`
`rev=rev*10+dig`
`print("\nreverse of ",no,"=",rev, "\n")`
`if(rev==no and flag==True):`
 `print(no," is a prime palindrome")`
`else:`
 `print(no," is a not a prime palindrome")`
- (ii) `for i in range(50,0,-5): print(i, end=' ')` [1]

Question 11

- (i) Advantage of IoT is task automation. [1]
Challenge of IoT is security and privacy risk.
- (ii) It is a branch of AI that enables computers to understand, interpret and produce human language. [1]
- (iii) Example of Non-malicious spamming: A renowned private bank continuing to send credit card promotional through mails. [1]
Example of Malicious spamming: A fake e-mail which claims that a package from a particular delivery company cannot be delivered to you until you download a “receipt” which would contain harmful spywares.
- (iv) Open Source Software is a source code developed and maintained by open collaboration. These codes are freely available for use, and anyone can examine, modify and redistribute. [1]
- (v) GPL stands for General Public Licence and as per GPL any modified or derived version of the OSS must also be released under the same GPL license. The source code must continue to remain open. [1]