(2)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1394 **I**

Unique Paper Code : 2342011103

Name of the Paper : Mathematics for Computing

Name of the Course : **B.Sc (H) Computer Science**

Semester : I

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll. No. on the top immediately on receipt of this question paper.
2. **Question No. 1** is compulsory.
3. Attempt any four of Question nos. **2 to 7**
4. Parts of a Question must be answered together.

1. (a) Find the dot product, cross product and angle between the vector $\vec{a} = \hat{\imath} + \quad 5\ 4\hat{\jmath} - 2\hat{k}$ and $\vec{b} = 5\hat{\imath} - \hat{\jmath} + 3\hat{k}$

(5)

P.T.O.

(b) Is $Q(x) = 6x_1^2 + 3x_2^2 + x_3^2 + 4x_1x_2 + 2x_1x_3 + 2x_2x_3$ is positive definite ? (5)

(c) Define bases of vector space. Check whether A={[1,0,0], [0,1,1],[1,1,1]} is a bases of vector space $\mathbb{R}^3$ or not? (5)

(d) Find Rank of the following matrix using reduced row echelon form

$$\begin{bmatrix} 3 & 0 & 2 & 2 \\ -6 & 42 & 24 & 54 \\ 21 & -21 & 0 & -15 \end{bmatrix}$$ (5)

(e) Determine whether $f: \mathbb{R}^3 \to \mathbb{R}^3$ such that $f([x_1, x_2, x_3]) = [x_2, x_3, x_1]$ is linear transformation or not. (5)

(f) Find the directional derivative of $F(x,y,z) = 4x^2 + y^2 + 3z^2$ at P(3,2,4) in the direction $5\hat{\imath} + 6\hat{k}$. (5)

2 (a) The set $\mathbb{R}^2$ defined with the addition operation $[x,y] \oplus [w,z] = [x + w - 2, y + z + 3]$ and scalar multiplication

$$a \odot [x,y] = [ax - 2a + 2, ay + 3a - 3].$$

Show that $\mathbb{R}^2$ is a vector space over addition and scalar multiplication. (8)

(b) Define inner product space. Consider a real vector space $\mathbb{R}^2$, which is defined as $\langle x, y \rangle = x_1 y_1 - x_1 y_2 - x_2 y_1 + 2x_2 y_2$. Show that it is inner product space. (7)

P.T.O.

3. (a) Solve using the Gauss Jordan Method

$$\begin{aligned} 2x_1 + x_2 + 3x_3 &= 16 \\ 3x_1 + 2x_2 + x_4 &= 16 \\ 2x_1 + 12x_2 - 5x_4 &= 5 \end{aligned} \qquad (8)$$

(b) Find the bases of row space and null space of the following matrix

$$\begin{bmatrix} 1 & 0 & 1 \\ 2 & 1 & 1 \\ -1 & 1 & -2 \end{bmatrix} \qquad (7)$$

4. (a) Solve the following set of equations using Gauss Elimination method.

$$\begin{aligned} 5x - 5y - 15z &= 40 \\ 4x - 2y - 6z &= 19 \\ 3x - 6y - 17z &= 41 \end{aligned} \qquad (8)$$

(b) Find value(s) of λ for which following system of equations is consistent.

$$\begin{aligned} 2x + 3y &= 4 \\ x + y + z &= 4 \\ x + 2y - z &= \lambda \end{aligned}$$ (7)

5. (a) Diagonalize the following matrix (8)

$$\begin{bmatrix} -4 & 8 & -12 \\ 6 & -6 & 12 \\ 6 & -8 & 14 \end{bmatrix}$$

(b) Define Cayley-Hamilton theorem and verify it for the following matrix

$$\begin{bmatrix} 7 & 1 & -1 \\ -11 & -3 & 2 \\ 18 & 2 & -4 \end{bmatrix}$$ (7)

6. (a) Apply Gram Schmidt orthonormalization process to obtain an orthonormal bases for given bases of $\mathbb{R}^3$:{[1,0,-1],[-1,4,-1],[2,1,2]} (8)

(b) Find inverse of the following matrix using row echelon form.

$$\begin{bmatrix} 2 & -6 & 5 \\ -4 & 12 & -9 \\ 2 & -9 & 8 \end{bmatrix} \quad (7)$$

7. (a) Calculate grad(div(curl $\vec{F}$)) of the following vector field

$$\vec{F} = x^3y^3z\hat{\imath} + x^2y^3z^4\hat{\jmath} + xyz\hat{k} \quad (8)$$

(b) A weather model uses a Markov chain to predict daily weather based on the states Sunny

(S), Rainy (R) and Cloudy (C) with transition matrix (1+3+3)

$$\begin{array}{c} \\ S \\ R \\ C \end{array} \begin{bmatrix} 0.7 & 0.2 & 0.1 \\ 0.3 & 0.4 & 0.3 \\ 0.2 & 0.3 & 0.5 \end{bmatrix} \\ \begin{array}{ccc} S & R & C \end{array}$$

(i) If today is **Sunny**, what is the probability that it will be **Cloudy** tomorrow?

If today is **Rainy**, what is the probability that it will be **Sunny** after two days?

(iii) If the initial state vector is:

$$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

What is the state probability vector after 2 days?

(3)

This question paper contains 6 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : 1375

Unique Paper Code : 2342011102

Name of the Paper : Computer System Architecture

Name of the Course : B.Sc. (H) Computer Science (NEP-UGCF)

Semester : I

Duration : 3 Hours Maximum Marks : 90

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 is compulsory.

Attempt any 4 of Question Nos. 2 to 7.

Parts of a question must be answered together.

Section–A

1. (*a*) Define the following types of memories : 2

   (*i*) PROM

   (*ii*) EPROM

   (*b*) Differentiate between isolated and memory mapped I/O. 3

   (*c*) List any *three* characteristics of a GPU. 3

   (*d*) Show the 8-bit representation of -14 in 3

   (*i*) Signed magnitude representation

   (*ii*) Signed-1's complement representation

   (*iii*) Signed-2's complement representation

P.T.O.

(*e*) Describe the functions of the following registers : 3

(*i*) AR

(*ii*) AC

(*iii*) DR

(*f*) Given the Boolean function F = A'B + ABC' : 4

Derive the algebraic expression for F'. Also, show that F.F' = 0.

(*g*) Write the micro-operations for the following instructions : 4

(*i*) CIR

(*ii*) SNA

(*h*) Give the logic diagram and truth table of a 2-to-4 line decoder using NAND gates only. 4

(*i*) Represent the decimal numbers 184 and 576 in binary code and BCD form. 4

Section-B

2. (*a*) Determine the number of 1024 × 16 memory chips required to achieve the following memory capacities : 4

(*i*) 8192 K × 16

(*ii*) 4096 × 32

(*b*) Explain why each of the following register transfer language statements cannot be directly executed in a basic computer. Also specify the correct sequence of micro-operations required to perform these operations : 5

(*i*) IR ← M[PC]

(*ii*) AC ← AC + TR

(*c*) Design a combinational circuit with three binary inputs *a*, *b* and *c* and three binary outputs *x*, *y* and *z*. When the binary input has even number of 1's, then the output is one more than the input. When the binary input has odd number of 1's, then the output is one less than the input. The output remains the same if the input is zero. 6

3. (*a*) Draw the block diagram of a 4-to-1 line multiplexer and explain its operation by means of a function table. 4

(*b*) Define the Interrupt Cycle. Illustrate the process with a flowchart depicting the sequence of operations involved in the interrupt cycle. 5

(*c*) Given the Boolean function F = xy'z + x'y'z + w'xy + wx'y + wxy 6

(*i*) List the truth table of the given function.

(*ii*) Draw the logic diagram using the original Boolean expression.

(*iii*) Simplify the function using Boolean algebra.

4. (*a*) What mechanism can be used to detect overflow condition while performing arithmetic computations on binary numbers ? Explain the same with the help of an example. 4

(*b*) Draw a space-time diagram for a six-segment pipeline showing the time it takes to process eight tasks. 5

(*c*) The content of the AC in the basic computer is A937 (all numbers are in hexadecimal) and the initial value of E is 1. Determine the contents of AC, E, PC, AR and IR in hexadecimal after the execution of the CMA instruction. The initial value of PC is hexadecimal 021 and hexadecimal code of CMA is 7200. 6

5. (*a*) Assuming the three bit binary code for a register corresponds to the register number and the binary codes for the operations supported by the processor are listed in Table 1. Specify the 14-bit binary control words consisting of four fields SELA, SELB, SELD and OPR that must be applied to implement the following operations : 4

(*i*) $R_1 \leftarrow R_2 + R_3$

(*ii*) $R_1 \leftarrow R_2 \vee R_3$

OPR select	Operation
0000	Transfer
01011	OR
10010	ADD
10100	Complement

Table–1 : Encoding of ALU operations

(*b*) An instruction is stored at location 100 with its address field at location 101. The address field has the value 500. PC has the value 100. The content of a processor register R_1 is 200. Evaluate the effective address (EA) if the addressing mode of the instruction is (All values are in decimal) : 5

(*i*) Direct

(*ii*) Relative

(*iii*) Indirect

(*iv*) Register Indirect

(*v*) Immediate.

(*c*) Perform the arithmetic operations (+70) + (+80) and (–70) + (–80) in binary using signed-2's complement representation for negative numbers. Use eight bits to accommodate each number together with its sign. 6

6. (*a*) Perform the following conversions : 4

(*i*) Convert the hexadecimal number E7B2D.75 to octal

(*ii*) Convert $(3431)_5$ to decimal.

(*b*) Give characteristics table and excitation table of D flip-flop. What is the disadvantage of D flip-flop ? 5

(*c*) Simplify the following Boolean function F together with don't care conditions *d* in SOP (sum of products) form and draw the logic diagram for the simplified F. 6

$$F(x, y, z, w) = \Sigma(0, 1, 8, 14, 15)$$

$$d(x, y, z, w) = \Sigma (2, 5, 10).$$

7. (*a*) What is a binary adder-subtractor ? Draw a diagram of a 4-bit binary adder-subtractor and explain its functionality. 4

(*b*) Explain Direct Memory Access (DMA) in brief. Differentiate between Burst Transfer Mode and Cycle Stealing Mode in DMA. 5

(*c*) A computer uses a memory unit with 256K words of 32 bits each. A binary instruction code a stored in one word of memory. The instruction has four parts : a mode field to specify one of the 16 addressing modes, an operation code, a register code part to specify one of 60 registers, and an address part :

(*i*) How many bits are there in the mode field, operation code, register code part, and the address part ?

(*ii*) Draw the instruction word format and indicate the number of bits in each part.

(*iii*) How many bits are there in the data and address inputs of the memory ? 6

(4)

[This question paper contains 15 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **1356** **I**

Unique Paper Code : 2342011104

Name of the Paper : Object Oriented Programming using Python (DSC-I)

Name of the Course : **B.Sc.(H) Computer Science**

Semester : I

Time : 3 Hours ***Maximum Marks : 90***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) **Section - A** is compulsory.

(c) Attempt any **4** questions from **Section-B**.

(d) Parts of a question must be answered together.

Section – A
(Compulsory)

30

1. (a) Which of the following are invalid identifiers ? Justify your answer : 2

(i) **Course - Name**

(ii) **7 wonders**

(iii) **Except**

(iv) **Riturn**

(b) Draw a flow chart to find the smallest of three numbers. 4

(c) Write a function **findFactors ( )** that takes two numbers, **number 1** and **number 2** as input parameters and returns a tuple comprising common factors of these two numbers. 4

For example, if **number 1** is **18** and **number 2** is **30**, then the function should return **(1, 2, 3, 6)**.

(d) Consider the following Python code segments and determine the output produced on their execution : 4

(i)
```
greetWith ="good morning friends"
result = ""
for i in greetWith. title ( ). split ( ) :
        result += (i[:-1] + i [-1]. upper ( )) + " "
print (result, strip ( ))
```

(e

(ii) Assume that the file '**notes. txt**' does not exist.

```
try :
    f = open ('notes. txt', 'w')
except IOError :
    print ('Error occurred while opening')
else :
    print ('File opened successfully for
     writing')
try :
    f = open ('notes.txt', 'r')
except IOError :
    print ('Error occurred while opening')
else :
    Print ('File opened successfully for
     reading')
```

Consider the following dictionary subjectMarks representing the subject names and marks obtained in corresponding subject : 5

```
SubjectMarks = {'Chemistry': 90, 'Hindi ': 85,
                'Mathematics' : 95, 'Physics' :
                89,
                'Biology ' : 92, }
```

Write Python statements for the following :

(i) Retrieve the marks in **'Mathematics'**.

(ii) Add the contents of the following dictionary to **subjectMarks:**

{'Sanskrit' : 78, 'Geography' : 88, 'Economics' : 84}

(iii) How will Python respond when the following statement is executed ?

```
subjectMarks.get ('Phylosophy', -1)
```

(iv) Delete the details of the subject **'Hindi'** from the dictionary.

(v) What should be the updated contents of the dictionary **subjectMarks** after the execution of the following statement :

```
subjectMarks ['Computer Sc'] = 100
```

(f) Consider the following Python program that defines a class Rectangle. There are some error (s) in the code, indentify them, and rewrite the corrected program : 5

```
class Rectangle
    def _init (self, 1, w) :
            self. length = 1
            self. breadth = w
    def area ( ) :
        return length * breadth
def main ( ) :
    ob = Rectangle (5, 4)
    print (area ( ))
main ( )
```

(g) What is the difference between the following statements ? 6

(i) `Y + = y + 5 and y = y + 5`

(ii) `y = = 10 and y = 10`

(iii)

```
for j in range (1, 6) :
    if (J % 2 = = 1) :
        continue
    print (j)
```

```
for j in range (1, 6) :
    if (j % 2 == 1) :
        break
    print (j)
```

Section – B

(Attempt Any Four Questions)

2. (a) Write a function named **seriesSum ( )** that takes an integer n and x as input parameters and returns the sum of the first **n** terms of the following series : 5

$$x^1/1! - x^2/2! + x^3/3! - x^4/4! + \ldots\ldots x^n/n!$$

(b) What will be the output produced on execution of the following Python statements ? 5

(i) **print (9 + 5 * 2** 3 ! = 15// 6 – 2)**

(ii) **print (64>>2)**

(iii) **print ('apple' > 'banana' and 'orange' < 'grape')**

(iv) **print ('Hello' * 2)**

(v) **print (2 ** 3** 2)**

(c) Write a function named as **oddWord ( )** that takes a string as an input parameter and returns a new string with every word of odd length replaced with the length of the corresponding word. 5

For example : **'I study in Delhi University'** is returned as **'1, 5 in 5 University'.**

(a) Identify the line number where an exception may be raised on execution. Also specify the reason for the exception. 4

```
marksLst = eval ('Input (Enter list of marks in three subjects : '))          # Line 1

maxMarks = int (input ('Enter maximum marks per subject : '))          # Line 2

marksObtained = marksLst [1] + marksLst [2] + marksLst [3]          # Line 3

result = marksObtained/(3*maxMarks)

                                                                    # Line 4

print (result)                                                      # Line 5
```

(b) Write a function **isComposite ( )** that takes an integer as an input parameter and returns **True** if the number is composite (i.e., not a prime number and greater than 1) and **False** otherwise. For example : 4

For is **Composite (4)**, the function should return **True** since **4** is a composite number.

For is **Composite (7)**, the function should return **False** since **7** is a prime number.

For is **Composite (1)**, the function should return False since **1** is neither prime nor composite.

(c) Write a program that takes a list of integers as input from the user and generates a corresponding cumulative list where each element in the resultant list at index **'i'** is the sum of all integers at index **J < = i.** 7

For example, consider the following list :

[7, 12, 4, 9]

Output : Cumulative List : **[7, 19, 23, 32]**

4. (a) Consider the following function **calculateSpeed ( )** that calculates speed using the formula **speed = distance/time :** 4

```
def calculateSpeed (distance, time) :

try :
        speed = distance/time

except ZeroDivissionError :

        print ('ZeroDivisionError')

except TypeError :
```

```
        print ('TypeError')
    except ValueError :
        print ("valueError")
    except :
        print ('An unexpected error occurred.')
    else :
        print ('Speed :', speed, 'm/s')
    finally :
        print ('Execution completed.')
```

What will be the output produced on the execution of the following statements ?

(i) **calculateSpeed (100, 0)**

(ii) **calculateSpeed (100, '20')**

(b) Consider the following list representing product details : 2+3=5

productList = [['Laptop', 800], ['Smartphone', 500], ['Tablet', 300]]

(i) Write a Python code segment to make a shallow copy, named, **copyProducts,** of **productList.**

(ii) What will be the output produced on execution of the following Python code segment ?

```
copyProducts [1] [1] = 550
copyProducts [2] = ['Smartwatch', 250]
print (productList)
print (copyProducts)
```

(c) Find all the errors (if any) in the following Python code segments : 3×2=6

(i)
```
f = open ('recordl', 'r')
f.write (Weather is great today')
f. close ( )
```

(ii)
```
name = 'Mohinder Amarnath'
name [-5] = 'u'
lastChar = name [len (name) -1]
```

(iii)
```
studentMarks = [1001, 'Rohan', [90, 85, 99, 50, 99)]
studentMakrs [2] = 95
print (max (studentMarks))
```

5. (a) Write a function named as **printPattern ( )** that accepts the number of rows **n** as an input parameter and prints the pattern comprising of **n**rows of the following format (say, for **n = 5**) : 5

1
12
123
1234
12345

(b) Write a program that takes a list of numbers as input from the user and creates a list of squares of all the positive even numbers using list comprehension method. 5

For example, if the input list is **[1, -2, 3, 4, 5, 6, -7, 8]**,

The program should produce the output **[16, 36, 64].**

(c) Consider the following string : 5

players = "kohli and rohit play great game "

Write the output produced on execution of the following function calls :

(i) **players.rfind ('i')**

(ii) **players.swapcase ( )**

(iii) **players.lstrip ( )**

(iv) **players.endswith ('!!')**

(v) **players.replace ('Great', 'outstanding')**

6. (a) Write a function that reads the file **report, txt** and copies even numbered lines to file **evenfile.txt** and odd numbered lines to file **oddfile.txt.** For example, 1st, 3rd, 5th, ... lines of the file **report.txt** should be copied to file **oddfile.txt** and 2nd, 4th, 6th, ... line of the file report.txt should be copies to file **evenfile.txt.** Handle all exceptions that can be raised. 7

(b) Consider the following **three** sets : 8

vehicles = {'Bicycle', 'Scooter', 'Car', 'Bike', 'Truck', 'Bus', Tempo Traveller', 'Rickshaw'}

heavyVehicles = {'Truck', 'Bus', 'Tempo Traveller'}

lightVehicles = {'Rickshaw', 'Scooter', 'Bike'}

Write Python statements to perform the following operations on the given sets :

(i) Add the transport '**Bicycle**' to set **lightVehicles.**

(ii) Remove the transport **'Tempo Traveller'** from the set **heavyVehicles.**

(iii) Determine the set of average weight vehicles which are neither heavy weight nor light weight.

(iv) Determine the number of **vehicles.** 5

7. (a) Consider the following function :

```
def addition (numl, num2 = 5, num3 = 38) :

    return num1 + num2 + num3
```

What will be the output returned on execution of the following function calls :

(i) **addition (num2 = 15, num 1 = 47)**

(ii) **addition (29)**

(iii) **addition ( )**

(b) Define a class **ComplexNumber** that represents complex numbers and supports basic arithmetic operations using operator overloading. The class should contain the following data members : 10

real – The real part of the complex number

imag – The imaginary part of the complex number

(i) The class should support the following methods :

* **_init_**for initializing the real and imaginary parts of the complex numbers.
* **_add_ ( )** to overload the + operator, allowing addition of two complex numbers.
* **_str_( )** that returns the complex number in the form **a + bi or a - bi** based on the values of **real** and **imag.**

(ii) Also write Python statements for the following :

* Create an object **C1** of the **ComplexNumber** class with the values **real = 3** and **imag = 4** to represent the complex number **3+4i.**
* Create an object **C2** of the **ComplexNumber** class withthe values **real = 4** and **imag = 5** to represent the complex number **4 + 5i.**

* Add the complex numbers referred by **C1** and **C2** and assign the result to **C3**.
* Display the complex number **C3** using the **_str_( ) method.**

***

(5)

[This question paper contains 20 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1133 **I**

Unique Paper Code : 2342012302

Name of the Paper : Operating Systems

Name of the Course : **B.Sc. (H) Computer Science**

Semester : III

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll. No. on the top immediately on receipt of this question paper.
2. Question No. 1 (Section A) is compulsory.
3. Attempt any 4 (four) questions from Section B.
4. Parts of a question should be attempted together.

P.T.O.

Section A

1. (a) Differentiate between Orphan process and zombie process giving one difference each. (2)

(b) Explain the convoy effect exhibited by FCFS scheduling algorithm with an example. (2)

(c) What will be the output of the parent and child processes in the following (2)

code?

```
#include <stdio.h>

#include <sys/types.h>

#include <unistd.h>

#include <iostream>

using namespace std;
```

```
int main(int argc, char* argv[])

{

        int pid;

        cout<<"Hello\n";

        pid = fork();

        if (pid == 0)

        cout << "World\n";

return 0;

}
```

(d) Discuss the problem of cache coherency with an example. (2)

(e) Why page sizes in memory management scheme are always chosen as power of 2? (2)

(f) Give any one difference between Asymmetric multiprocessing and Symmetric multiprocessing. (2)

(g) Which of the following components of program state are shared across threads in a multithreaded process? Answer with yes or no. (2)

(i) Register values

(ii) Heap memory

(iii) Global variables

(iv) Stack memory

(h) Give an example for each of the following: (2)

(i) Privileged Instruction

(ii) Instruction that can be run in user mode

(i) Define data parallelism with suitable example. (2)

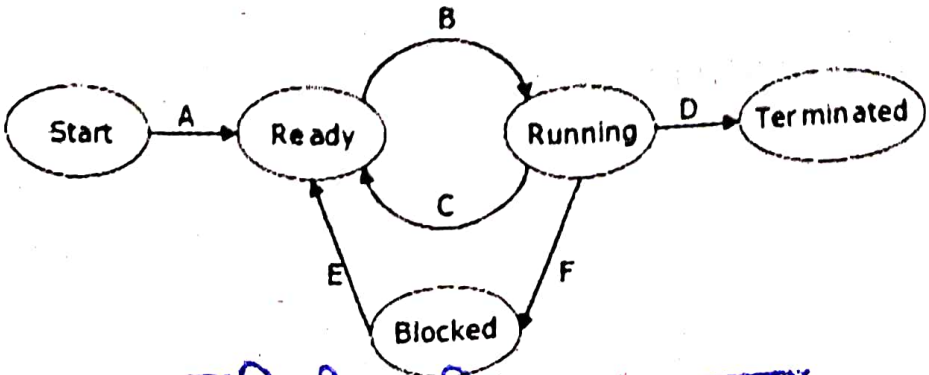
(j) Consider a process P1 with values of relocation and limit registers as 600 and 250 respectively. Assume that the process tries to reference the logical address 200. What will be the corresponding physical address and how is it computed? (2)

(k) Differentiate between Monolithic and Microkernel approach to operating system design. Give any one difference. (2)

(1) In the given process state transition diagram for a uniprocessor system, assume that there are always some processes in the ready state. Which of the following statements are true? Justify. (4)

(i) Termination of a process (Transition D) will result in invoking the long term scheduler to bring another process in the memory (Transition A).

(i) Consider a process P2 that is currently in the "Blocked state". Process P2 can make transition E to the ready state while another process P1 is in running state.



(m) Fill in the blanks. (4)

(i) _____ Scheduler controls the degree of multi-programming.

(ii) Privileged instructions are executed in _____ mode.

(iii) The time it takes disk head to reach the required cylinder during a disk access is termed as _____ .

(iv) Switching the CPU to another process requires performing a state save of the current process and a state restore of a different process. This task is known as a _____ .

Section B

2. (a) In a demand paging system with the page table stored in memory, if the memory reference time

is 200 nanoseconds and the page fault service time is 5 milliseconds, what should be the maximum page fault rate to achieve an effective access time of 350 nanoseconds? (4)

(b) Explain diagrammatically many-to-many multi-threaded model giving one advantage and disadvantage. (3)

(c) Consider the following set of processes, with the length of CPU burst time given in milliseconds as below: (4+2+2)

Process	Arrival Time	Burst Time	Priority
P1	0	6	3
P2	2	3	1 (Highest)
P3	4	2	2
P4	8	9	4 (Lowest)

Perform the following:

(i) Draw the Gantt Charts for priority scheduling (Pre-emptive), and Round Robin (Quantum = 3 ms) scheduling algorithms

(ii) Calculate waiting time for processes P1 and P3 in case of priority scheduling (Pre-emptive)

(iii) Calculate turnaround time for processes P2 and P4 in case of Round Robin (Quantum = 3 ms) scheduling algorithm.

3. (a) Consider the program given below. Assume that the actual PIDs of the parent and child processes are 1500 and 1567 respectively. : (4)

Identify the output of the lines A, B, C, and D.

```
#include <sys/types.h>
```

1133

```
#include <stdio.h>

#include <unistd.h>

int main()

{

    pid_t pid;

    pid=fork();

    if (pid==0)

    {

        cout<<pid;              //Line A

        cout<<getppid();        //Line B

    }
```

```
else if (pid>0)

{

        cout<<pid;              //Line C

        cout<<getpid();         //Line D

}

}
```

(b) Consider the following processes P1 and P2.

(2+3)

P1: counter ++

P2: counter —

Assume that the initial value of counter is 10. Show how P1 and P2 can exhibit race condition

while executing concurrently. State three requirements that a solution to critical-section problem must satisfy.

(c) For the given sets P (processes), R (resources) and E (edges) (3+3)

P= {P1, P2, P3, P4}

R={R1, R2}

E= {P1→R1, R1→P2, R1→P3, P3→R2, R2→P1, R2→P4}

There are two instances each of resources R1 and R2.

(i) Draw Resource allocation graph.

(ii) Is the given system in deadlock state? Justify your answer.

4. (a) Consider a system with logical address space comprising of 256 pages having 1024 bytes each, mapped to physical address space of 128 frames. (4)

(i) How many bits are there in the logical address?

(ii) How many bits are there in the physical address?

(b) Name any two operations which can be performed on a directory. List any one disadvantage of Two-level directory structure. How can this disadvantage be overcome using Tree Structured directory structure? (5)

(c) Consider the following page reference string: (6)

9, 5, 3, 6, 5, 8, 2, 1, 9, 9, 0, 7

5. (a) In case of demand paging, assuming four frames, how many page faults would occur for following page replacement algorithms: (4)

(i) FIFO replacement

(ii) Optimal replacement

The program shown below uses the Pthreads API. What would be the output from the program at LINE X and LINE Y respectively? Justify your answer.

```
#include <pthread.h>

#include <stdio.h>

#include <types.h>

int value = 10;

void *printing (void *param);
```

```
int main(int argc, char *argv[])

{

        pthread t tid;

        pthread_attr_t  attr;

        pthread_attr_init(&attr);

        pthread_create (&tid, &attr, printing,
        NULL);

        pthread_join(tid, NULL);

        cout<<value;                    // LINE X

}

void printing (void *param)
```



```
{
```

```
int value = 20;

value +=10;

cout<< value;                    // LINE Y

}
```

(b) Define external fragmentation? Does paging suffer from external fragmentation? Justify your answer. (2+1+2)

(c) Consider a disk drive of 2000 cylinders, numbered from 0 to 1999. Drive is currently serving a request at cylinder 500, and the previous request was at cylinder 250. The queue of pending request is 150, 1500, 900, 1700, 800, 1900. Starting at current head position, show the head movement and calculate the total distance in cylinders that the disk arm moves to satisfy all pending requests for

each of following disk scheduling algorithms: (6)

(i) Shortest Seek Time First

(ii) LOOK Scheduling

6. (a) Consider the following segment table (4)

Segment	Base	Length
0	519	500
1	1800	95
2	170	300
3	1920	780
4	1860	50

What are the physical addresses for the following logical addresses?

(i) 0,240

(ii) 2,320

(iii) 3,670

(iv) 4,10

(b) For a paged system, Translation Look aside Buffer (TLB) hit ratio is 80%. Let memory access time be 150 ns and TLB buffer access time be 10 ns. Calculate the following: (2+3)

(i) Effective memory access time without TLB

(ii) Effective memory access time with TLB

(c) Consider the following: (6)

(i) TLB miss with no page fault

(ii) TLB miss and page fault

(iii) TLB hit

For each of the above cases, state the situation in which they occur. Also show how the frame number is determined in each case.

7. (a) Assuming a 2-KB page size, what are the page numbers and offsets for the following address references (provided as decimal numbers): (4)

(i) 3085

(ii) 42095

(b) Describe Belady's anomaly in context of Demand paging. Which of the following algorithms suffer from Belady's anomaly: (3+2)

(i) FIFO

(ii) Least Recently Used algorithm

(c) Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order). How would the following scheduling algorithms place processes of size 115 KB, 500 KB and 375 KB (in order)? (6)

(i) First-fit algorithm

(ii) Best-fit algorithm

(6)

[This question paper contains 16 printed pages.]

Your Roll No.....

I

Sr. No. of Question Paper : 1290

Unique Paper Code : 2343012011

Name of the Paper : Data Analysis and Visualization using Python

Name of the Course : **B.Sc. (Hons.) Computer Science**

Semester : III

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** is compulsory.
3. Attempt any **4** questions out of **Q. 2** to **Q.7.**
4. Answer parts of a question together.
5. Assume that the following libraries have already been imported :

   import numpy as np, pandas as pd

Section A

1. (a) What is the difference between interpolation and extrapolation? Explain with the help of an example. (6)

(b) What is the output of the following code segment? (6)

```
a = np.array([25, 35, 45, 28, 60, 22, 38, 50,
              42, 29, 52, 24]).reshape(3,4)
print(a)
print(a[:, 2])
print(a[[True, False, True], :2])
print(a[[1, 0, 2],[3, 2, 1]])
print(a[a > 25].min())
print(a + 2)
```

(c) For the following data frame: (6)

```
myDF = pd.DataFrame([[16, 32, np.NaN], [2, 4, 8],
       [np.NaN, 64, np.NaN], [128, 256, np.NaN]],
       index = ['one', 'two', 'three', 'four'],
       columns = ["Col1", "Col2", "Col3"])
```

Write Python statements to do the following :

(i) print part of myDF as follows:

	Col3	Col2
three	NaN	64
one	NaN	32
two	8.0	4

(ii) print row with index ' three ' using loc and iloc operators.

(iii) create a new column 'Col4' having the minimum values of the corresponding rows.

(d) Write Python code to do the following : (6)

(i) Create a data frame Employee_data containing 50 rows and three columns as mentioned below:

EmployeeID: starting from 1001 to 1050

Salary: randomly generated values ranging between 20000 and 300000.

(ii) Using Salary column of Employee_data, create 4 bins with labels and their corresponding ranges as below:

Label	Salary Range
Beginner	20000 – 50000
Mid-level	50000 – 100000
Senior	100000 – 200000
Expert	20000 onwards

And display the number of employees under every label.

(e) Consider the below data df (6)

```
data = {
    "Age (years)": [2, 3, 4, 5, 6, 7, 8, 9],
    "Height (cm)": [85, 95, 105, 110, 115, 125,
                    130, 140],
    "Weight (kg)": [12, 14, 18, 20, 22, 25, 28, 30],
    "Gender": ["Boy", "Girl", "Girl", "Boy", "Girl",
                    "Boy", "Boy", "Girl"]
}
df = pd.DataFrame(data)
```

Write Python statements to create a scatter plot to analyze the relationship between a child's age and height, using the marker size to represent their weight. Label the axes appropriately. Use different colors for boys and girls.

Section B

2. (a) Consider the dataframe, df, of a store : (8)

	CustomerID	ItemType	Amount	Group
0	C1	Clothing	12000	Working
1	C2	Clothing	2500	Working
2	C3	Electronics	1500	Student
3	C4	Clothing	5000	Student
4	C5	Books	1000	Working
5	C6	Books	900	Student
6	C7	Electronics	1000	Working
7	C8	Clothing	500	Student

What is the output of the following code snippet :

```
group1 = df.groupby('ItemType')['Amount'].sum()
print(group1)
group2 =
    df.groupby(['Group','ItemType'])['Amount'].sum()
print(group2)
table1 = df.pivot_table(index =['ItemType','Group'],
                values = 'Amount')
print(table1)
table2 = pd.crosstab(df['ItemType'], df['Group'])
print(table2)
```

(b) Following are some of the attributes of a dataset of employees : (3)

Attribute Name	Description
EmployeeID	A unique identification number of the employee within the organization
Salary	Monthly salary of the employee
Designation	Can be one of the following: Intern, Analyst, Team Leader, Manager, Director

Classify the attributes to be quantitative or categorical data. If an attribute is categorical then further classify it to be ordinal or nominal. Justify your answers.

(c) What is a boxplot and how can it be used to identify outliers? (4)

3. (a) Given the following two data frames Customer and Orders : (9)

Customer

customerID	Name	City
101	Anand	Mumbai
102	Vishal	Chandigarh
103	John	Lucknow
104	Anita	Hyderabad

Orders

orderID	customerID	Product	Amount
1	101	Shirt	600
2	102	Pants	800
3	101	Kurta	650
4	105	Shoes	1000

(i) What is the output of the following code statement?

```
print(pd.merge(customers, orders, how = 'outer'))
```

(ii) Write statements in Python for the following :

1) Find the customerID, name and products purchased for the customers who have purchased at least one product.

2) Display the details of the customers who have not purchased anything.

(b) Find the output that will be produced on the execution of the following code snippet: (6)

```
df = pd.DataFrame(np.arange(12).reshape((4, 3)),
     index =[['MP', 'PB', 'MP', 'PB' ],['Wheat',
                'Wheat', 'Rice', 'Rice']],
     columns = ['C1', 'C2', 'C3'])
print(df)
print(df.sort_index(level = 0))
```

4. (a) Consider the below data (8)

```
data = pd.DataFrame({'A': [1, 2, np.nan],
                     'B': [4, np.nan, np.nan],
                     'C': [7, 8, 9]})
```

Write Python code for the following :

(i) Count the total number of missing values in the entire data frame.

(ii) Drop rows where more than 50% of the values are missing.

(iii) Replace missing values of column 'A', 'B', 'C' with 1, 2, 3 respectively.

(iv) Replace every value of data by its square using apply function.

(b) Consider the following data frame df containing the heights of individuals (7)

```
df = pd.DataFrame({
    'Gender': ['Male', 'Female', 'Male', 'Female',
               'Male', 'Female', 'Male', 'Female',
               'Male', 'Female'],
    'Height': [175, 160, 180, 155, 170, 165, 185,
                    150, 178, 162]})
```

Write Python code to plot histograms of heights of males and females separately. Add appropriate title, x-axis and y-axis labels to the graph. Save graph to 'heights.jpeg'.

5. (a) Consider a CSV file named student_data.csv which has the marks of the student in five subjects (P, C, M, B and E) as shown below : (2×5=10)

```
studentID;Name;P;C;M;B;E
101;Rohan;93;98;90;96;92
102;Mike;83;78;82;90;86
103;Sagar;73;70;54;78;79
104;Lalit;56;65;72;74;60
105;Sonal;84;83;81;87;95
```

Write Python code to do the following :

(i) Use Pandas to read the student_data.csv file with studentID column as the index of the data frame.

(ii) Add another column 'Rank in the Class' which has the rank of the student as per the total marks (of all the five subjects) obtained by him/her.

(iii) Change the names of the columns as mentioned below :

P to Physics

C to Chemistry

M to Mathematics

B to Biology

E to English

(iv) Display the details of the student who scored highest marks in English.

(v) Draw a stacked bar graph of the marks obtained by a student in 5 subjects, with studentID on the x-axis.

(b) What will be the output of the following code segment? (5)

```
a = np.array([[[54, 46], [92, 38]], [[98, 91],
                        [29, 83]]])
print(a.shape)
b = a.swapaxes(2, 1)
print(b)
print(b.shape)
```

6. Consider the following dataframe expenseDF where each row represents a customer transaction, including customer age, transaction amount, and region.

```
expenseDF = pd.DataFrame({
    'CustomerID': [1, 2, 3, 4, 5, 6, 7, 8, 9, 10],
    'Age': [25, 35, 45, 28, 60, 22, 38, 50, 42, 29],
    'Transaction_Amount': [200, 450, 350, 300, 500,
              250, 600, 400, 550, 300],
    'Region': ['North', 'South', 'East', 'West',
               'North', 'South', 'East', 'West',
               'North', 'South']
```

Write Python statements for the following :

(a) How will you determine whether there is any relationship between age and the expenditure done by a person? Write the Python statement to determine the same for expenseDF. How will you interpret the result obtained after executing the Python statement? (3)

(b) Determine the region which has the maximum number of spenders. If there is a tie for the same, then it should display all those regions. (3)

(c) Determine region-wise total expenditure done by customers along with the number of customers in the region. (3)

(d) Create a new column 'Age_Group' and using binning assign a label out of 'Under 30', '30-40', '40-50', and '50+' depending upon age of the person. (3)

(e) Create a pivot table to calculate the average transaction amount for each of the Region under each Age Group. (3)

7. (a) What will the output of the following code segment? (5)

```
a = np.array([[52, 28, 91], [37, 72, 18],
              [65, 42, 87], [6, 21, 95]])
print(a)
b = a[1:3, :2]
print(b)
s = str(b[0, 1])
b[0, 1] = int(s[::-1])
print(b)
print(a)
```

(b) Write Numpy/Pandas statements to : (10)

(i) create a 3-dimension ndarray arr1 of size 4 x 2 x 3 filled with random integers between 1 and 100.

(ii) create an arr2 from the sum of the elements of arr1 [0] and arr1[2]. What will be the shape of arr2?

(iii) create a data frame df1 for the following table with Name, Gender and Salary as column names :

Name	Gender	Salary
Arnav	Male	15800
Ruhi	Female	16000
Sandesh	Male	18000
Sahil	Male	16500
Shuchi	Female	16200

(iv) create a series S1 from df1 with Name as index and Salary as values.

(v) create a data frame employees from the following lists such that department is the outer index along the column and month is the next level index:

```
employee = ["Sam", "Tom", "Sam", "Tom", "Anna",
                "Anna"]
department = ['Sales', 'Marketing', 'Sales',
                 'Marketing', 'HR', 'HR']
sales = [5000, 7000, 6000, 8000, 12000, 11000]
month = ["Jan", "Jan", "Feb", "Feb", "Jan",
            "Feb"]
```

(7)

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1076 **I**

Unique Paper Code : 2342012301

Name of the Paper : Data Structures

Name of the Course : **B.Sc. (H) Computer Science (DSC)**

Semester : III

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The paper has **two** sections. **Section A** is compulsory.
3. Attempt any **four** questions from **Section B.**
4. All parts of a question must be answered together.

SECTION A

1. (a) Define a binary tree. How does it differ from a binary search tree (BST)? (2)

(b) Show the final array track[ ] after performing the following function func()? (2)

```
int func()
{
    int track[] = {10, 20, 30, 40}, *striker;

    striker = track;
    track[1] += 30;
    *striker -= 10;
    striker++;
    return 0;
}
```

(c) Which data structure is more suitable for an application that requires frequent insertions and deletions to store and maintain data items: a linked list or an array? Justify the answer. (3)

(d) How can we determine if a circular queue is full? Explain along with C++ code. (3)

(e) Solve the recurrence relation using the master theorem : (4)

$$T(n) \rightarrow 4T(n/2) + \log n$$

(f) Consider the following function : (4)

```
int recursion(int x, int y)
 {
 if (x < 0)
{
 return -recursion(-x, y);
 }
else if (y < 0)
{
 return -recursion(x, -y);
 }
else if (x == 0 && y == 0)
{
 return 0;
 }
else
{
 return 100 * recursion(x / 10, y / 10)
 + 10 * (x % 10) + y % 10;
 }
}
```

What would be the output of recursion (10, 39) and recursion (62,–8)?

(g) A single array A [1... MAXSIZE] is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables top1 and top2 (top 1< top 2) point to the location of the topmost element in each of the stacks. If the space is to be used efficiently, write the condition for "stack full". (4)

(h) Build a min-heap using the following data :

65, 60, 55, 50, 40, 33, 30, 22, 11

Show the heap after each insertion. (4)

(i) Consider an array with the following elements:

102, 280, 405, 513, 642, 746, 910, 958, 1004

Which searching technique (linear or binary) is more suitable and why? Will this technique still be appropriate if the same data is stored using a linked list? Justify your answer. (4)

SECTION B

2. (a) Write the C++ code for implementing a stack using the given class templates: (4)

```
template <class T> class Stack {
public:
        Stack();
        void push(T k);
        T pop();
        T topElement();
        bool isFull();
        bool isEmpty();
private:
    int top;
    T test_Stack[SIZE];
};
```

(b) Construct a binary tree from the given Inorder and Preorder traversals: (5)

Inorder : x, y, z, a, p, q, r

Preorder : a, y, x, z, q, p, r

Also write post order traversal.

(c) Consider a linear queue created using an array of size 4. Perform the following operations in the given order and show the status of the queue after every operation : (6)

Enqueue(4), dequeue(), dequeue(), Enqueue(5), Enqueue(6), Enqueue(8)

If the above queue was circular, show the final contents of the queue after performing the above operations.

3. (a) Sort the following set of elements using insertion sort. Show the contents of the array after every pass : (4)

34, 56, 12, 8, 92, 9, 44, 23

(b) Consider the linked list : (5)

8–>12–>91–>13–>42–>5–>NULL

Give the output of the following function List (head); where pointer head is initially pointing to element 8.

```
Node* List(Node* head) {
    Node* prev = nullptr;
    Node* curr = head;
    Node* next = nullptr;

    while (curr != nullptr) {
        next = curr->next;
        curr->next = prev;
        prev = curr;
        curr = next;
    }
    return prev;
}
```

(c) Insert the following keys into a binary search tree one by one in the given order: (6)

24, 30, 16, 43, 51, 65, 48, 75, 34, 4

Show all the steps involved. After that, Delete the key 16 using deletion by copying and show the resulting tree.

4. (a) Write a function to calculate the number of leaves in a binary tree. (4)

(b) Consider a stack of size 5. Perform the following operations in the given order and show the status of the stack after every operation: (5)

Push (4), pop(), pop(), push(5), push(6), push(8), peek(), pop(), pop(), push(90)

Show the final contents of the stack after performing the above operations.

(c) Give the output of the following code : (6)

```
#include <deque>
#include <iostream>
using namespace std;

void showdq(deque<int> g)
{
    deque<int>::iterator it;
    for (it = g.begin(); it != g.end(); ++it)
        cout << '\t' << *it;
    cout << '\n';
}

int main()
{
    deque<int> dd;
```

```
    dd.push_back(10);
    dd.push_front(20);
    dd.push_back(30);
    dd.push_front(15);

    cout << "The deque dd is : ";
    showdq(dd);

    cout << dd.size();
    cout << dd.front();
    cout << dd.back();

    dd.pop_front();
    showdq(dd);

    dd.pop_back();
    showdq(dd);

    return 0;
}
```

5 (a) Create an AVL tree by inserting : (4)

14, 23, 26, 10, 9, 8

Show the tree after each insertion,

(b) Write the C++ code snippet for inorder traversal of the binary search tree. (5)

(c) Suppose a character'array to be sorted (into alphabetical order) by MIN–HEAPSORT initially contains the following sequence of letters : (6)

Show how would they arranged after BUILD-MIN-HEAP is over. What is the number of comparisons done to construct this heap?

6. (a) Solve the recurrence relation using the recurrence tree method: (4)

$$T(n) \rightarrow 2T(n/2) + n\log n$$

(b) Consider the following lists : (5)

List1: 5->7->9->11->13->15->NULL (Head Pointer LI is pointing to starting node element 5)

List2: 2->4->6->8->10->12->NULL (Head Pointer LI is pointing to starting node element 2)

What will be the output of op_Lists(L1, L2).

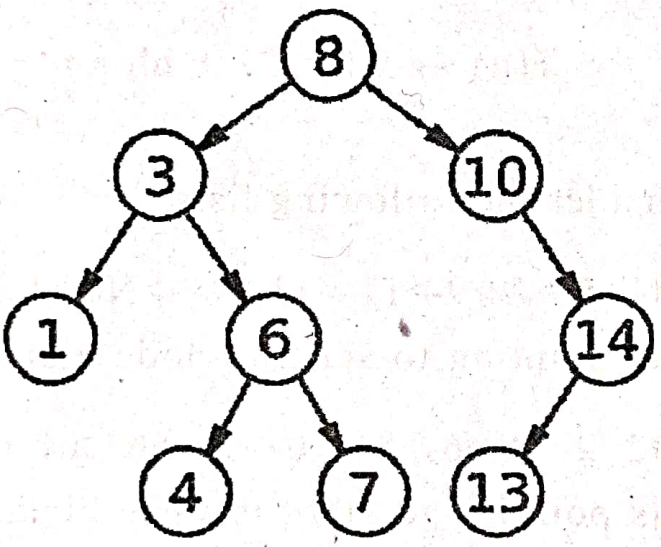
```
void op_Lists(Node* list1, Node* list2) {
    if (!list1) {
        list1 = list2;
        return;
    }

    Node* temp = list1;
    while (temp->next) {
        temp = temp->next;
    }
    temp->next = list2;
}
```

(c) Convert the following expression from prefix to postfix : (6)

+ – * 2 2 / 16 8 5

7. (a) Consider the following binary search tree and answer the questions given below : (4)



(i) Height of the tree

(ii) Number of internal nodes

(iii) Breadth first traversal

(iv) Number of leaves

(b) Sort the following functions in decreasing order of asymptotic (Big-O) complexity: (5)

(i) $f_1(n) = n^2 \cdot \log n$

(ii) $f_2(n) = n^{1.5} + 10^6$

(iii) $f_3(n) = 2^n$

(iv) $f_4(n) = n^3/1000$

(v) $f_5(n) = n(n-1)/2$

Justify your answer.

(c) Suppose the following class definitions of a circular single linked list are given: (6)

```
class Node
{
      int info;
      Node *next;
      Node(int i) {info = i; next=NULL;}
}
class IntCSLL
{
   Node *head, *tail;
   delete()
        // This function deletes a node from the head of the
circular linked list
   {
         Node *Temp = head;
         head->next = head;
         head = head->next;
         delete Temp;
     }

insert(int info)
         // This function inserts a node at the beginning of
a single linked list
     {
         Node *pNode = new Node(info);
         pNode = head;
     }
```

```
traverse()
          // This function traverses the single linked list
    {
       while (head != NULL)
       {
            cout << head->Info;
            head = head->next;
       }
    }
```

Find the errors in delete(), insert() and traverse() functions given in the above code (if any). Write the corrections.

(8)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1095 **I**

Unique Paper Code : 2342013502

Name of the Paper : Theory of Computation

Name of the Course : **B.Sc. (Hons.) Computer Science**

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The paper has **two** sections. **Section A** is compulsory.
3. Attempt any **four** questions from **Section B**.
4. Part of the questions to be attempted together.
5. Assume $\Sigma = \{a, b\}$ is the underlying alphabet unless mentioned otherwise.

P.T.O.

Section A

1. (a) Prove that for all sets S, $(S^+)^* = (S^*)^*$. (3)

(b) Prove that if x is in PALINDROME then so is x^n for any n. (3)

(c) Construct a Regular expression for the language consisting of all words with exactly two a's. (3)

(d) Consider the language S*, where S = {aa, b}. How many words of this language have a length of 6? (3)

(e) Construct a Deterministic Finite Automata that accepts all strings from the language L = {all strings with odd number of b's}. (3)

(f) Determine whether the language L = { w | w = $a^m b^n$ and m, n ≥ 1} regular or not. Justify. (3)

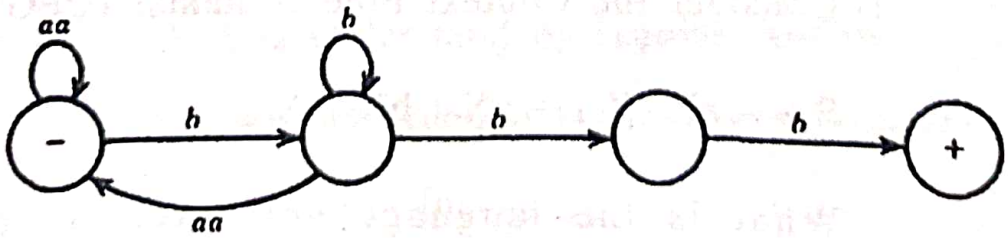
(g) Show that the complement of a context free language may or may not be context free. (4)

(h) Find the Context Free Language for language $L = \{aa^nb^nb \text{ where } n >= 0\}$. (4)

(i) Design a Turing machine for the language a(a+b)*. (4)

Section B

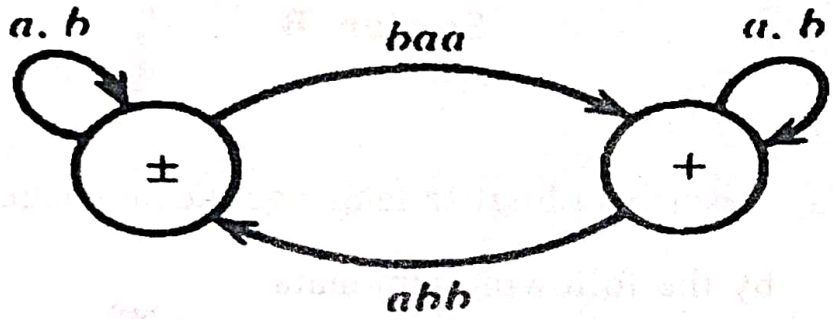
2. (a) Describein English language the language accepted by the following automata (2)



(b) Construct a regular expression for all words that contain two b's or exactly three b's. (3)

(c) Build a finite automata that accepts only those words that do not end with ba. (5)

(d) Convert the following Transition Graph into Regular Expression (5)



3. (a) Consider the Context Free Grammar (CFG):

S -> aX, X -> aX | bX | ^.

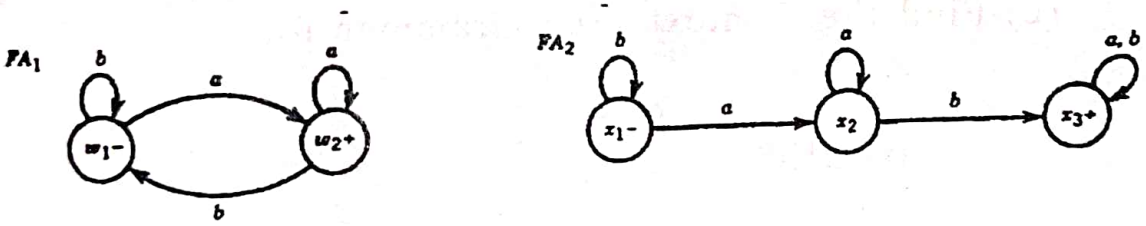
What is the language generated by above CFG? (3)

(b) What do you understand by Total language tree? Explain with an example. (6)

(c) Explain what this machine does. (6)

$$>R \xrightarrow{a \neq \sqcup} R \xrightarrow{b \neq \sqcup} R_{\sqcup}aR_{\sqcup}b$$

4. (a) For the following Finite Automata, find a finite automaton for $FA_1 \cup FA_2$. (5)



(b) What do you understand by regular language? If L_1 and L_2 are two regular languages, then so are $L_1 + L_2$ and L_1L_2. Justify your answer. (5)

(c) Convert the given Context Free Grammar into Chomsky Normal Form :

S - > aXX, X - > aS | bS | a (5)

5. (a) Construct a finite automata for $L_1 \cap L_2$ where $L_1 = (a+b)^*a$ and $L_2 = b(a+b)^*$. (5)

(b) Using pumping lemma show that the language $L = \{a^{n+1}b^n$ where n = 1 2 3 ...$\}$ is non regular. (5)

(c) Find the Context Free Grammar for

(i) a*b*

(ii) (ab+ba)* (5)

6. (a) Show that the Context Free Grammar,

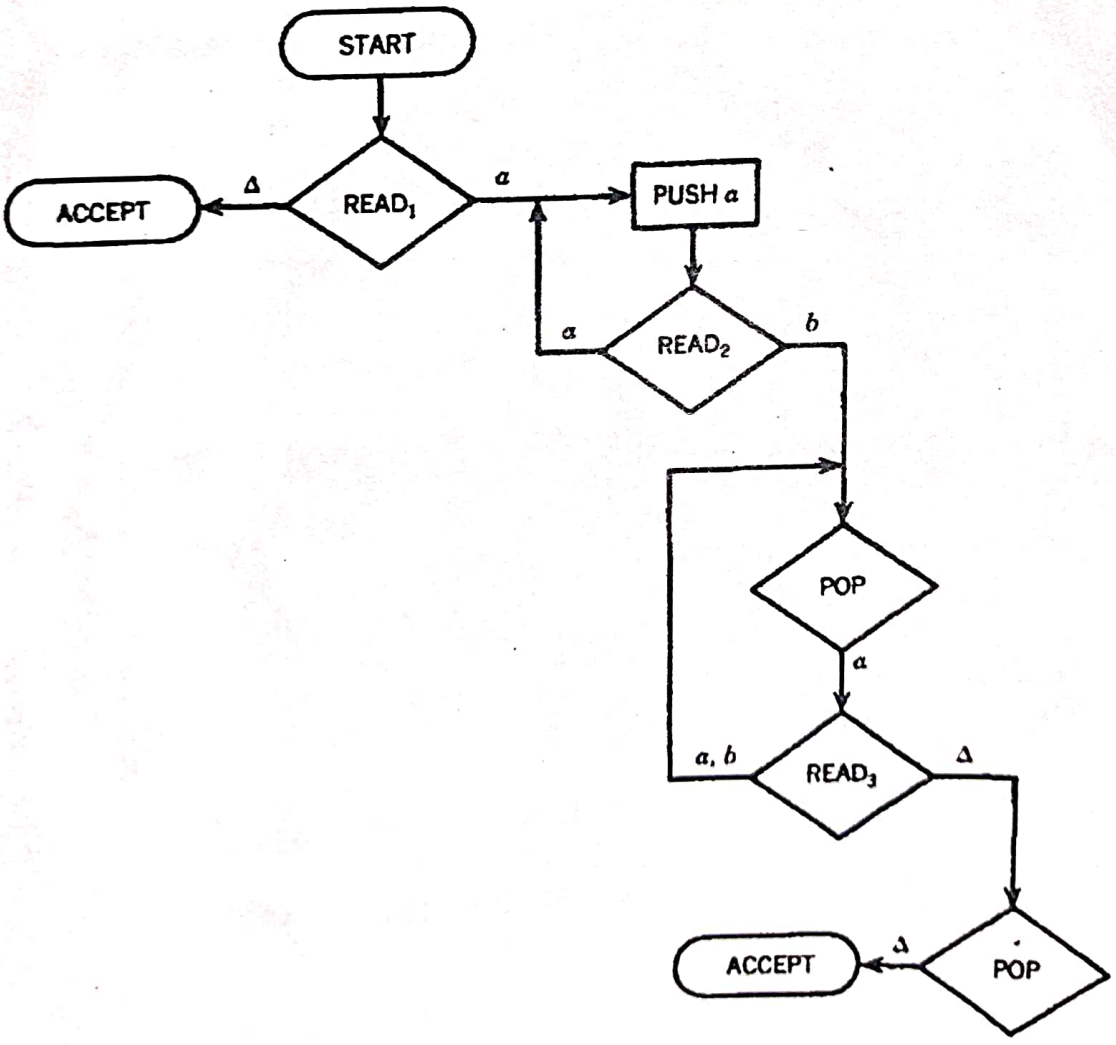
S -> aSb | Sb | Sa | a is ambiguous. (5)

(b) Design a Push down automata for language $L = \{a^{2n}b^n$ where $n = 0, 1, 2, 3...\}$. (5)

(c) Prove that the language $\{a^nb^na^nb^na^n$ where $n = 1\ 2\ 3\ 4\ ...\}$ is non context free. (5)

7. (a) Explain Church Turing thesis. (3)

(b) Consider the following Push Down Automata : (6)



This question paper contains 5 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : 1114

Unique Paper Code : 2342013503

Name of the Paper : Software Engineering (NEP)

Name of the Course : B.Sc. (H) Computer Science

Semester : V

Duration : 3 Hours Maximum Marks : 90

(Write your Roll No. on the top immediately on receipt of this question paper.)

Section A is compulsory.

Attempt any *four* questions from Section B.

Parts of a question should be attempted together.

Section A

1. (*a*) Describe the following characteristics of Software Requirement Specification (SRS) document : 3

   (*i*) Consistent

   (*ii*) Verifiable

   (*iii*) Unambiguous.

   (*b*) Discuss the advantages of the Incremental process model. 3

   (*c*) What is the difference between conceptual and technical design ? 3

P.T.O.

(*d*) What do you mean by design strategy ? Discuss the various types of design strategies in brief. 3

(*e*) Illustrate the requirement process with the help of a suitable diagram. 3

(*f*) Consider a software project with the following information domain values :

Number of external inputs (I) = 30

Number of external outputs (O) = 60

Number of external inquiries (E) = 23

Number of files (F) = 08

Number of external interfaces (N) = 02

All these values are of average complexity with 4, 5, 4, 10 and 7 respectively. Assume the complexity adjustment value is 1.25. Compute Function Points for the system. 3

(*g*) Discuss how the following activities help in achieving high quality for the soflware : 3

(*i*) Software Engineering Methods

(*ii*) Project Management Techniques.

(*h*) Describe the various levels of software testing in brief. 3

(*i*) What is coupling ? List different types of coupling. 3

(*j*) What are umbrella activities ? Describe any *two* umbrella activities. 3

Section B

2. (*a*) Discuss the various process flows with the help of suitable diagrams. 7.5

(*b*) A Rental Agency needs to develop software for the following requirements : 7.5

(*i*) The owner wishing to put his property for rent needs to supply his residence address, telephone number, and the driving license number.

(*ii*) Each owner who registers for this is assigned a unique number (UN) by the computer.

(*iii*) After registration, all the above details are stored in the Owner database.

(*iv*) A similar registration process is undertaken by the potential tenants wishing to rent the property. A tenant can present his UN to the estate agent when he decides to rent the property.

(*v*) The rental agency matches the potential tenant's requirements with the available properties and sends them the details of selected properties.

(*vi*) When a contract between an owner and tenant is completed, the tenant confirms that the contracts have been exchanged and an invoice is sent to the owner and tenant.

Create a Context diagram and level-1 DFD for the Rental Agency.

3. (*a*) What is coupling ? Discuss any *five* types of coupling. 7.5

(*b*) What is the purpose of using a structure chart ? Prepare a structure chart for the following problem : 7.5

A system requires a user to login by entering User ID and Password. The system searches for the User ID and the Password for a match. The system allows the user to input the correct password. If the user enters the correct password, the message "Login Authorised" is output. If the password is incorrect, a warning message "Access Denied" is output.

4. (*a*) Draw a Timeline chart for developing an online course registration system for a University. Give *three* ways of tracking a project schedule. 7.5

(*b*) Differentiate between the following : 7.5

(*i*) Stub and driver

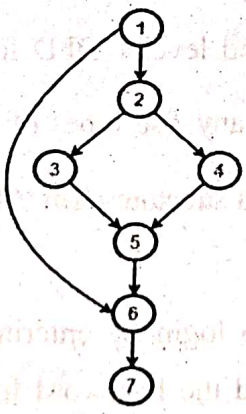
(*ii*) Verification and validation

(*iii*) Error and defect

(*iv*) White-box and black-box testing.

5. (*a*) Draw the risk table with at least three entries and discuss its components in brief. Make the necessary assumptions. 7.5

(*b*) Find the cyclomatic complexity of the graph given below using three different methods and find all independent paths. 7.5



6. (*a*) How can Risk Mitigation, Monitoring, and Management (RMMM) be applied to "staff turnover" risk ? Discuss in brief. 7.5

(*b*) Consider a simple program to classify a triangle. Its inputs is a triple of positive integers (say x, y, z) and the date type for input parameters ensures that these will be integers greater than 0 and less than or equal to 100. 7.5

The program output may be one of the following words :

[Scalene; Isosceles; Equilateral; Not a Triangle]

Design the Boundary Value test cases.

7. (*a*) Discuss any *seven* elements of Software Quality Assurance (SQA). 7.5

(*b*) Briefly explain the following : 7.5

(*i*) Scrum

(*ii*) Use cases.

(10)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5825 **I**

Unique Paper Code : 32341501

Name of the Paper : Internet Technologies

Name of the Course : **B.Sc.(H) Computer Science**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll. No. on the top immediately on receipt of this question paper.
2. All parts of **Question 1 (Part A)** are compulsory.
3. Attempt any four questions from **Part B.**
4. All questions in Part B carry equal marks.

Part A

1. **Answer the following questions:**

   (a) Give two differences between cookies and sessions in the context of web development. (2)

(b) What is meant by responsive web design? (2)

(c) What is the output of the following JavaScript Code?

```
<script type="text/javascript">

function x() {

document.write ("8"+15)

}
```

(2)

(d) Explain the **serialize method** used in jQuery. (2)

(e) Give any two advantages of dynamic routing compared to static routing. (3)

(f) What is Network Address Translation (NAT), and how does it solve the issue of IP address depletion? (4)

(g) What is the difference between the operator "= =" and "= = ="? Explain with the help of an example. (4)

(h) Describe the following Networking Protocols with a suitable example:

- ping
- tracert (4)

(i) Why are **Class C** address blocks considered inadequate for meeting the infrastructure demands of medium to large-scale enterprise network architectures? Justify with an example to support this answer. (4)

(j) Write a JavaScript code with the following validations for **username** and **password** fields:

- If the username or password field is not filled by values, an error message will appear

stating, **"You forgot one of the required fields. Try Again."**

- If the fields values entered do not match the hard-coded values, an error message will appear stating, **"Enter valid username and password."**

- If the values entered match, display the message: **"Welcome (username)".** **(4)**

(k) What is a JSON object? Write the syntax to add a JSON object to define an employee with details such as **name, age, salary, designation, and mobile number.** (4)

Part B

2. (a) Why do we need AJAX in web applications? What are the steps taken by the browser to handle AJAX Requests and Responses? (6)

(b) Write Node.js commands to connect to the MYSQL database with the name **"Customer_db" and** a table named **"Customer"** to print all the records of **Customer** whose **age** is above 40 and **salary** is more than 20,000. The fields of the **Customer** table are **CustId, Name, Age, and Salary.** (4)

3. (a) Differentiate between the following (any two): (6)

(i) Internet and Intranet

(ii) Blog and Forum

(iii) $.post and $.get

(b) Write the network address, broadcast address, valid host addresses and 4 subnet mask for the IP address: **122.161.50.253/30.** (4)

4. (a) Create a JavaScript object representing an **Employee** with properties like **name, department, and date of birth.** Implement a method within the object that calculates the **Employee's age.** Instantiate the object with sample data and display the **Employee's names, department, and age** on the webpage. (6)

(b) What are the advantages of using Bootstrap? Discuss **any two** components of Bootstrap. (4)

5. (a) Create an HTML file containing a list of items using **<ul>** and multiple **<li>** elements. Use jQuery to:

(i) Select the first **<li>** element and change its text color to blue and background color to red.

(ii) Select the last **<li>** element and change its background color to green.

(iii) Select all **<li>** elements with the class attribute set to **hot** and add a new class called **cool** to them. (6)

(b) Write any two advantages and two drawbacks of using proxy servers. (4)

6. (a) Create a JSON object that represents information about a **Cricketer** with the following fields: **name, age and average-score.** Create an HTML button that triggers an AJAX request to fetch this JSON data from a server or a local file when clicked.

Provide the necessary JavaScript code to handle the onclick event and display the retrieved JSON data on the web page. (6)

(b) Write the important function of FTP protocol. What are the ports associated with it? (4)

7. Write short notes on the following terms **(any two):** **(10)**

(i) Domain Name Server

(ii) Crawling

(iii) Browser Object Model

(iv) Event Listeners

(11)

[This question paper contains 8 printed pages.]

Your Roll No.....

आपका अनुक्रमांक.....

Sr. No. of Question Paper : 5879 **I**

Unique Paper Code : 32341502

Name of the Paper : **Theory of Computation**

Name of the Course : **B.Sc (H) Computer Science**

Semester : V (Admissions 2019-2021)

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Section-A (Question No. 1) is compulsory.
3. Attempt any four Questions from Section-B (i.e, from Question No. 2 to 7).
4. Parts of a Question must be answered together.
5. Consider $\sum = \{a, b\}$ for all the questions unless specified otherwise.

P.T.O.

Section - A

1. a) Given the language L = {ab, aa, baa}, determine whether the string 'abaabaaabaa' is in L*? (2)

b) Consider a language consisting of all the words that end with sub- string 'bb'. Write a regular expression for the language. (3)

c) Let us consider the regular expression (a+b)*a(a+b)*b(a+b)*. Show that this is equivalent to (a+b)*ab(a+b)*. (3)

d) A context-free grammer(CFG) G is given by the following productions (3)

$S \rightarrow aS \mid A$

$A \rightarrow aAb \mid bAa \mid A$

Determine whether the string 'abababb' can be generated by the grammar given above.

e) Consider the following CFG: (5)

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bs \mid aBB$

i) Describe the language generated by the given grammar.

ii) Is the language ambiguous or unambiguous? Justify your answer.

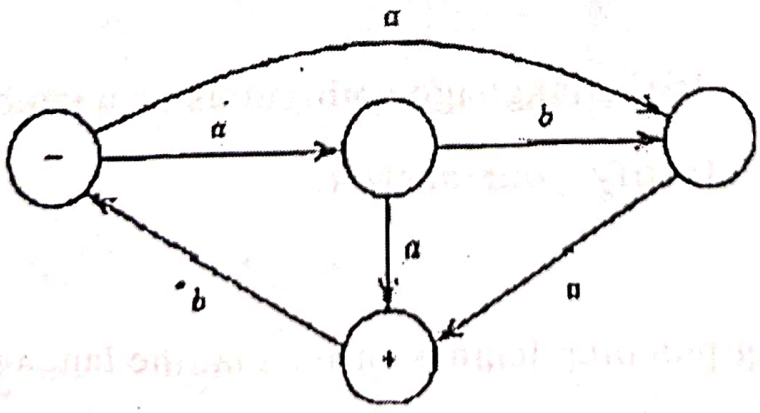
f) Using pumping lemma, prove that the language $a^{2n}b^n$ is not regular. (4)

g) Design a Turing machine for the language $a^nb^na^n$.(5)

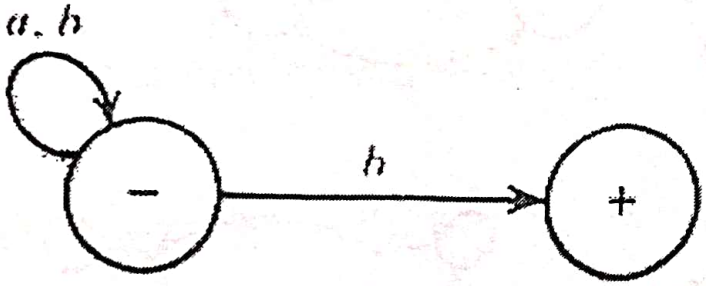
Section - B

2. a) Consider the language S = { aa, ba, ab, bb}. Describe the language S*. (4)

b) Convert the following Non-deterministic finite automata(NFA) into a regular expression. Also, construct a automata(DFA) for the given NFA. (6)



3. a) Consider the following transition graph(TG). Describe the language accepted by it. Also construct a DFA for the given TG. (6)



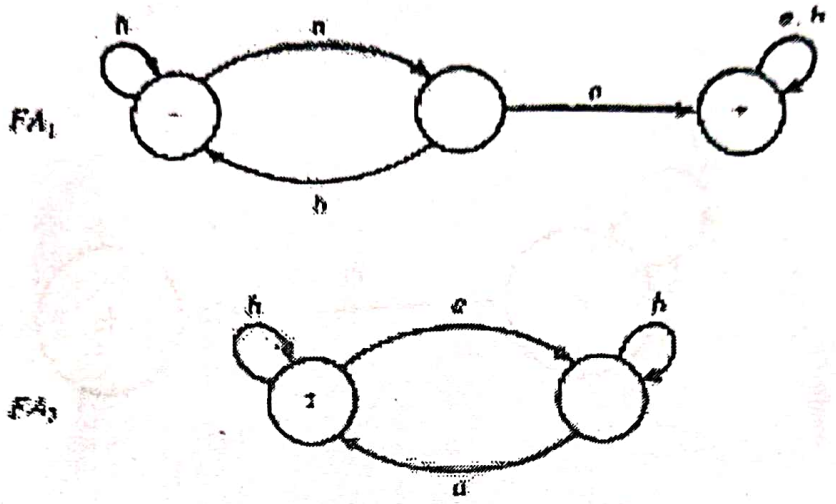
b) Construct a push down automata(PDA) for the language L given be low: (4)

$L = \{a^n b b^n \mid n > 0\}$

4. a) Construct a CFG for the language containing all words having differ- ent first and last letters.(4)

b) Design a Turing Machine which computes the function f(w) = ww. (6)

5. a) Find the union machine for the given deterministic finite automata FA1 and FA2: (6)



b) Design a context-free grammar for the the language described by regular expression a*b*. (4)

6. a) Build a deterministic finite automaton for the language of all words that do not end with ba.(4)

b) Consider the following context-free grammar G(6)

$S \rightarrow SS|ab|ba|A$

i) Which of the following words can be generated by the given grammar: ababba, ababbba

ii) Draw derivation tree for the word that belongs to the language produced by the grammer.

iii) Is the language ambiguous?

7. a) Consider the following CFG. Convert it into Chomsky Normal Form. (5)

$S \rightarrow aB \mid bA,$

$A \rightarrow a \mid aS \mid bAA,$

$B \rightarrow b \mid bs \mid aBB$

b) Prove that the language $\{a^n b^n c^n d^n$ for n= 1, 2, 3, 4,....$\}$ is not context-free. (5)

(12)

[This question paper contains 12 printed pages.]

Your Roll No.....

I

Sr. No. of Question Paper : 1057

Unique Paper Code : 2342013501

Name of the Paper : Algorithms and Advanced Data Structures

Name of the Course : **B.Sc. (H) Computer Science**

Semester : V – DSC (NEP-UGCF-2022)

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. This question paper has **two** sections **A** and **B**.
3. Question **1** in **Section A** is compulsory.
4. Attempt any **4** questions from **Section B**.
5. Parts of a question must be attempted together.
6. **Section A** carries **30** marks and each question in **Section B** carries **15** marks.

P.T.O.

Section A

1. (a) Analyze the performance of the following operations of the List data structure as specified by the Standard Template Library of C++: push_front(e), push_back(e), pop_front( ), and pop_back( ).

Under what circumstances would you prefer a std::list over a std::vector? (3+2)

(b) Explain Kruskal's Algorithm for finding the Minimum Spanning Tree (MST) in an undirected weighted graph.

Discuss how the Union-Find data structure is used by Kruskal's algorithm to efficiently detect cycles during edge addition. (3+2)

(c) Consider the following array:

A = [6, 12, 23, 29, 31, 36, 42, 48, 59, 60]

Compare the performance of Quicksort and Randomized Quicksort for sorting the given array, A. Explain the impact of pivot selection on the partitioning process for both the algorithms and how it influences the overall time complexity. (3+2)

(d) Given a residual graph, G with a flow, f and v(f) be the value of flow. The function bottleneck(p,f) for an augmenting path P is the minimum residual capacity with respect to the flow f. Argue that the bottleneck(P,f) always greater than zero.

If the v(f') is equal to the v(f) + bottleneck(P,f).

Prove that v(f') is greater than v(f) and the capacity condition holds for f'. (2+3)

(e) Given the sequence of probes generated by quadratic probing for keys, K

$$p(i) = h(K) + (-1)^{i-1}((i + 1)/2)^2$$

for i = 1, 2, ... , TSize – 1 i.e. h(K), h(K)+1, h(K)–1, h(K)+4, h(K)–4,...

What happens if the table size, TSize is not prime?

Can quadratic probing guarantee the use of all positions in the table for a non-prime table size? (2+2)

(f) Given that in a vh-tree, the shortest path to a leaf consists only of vertical links, and the longest path to another leaf may use both vertical and horizontal links alternately, derive the relationship between the longest path, $path_{longest}$ and the shortest path, $path_{shortest}$. Given a vh-tree with height h, derive the minimum number of nodes n_{min} that the tree can have. (2+2)

(g) What is inverted index (or inverted file) with respect to search engines. (2)

Section B

2. (a) Given a text string T="ABABDABACDABABCA BAB" and a pattern string P="ABABCABAB", perform the Knuth-Morris-Pratt (KMP) string matching algorithm to find first occurrence of P in T. Show the steps, including the construction of the failure table.

Compare the Brute Force and KMP algorithms in terms of time complexity. (4+3)

(b) Consider the following weighted directed graph with 4 nodes (A, B, C, D) with the following edges and weights :

A → B (weight 3)

A → C (weight -2)

B → D (weight 2)

C → B (weight -1)

D → A (weight 1)

Use the Bellman-Ford algorithm to find the shortest path from vertex A to D.

Can we find the shortest path in a graph, if it contains a negative cycle? Support your answer with proper arguments. (5+3)

3. (a) Consider a hash table of size 8, with the following hash function:

$$H(k) = (k \bmod 8).$$

Insert the following set of keys : {14, 30, 22, 10, 50, 60, 90} using the given hash function and for collision resolution use linear probing.

Discuss the advantages and disadvantages of linear probing and quadratic probing in terms of collision handling and performance. (4+3)

(b) Does the splitting of a node at the time of insertion always increase the height of the tree?

Construct a B-tree of order 5 which is initially empty. Insert the following keys into the B-tree: 7,15,11,25,12,10,22,30,20,5,27,30,18. After each insertion, show the structure of the B-tree. What is the height of the final tree? (2+6)

4. (a) Given the following set of words: ["cat", "bat", "rat", "at", "batman", "sat", "saturday", "rattle", "cattle", "ate", "battle", "satin"], Construct a standard trie to store these words.

Also show the Compressed trie for the standard trie created above. What is the advantage of using a compressed trie? (3+4)

(b) Consider the array implementation of the Union-Find data structure for set S of size n, where unions keep the name of the larger set. Prove the following :

(i) Find operation takes O(1) time,

(ii) MakeUnionFind(S) takes O(n) time, and

(iii) Sequence of k Union operations takes at most O(k log k) time.

Explain the role of the "name of the larger set" optimization in the Union-Find data structure. How does this optimization reduce the height of the tree created during the union process? (4+4)

5. (a) Give pseudo-code for the following operations of Sequence Abstract Data Type using an array implementation :

(i) Insert from the back,

(ii) Remove from the end,

(iii) To access an element at any index

What is the running time for each of these operations? (7)

(b) Do we need to restrict the number of levels in a skip list? Justify your answer.

Consider a skip list S with n elements and the insertion policy that restricts the top-level h to a fixed value h=max{10, 2[logn]}, where n is the current number of entries in the skip list.

How does the given policy impact the structure of the skip list during insertion?How does the condition [logn] < [log(n+1)] help allow an insertion to increase the height of the skip list by atmost one level? (2+3+3)

6. (a) Consider the following unsorted array of integers:

A = [39, 12, 57, 23, 89, 11, 4, 70, 18, 42, 35, 8, 61, 26]

Find the i-th smallest element where i = 7 from the array A using the Randomized Select algorithm, where the first element of the resulting array is selected as the pivot.

When do we say a partition is helpful and show that the probability of helpful partition is atleast ½. (4+3)

(b) Consider the following directed graph, G with A, B, C, D, S, T as the nodes representing a flow network :

S → A (capacity 10)

S → C (capacity 10)

A → B (capacity 4)

A → C (capacity 2)

A → D (capacity 8)

B → T (capacity 10)

C → D (capacity 9)

D → B (capacity 6)

D → T (capacity 10)

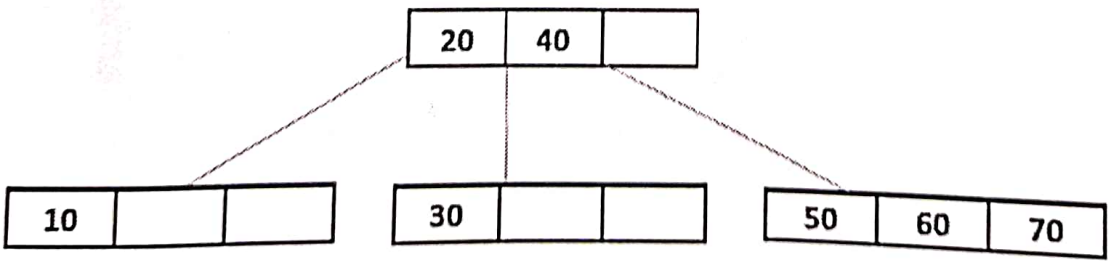
Apply the Ford-Fulkerson algorithm to find the maximum flow from source S to sink T. How does the Ford Fulkerson algorithm ensure that the flow is maximized? (8)

7. (a) Let V be a vector implemented by means of an extendable array A which is extended with [N/4] additional cells. Capacity of V increases from N to N + [N/4]. Initially V is empty and A has size N = 1, Show that the total time to perform a series of n push operations in V is O(n).

If we extend the array from N to N + k where k is a constant, can the sequence of N push operations in V still be done in O(n) time.

(4+3)

(b) Explain the deletion process in B-trees.Consider a B-tree of order 4 (maximum 3 keys per node) with the following initial structure:



P.T.O.

Delete the keys 30 and 50 from the B-tree. Show all the necessary steps involved in the deletion process. (3+5)

1502

This question paper contains 4 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **1196**

Unique Paper Code : **2343010010**

Name of the Paper : **Data Privacy**

Name of the Course : **B.Sc. (Hons.) Computer Science**

Type of the Paper : **DSE NEP-UGCF**

Semester : **V**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

The question paper consists of two sections.

Section A is compulsory.

Attempt any *four* questions from Section B.

All parts of a question must be attempted together.

Section A

1. (*a*) What ethical principles should organizations follow when collecting user data ? 3

(*b*) What is a masquerade attack ? Is it an active or a passive attack ? Justify your answer. 3

(*c*) Explain the following terms with respect to a hash function : 3

(*i*) Preimage resistant

(*ii*) Pseudorandomness.

P.T.O.

(*d*) Which of the following could be considered personally identifiable information (PII) ? Justify your answer : 3

(*i*) Date of birth

(*ii*) Device ID

(*iii*) Publicly available Job Title.

(*e*) Explain the concept of the 'Right to be Forgotten'. What are the conditions under which an individual can request the erasure of their personal data ? 3

(*f*) Discuss the following terms with respect to GDPR : 3

(*i*) Natural Person

(*ii*) Legal Person

(*iii*) Data Subject.

(*g*) Why is it difficult to achieve a perfect balance between data utility and privacy in anonymization processes ? 3

(*h*) What is the need of anonymizing data ? 3

(*i*) Can digital signatures be forged ? If not, why ? 3

(*j*) What is a security service ? Explain any *two* security services. 3

Section B

2. (*a*) Explain the CIA triad with respect to Information Security. Additionally, discuss how the concepts of authenticity and accountability complement these objectives. 7

(*b*) What is the difference between a threat and an attack ? Compare and contrast active and passive attacks. 8

3. (*a*) (*i*) Classify the following attributes into Explicit Identifiers (EI), Quasi-Identifiers (QI), Sensitive Data (SD), or Non-Sensitive Data (NSD) : 7

- Email ID
- Income Level
- Gender
- Voter ID

(*ii*) Discuss why it is crucial to anonymize QI and SD before sharing data publicly.

(*iii*) Provide two methods that could be used to anonymize Quasi-Identifiers in this dataset.

(*b*) Explain cryptographic hash function. Also, discuss the purpose of using a cryptographic hash function in digital signatures and message integrity ? 8

4. (*a*) Describe the potential harms caused by loss of privacy. What is the need for separating consumer protection issues from data protection issues ? 7

(*b*) A healthcare company developed a machine learning model to predict patient risk factors using data from hospitals. However, the dataset was skewed, with more data from wealthier, majority-group patients, leading to less accurate predictions for minority and low-income groups. 8

(*i*) Was the data collection process ethical ? Why or why not ?

(*ii*) How can bias in the data lead to discrimination in the model's predictions ?

(*iii*) What steps can the company take to reduce bias and improve fairness in the model ?

P.T.O.

5. (*a*) Elaborate and discuss DPDPA. Define a personal data breach and explain the general obligations of a Data Fiduciary to prevent and report such breaches. 7

(*b*) Discuss Model Surveillance System. Explain its *five* steps with the help of a neat diagram. 8

6. (*a*) How is anonymization done in Multidimensional Data ? What are the challenges associated with privacy preservation of multidimensional data ? 7

(*b*) Define Data Privacy. Also, explain the role of all the stakeholders of data privacy in an organization with the help of an example. 8

(14)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2427 **I**

Unique Paper Code : 2343010010

Name of the Paper : Data Privacy

Name of the Course : **B.Sc. Hons Computer Science**

Semester : V – DSE NEP-UGCF

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The Question paper consists of **two** sections.
3. **Section A** is compulsory.
4. Attempt any **Four** questions from **Section B.**
5. All parts of a question must be attempted together.

P.T.O.

Section – A

1. (a) Differentiate between Privacy and Anonymity. (3)

(b) is the importance of public key certificates and certificate authorities? (3)

(c) Explain the concept of the "Right to Privacy" and its relevance in the digital age. (3)

(d) Differentiate between Insecure and Imprecise Use of Data. (3)

(e) What are the challenges associated with privacy preservation of Time series Data? (3)

(f) Define a replay attack. Is it an active or a passive attack? Justify your answer. (3)

(g) What are the duties of Data Principal with respect to DPDPA. (3)

(h) Compare and contrast Symmetric and Asymmetric encryption. (3)

(i) How can we differentiate between Law and ethics in cybersecurity? (3)

(j) What is the goal of privacy by design in PII? (3)

Section – B

2. (a) Explain the problems encountered by the user with the use of their personal data with the help of an example. (7)

(b) Describe the active and passive attacks and their types. (8)

3. (a) Explain the CIA triad with respect to Information Security. Additionally, discuss how the concepts of authenticity and accountability complement these objectives. (7)

(b) Explain the role of the following stakeholders in data privacy organization: (8)

(i) Customer

(ii) Data Analyst

(iii) Business operation Employee

(iv) Data Anonymizer

4. (a) What is personally identifiable information (PII), and why is it important to protect it in the context of data privacy and security? Which of the following examples would be considered personally identifiable information (PII)? Explain why or why not :

- Name and address
- IP address
- Social media account information
- Anonymous survey data (7)

(b) List and briefly describe the main objectives of the GDPR. Also, explain the key responsibilities of a Data Protection Officer (DPO) in an organization. (8)

5. (a) Define Digital signatures. How are digital signatures created and verified? (7)

(b) What is the difference between Security and Privacy. What are the objectives of cybersecurity with the help of a diagram? (8)

6. (a) Briefly explain the five steps of the Model Surveillance System. (7)

(b) What are the different methods of protecting data? Explain each with the help of an example. (8)

This question paper contains 4 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **6048**

Unique Paper Code : **32347504**

Name of the Paper : **Microprocessor**

Type of the Paper : **DSE–I CBCS-LOCF**

Name of the Course : **B.Sc. (H) Computer Science**

Semester : **V**

Duration : **3 Hours**

Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

The question paper consists of two sections.

Section A is compulsory.

Attempt any four questions from Section B.

SECTION–A

1. (*a*) Will an overflow occur if a signed FFH is added to a signed 01H ? 2

(*b*) In the real mode, what will be the starting and ending addresses, given DS = ABCDH. 2

(*c*) State the significance of $\overline{Lock}$ and the $\overline{Busy}$ pins. 2

(*d*) Develop a sequence of instructions that : 2

Clears (0) the leftmost 3 bits of AX;

and inverts bits 7, 8 and 9 of AX.

P.T.O.

(e) Explain the difference between the MOV BX, DATA instruction and the MOV BX, OFFSET DATA instruction. 3

(f) Explain the concept of two memory banks. 3

(g) What is the purpose of the IP/EIP register ? Determine the memory location addressed by the given real mode 80286 register combination : 3

ES = 2000H and DI = 3000H

(h) Which type of JMP instruction (short, near, or far) assembles for the following : 3

(i) if the distance is 0210H bytes

(ii) if the distance is 0020H bytes

(iii) if the distance is 10000H bytes.

(i) Explain the use of $\overline{CS}$, $\overline{OE}$ and $\overline{RD}$ pins on a memory chip. 3

(j) Compare fixed port addressing with variable port addressing. 3

(k) What software commands are used in 8237 DMA Controller chip ? 3

(l) Explain BOUND interrupt instruction. 3

(m) When does a JA instruction execute ? What flags are checked ? 3

SECTION–B

2. (a) Explain the ICWs and OCWs of the 8259A chip. 6

(b) What is program invisible register ? How is the local descriptor table addressed in the memory system ? 4

3. (*a*) Consider the instructions given below. If they are correct, state what do they accomplish and if they are incorrect, state the reason : 6

(*i*) MOV [BX], [DI]

(*ii*) MOV [DI], 10H

(*iii*) MOV ES, DS

(*iv*) POP CS

(*v*) ADD DS, AX

(*vi*) SUB RCX, EBX.

(*b*) With the help of a neat diagram explain the Read Cycle of 8086. 4

4. (*a*) Differentiate between the following : 6

(*i*) SUB and CMP instructions

(*ii*) Inter-segment and Intra-segment jump

(*iii*) 8086 and 8088 microprocessors.

(*b*) What are UART Errors ? Outline the line control register of 16550 chip. 4

5. (*a*) State the purpose of the following instructions : 6

(*i*) PUSHA

(*ii*) LODSB

(*iii*) IN AL, 12H

(*iv*) XLAT

(*v*) LSS EBX, DATA

(*vi*) WAIT.

(*b*) List the sequence of steps that are performed when an IRET instruction is executed. 4

P.T.O.

6. (*a*) Contrast the operation of a JMP DI with a JMP [DI] and a JMP FAR PTR [DI]. 6

(*b*) Explain the 3-to-8 line decoder. 4

7. (*a*) Explain the modes of operation of 8254 chip. 6

(*b*) Suppose EAX = 00000200, EBX = 00000250, DS = 0300H, SS = 0440H, BP = 0110H and SI = 0010H.

Determine the address accessed by each of the following instructions, assuming real mode operation :

(*i*) MOV ECX, [BP – 200H]

(*ii*) MOV DL, [BP + SI – 10H]

(*iii*) MOV BX, [SI + 100H]

(*iv*) MOV ECX, [EAX + 2*EBX + 10]. 4

(16)

This question paper contains 6 printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **1558**

Unique Paper Code : **2342571101**

Name of the Paper : **Programming Fundamentals Using C++**

Name of the Course : **B.A. (Prog.)/B.Sc.(P)/B.Sc. Maths. Sc.**

Semester : **I**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Section A is compulsory.

Attempt any **4** (*four*) questions from Section B.

All parts of a question must be answered together.

Section A

1. (*a*) Differentiate between Object-Oriented Programming (OOP) and Procedural Oriented Programming (POP). 3

(*b*) What are the manipulators ? Explain the use of endl and setw( ) with appropriate example. 3

(*c*) Consider the value of x = 75 and y = 15 for each of the following expression written in C++. What is the value of each expression ? 3

(*i*) x % 15 * y

(*ii*) (x / 10) % 5 + y

(*iii*) x ++ + y ++.

P.T.O.

3. (*a*) Write the output of the following C++ program codes : 10

(*i*)
```
int x = 10, y = 5, p, q;
        P = x > 9;
        q = x > 3&& y!=3;
        cout<<P<<q;
```

(*ii*)
```
int a = 500, b = 100, c;
        if (! a >=400)
        b = 300;
        c = 200;
        cout<<b<<c;
```

(*iii*)
```
int x = 1, y = 2, z;
z = x++ + ++y;
cout << x << " " << y <<" " <<z;
```

(*iv*)
```
int a=5, b=9;
    a=!a;
    b=!a&&!b;
    cout<<a<<b;
```

(*v*)
```
int a=5;
do
{ cout<<a;
  a =2;
}while(a>0);
```

(*b*) Write a program in C++ that display entered string into reverse order. 5

4. (*a*) Write a C++ program to swap two integer numbers and swap two float numbers using function overloading. 5

(*b*) Write a C++ program to count number of spaces present in contents of file. 5

(*c*) Write a C++ program to find whether the entered number is even or odd. 5

5. (*a*) Explain the following terms in reference to C++ language : 10

(*i*) Abstract class

(*ii*) Break and Continue

(*iii*) This pointer

(*iv*) Selection control structure

(*v*) Destructor.

(*b*) Describe any *three* user defined data types in C++ with examples. 5

6. (*a*) Explain public, private and protected access specifiers and show their visibility when they are inherited as public, private and protected. 5

(*b*) Differentiate the following : 5

(*i*) Implicit conversion and explicit conversion.

(*ii*) Private member function and public member function.

(*c*) Write a C++ program to declare a class 'employee' with members as empid and empname. Accept and display data for one employee using getdata and putdata member functions. 5

7. (*a*) Define polymorphism and explain virtual functions with an example. What is the difference between static & dynamic binding ? 5

(*b*) (*i*) What is a pointer ? How is it used in C++ ? Give an example. 5

(*ii*) What is derived class ? How is it defined in C++ ? Show with an example.

(*c*) Does multiple inheritance leads to ambiguity ? If yes, how can it be removed ? Explain with a suitable example. 5

(17)

This question paper contains 8 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **2534**

Unique Paper Code : **2342571101**

Name of the Paper : **Programming Fundamentals Using C++**

Name of the Course : **B.A. (Prog.)/B.Sc.(P)/B.Sc. Maths. Sc.**

Semester : **I**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Section A is compulsory.

Attempt any 4 *(four)* questions from **Section B.**

All parts of a question must be answered together.

Section A

1. (*a*) What are identifiers in C++ ? Identify which of the following identifiers are valid and which are invalid ? 3

   (*i*) Po178_ddm

   (*ii*) _78hhvt4

   (*iii*) 902gt1

   (*iv*) Tyy;ui8

   (*v*) For

   (*vi*) Fg026 neo

P.T.O.

(*b*) Explain the following : 3

(*i*) Built-In data Types

(*ii*) User defined data types

(*iii*) Derived data types

(*c*) Explain pointers in C++ with an example. How does a pointer differ from a regular variable ? 3

(*d*) Write the output of the following C++ code : 3

```
#include <iostream>
using namespace std;
int main( ) {
int num1 = 10;
double num2 = num1;
cout << "num1: "<< num1 << endl;
cout << "num2: "<< num2 << endl;
return 0;
}
```

(*e*) Write a C++ program to find largest of 2 numbers. 3

(*f*) Find the output of the following C++ code : 3

```
#include <iostream>
using namespace std;
int main( ) {
int a = 15, b = 4;
```

```
int result1 = a / b * b + a % b;
bool result2 = (a == 15) && (b < 10);
int result3 = a++ + --b;
int result4 = 10 + 2 * 3 / 4 - 5;
cout << "Result 1: " << result1 << endl;
cout << "Result 2: " << result2 << endl;
cout << "Result 3: " << result3 << endl;
cout << "Result 4: " << result4 << endl;
return 0;
}.
```

(g) Which of the following statements is true or false : 3

(*i*) A constructor is automatically invoked on object creation, cannot have a return type-not even void, and does not return any value.

(*ii*) A destructor is a member function that is specifically called on an object by a programmer when the object goes out of scope.

(*iii*) The constructor can be overloaded. That is, you can have more than one constructor in a class having different parameter lists.

(*h*) Write a C++ program to ensure that a user enters a positive integer. Initially, the program should ask the user for a number. If the user enters a number less than or equal to zero, the program should keep asking until a valid positive number is provided. 3

(*i*) Differentiate between single and multiple inheritance. 3

P.T.O.

(j) Identify the error in the following Try-Catch block and correct the same : 3

```
int main( ) {
   int a = 10, b = 0;
      try {
         if (b == 0) {
            throw "Division by zero error!";
         } else {
      cout << "Result: " << a / b << endl;
         }
       } catch (int e) {
         cout << "Error: Division by zero!" << endl;
       }
      return 0;
}
```

Section B

2. (a) Write a C++ program that takes a positive integer n and produces n lines of output as shown : (n = 4 as output) : 5

```
1
1 2
1 2 3
1 2 3 4
```

(*b*) Explain the following jump statements with the help of an example : 5

(*i*) break

(*ii*) continue

(*iii*) return

(*c*) What do you mean by header files in C++ ? How do header files reduce the compilation time and efforts of the programmer ? How do you include a header file in a C++ program ? 5

3. (*a*) Write a C++ program that uses a for loop to compute the sum of the first *n* natural numbers. Prompt the user to input a value for n; print out the sum. 5

(*b*) Write a C++ program to take an integer as an input, reverse the digits of that integer and print that reversed integer. 5

(*c*) Write a C++ program that prints the Fibonacci sequence up to the *n*th term. The program should ask the user to enter the value of *n*, then print the first *n* Fibonacci numbers. 5

(*a*) Which of the following statements is true or false : 5

(*i*) In C++, a pointer may be assigned the address of a variable of any type without any problem.

(*ii*) The * stands for address of the pointer variable.

(*iii*) You can increment a pointer to point at the next memory location of the type that it is pointing at.

(*iv*) A pointer can be dereferenced before it is declared, and the program will still run with no issues.

(*v*) In C++, delete is used to free up memory which was allocated using malloc( ).

P.T.O.

(*b*) Write a C++ program simulating a simple **Shape** hierarchy. Declare a **base class called Shape** with a **virtual function area( )**. Derive two classes, **Circle and Rectangle**, each **overriding the area( )** function to calculate the area of a circle and a rectangle respectively. Program to ask for all inputs necessary-for example, the radius for the circle and the length and width for the rectangle. Then calculate the area and print the results. 5

(*c*) Enumerate any *five* characteristics of object-oriented programming. 5

5. (*a*) What will be the output of the following code when the value of num is : 5

(*i*) 1

(*ii*) 67

(*iii*) 2

(*iv*) A and

(*v*) default

```
#include <iostream>
using namespace std;
int main( ) {
   switch (num) {
      case 1:
         cout << "One" << endl;
      case 2:
         cout << "Two" << endl;
         break;
```

```
        case 3:
            cout << "Three" << endl;
            break;
        case 4:
            cout << "Four" << endl;
            break;
    default:
        cout << "Invalid" << endl;
    }
    return 0;
}
```

(*b*) What are default constructors in C++ ? Explain with an example. 5

(*c*) What is constructor overloading ? Explain with the help of an example. 5

(*a*) Write a C++ program for a library system that stores the details of books in an array. Each book has the following information : 5

- Title (a string)
- Author (a string)
- Year of publication (an integer)

You are given an array of pointers, each pointing to a dynamically allocated object of type **Book**. The user can add new books to the system, display the information of all the books, and delete a book when it is no longer needed.

P.T.O.

(*b*) Write a C++ program that swaps the values of two integers using pointers. Create a function swapValues( ) that takes two integer pointers and swaps the values they point to. In main( ), declare two integers, pass their addresses to the function, and display their values before and after the swap. Use pointers to directly manipulate the variable values. 5

(*c*) Identify whether the following pointer declarations are valid or invalid. Explain your answer. 5

(*i*) char* ptr = &someCharVariable;

(*ii*) int* ptr, ptr2;

(*iii*) float* ptr = new float;

(*iv*) int** ptr1;

(*v*) double ptr*;

7. Explain the following : 15

(*i*) Function Overloading

(*ii*) Arrays in C++

(*iii*) Inheritance.

(18)

This question paper contains **10** printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **2554**

Unique Paper Code : **2342571101**

Name of the Paper : **Programming Fundamentals Using C++**

Name of the Course : **B.A. (Prog.)/B.Sc.(P)/B.Sc. Maths. Sc.**

Semester : **I**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Section A is compulsory.

Attempt any **4** (*four*) questions from **Section B.**

All parts of a question must be answered together.

Section A

1. (*a*) What are keywords in C++ ? Identify which of the following keywords are valid and which are invalid ? 3

(*i*) forEach

(*ii*) int

(*iii*) Publicly

(*iv*) if

(*v*) while

(*vi*) abc_123

P.T.O.

(*b*) List any *three* primitive data types with their respective sizes. 3

(*c*) Write a C++ function swapValues( ) that accepts arguments in the form of two integer pointers swaps the values of the integers without using a temporary variable. 3

(*d*) Write the output of the following C++ code : 3

```
#include <iostream>
using namespace std;
void modify(int *x) {
  *x = *x * 2;
}
int main( ) {
  int num = 5;
  modify(&num);
  cout << "Value of num: " << num << endl;
  return 0;
}
```

(*e*) Write a C++ program to check whether a number is even and odd. 3

(*f*) Find the output of the following C++ code : 3

```
#include <iostream>
using namespace std;
int main( ) {
```

3

(j) Identify the error in the following Try-Catch block :

```
#include <iostream>
using namespace std;
void divide(int a, int b) {
    try {
        if (b == 0) {
            throw runtime_error("Error: Division by zero");
        }
        cout << "Result: " << a / b << endl;
    }
    catch (const runtime_error& e) {
        cout << "Caught exception: " << e.what( ) << endl;
    }
}
int main( ) {
    int num1 = 20, num2 = 0;
    divide(num1, num2);
    return 0;}
}
```

Section B

2. (*a*) Write a C++ program that takes a positive integer n and produces a rhombus of 1s. 5

Sample output with n = 3 is shown below :

```
    1
  1 1 1
1 1 1 1 1
  1 1 1
    1
```

(*b*) What will be the output of the following program : 5

```
#include <iostream>
using namespace std;
int main( )
{
for (int i = 1; i <= 5; i++)
{
for (int j = 1; j <= i; j++)
{
if ((i + j) % 2 == 0)
cout << "X ";
```

```
else
cout << "O ";
}
cout << endl;
}
return 0;
}
```

(c) Find errors, if any, in the following C++ statements : 5

(i) cout<<"x="x;

(ii) m=5;//n=10;//s=m+n;

(iii) cin>>x;>>y;

(iv) cout<<\n"Name:"<<name;

(v) /*addition*/z=x+y;

3. (a) What is function overloading ? Why is it required ? 5

(b) Find errors, if any, in the following function prototypes : 5

(i) float average(x,y);

(ii) int mul(int a,b);

(iii) int display(...);

(iv) void Vect(int? &V int & size);

(v) void print(float data[],size=20);

(c) State if the following statements are true or false : 5

(i) In C++, a function must always return a value.

(ii) C++ supports function overloading, allowing multiple functions with the same name but different parameters.

(iii) Default arguments in C++ functions must always be placed at the beginning of the parameter list.

(iv) Functions in C++ can have both pass-by-value and pass-by-reference parameters.

(v) A function declared with the inline keyword is guaranteed to be inlined by the compiler.

4. (a) Define a class to represent a bank account. Include the following members : 5

Data Members : Name of the depositor, Account number, Type of Account and Balance amount in the account.

Member Functions : To assign initial values, To deposit an amount, To display name and balance.

(b) Give the C++ syntax to access data members (public and private) and member functions in the following cases : 5

(i) Inside main program

(ii) Inside member function of the same class.

(c) Complete the following C++ program to find maximum of two numbers using a function **maximum** : 5

```
#include <iostream>
using namespace std;

int maximum(int a, int b);

int main( )

{

int x = 10, y = 20;

int max = maximum(x, y);

cout << "The maximum value is: " << max << endl;

return 0;

}

int maximum(int a, int b)

{

...

}
```

5. (a) What is a constructor ? Explain *three* types of constructors we use in C++. 5

(b) Debug the following C++ code : 5

```
#include <iostream>

using namespace std;

class Rectangle
```

```
{
int width, height;
Rectangle(int w, int h)
{
width = w;
height = h;
}
void displayArea( )
{
cout << "Area: " << width * height << endl;
}
};
int main( )
{
Rectangle r(10, 20);
r.display Area( );
return 0;
}
```

Explain why does the code fail to compile or produce the expected output ?

(*c*) Distinguish between the following two C++ statements : 5

Time T2(T1);

Time T2=T1;

T1 and T2 are objects of Time class.

6. (*a*) Class D is derived from class B. The class D does not contain any data members of its own. Does the class D require constructors ? If yes, then why ? 5

(*b*) Write a C++ program, to create a library system using inheritance. The Book class holds common details like title and authir and has a method displayDetails( ). The PrintedBook and Ebook classes inherit from Book and add specific details like numberOfPages and fileSize. Each class has its own version of displayDetails( ) to show its unique information. In the main( ) function, we store objects of both printedBook and Ebook in an array of Book pointers and call displayDetails( ) on each object. 5

(*c*) What are different forms of inheritance ? Give an example for each. 5

7. Explain the following with examples : 15

(*i*) Polymorphism

(*ii*) Multidimensional Arrays in C++

(*iii*) Data Encapsulation.

(19)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2585 I

Unique Paper Code : 2342201102

Name of the Paper : Programming Fundamentals Using Python

Name of the Course : B.A. Program

Semester : I

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The paper has **two** sections.
3. **All** questions in **'Section A'** are compulsory.
4. Attempt any **four** questions from **'Section B'**.
5. Parts of a question must be answered together.

P.T.O.

Section A

1. (i) Draw a flowchart to find the sum of the first 100 natural numbers. (4)

(ii) What is the difference between variables and constants in Python? Give suitable examples of each. (3)

(iii) Give output for the following print statements: (4)

(a) print(('Smile\t' + 'World\n')*4)

(b) print(3 + 5 * 2 ** 3 – 4)

(c) a, b = 5, 10

print(a > 3 and b < 20 or a == 5)

(d) print(5 | 2 ^ 3)

(iv) Write a Python program that takes an input n from the user and prints all the positive numbers from 1 to n. (4)

(v) Describe various control structures in Python. (4)

(vi) Write a Python program to count the total number of vowels, consonants and blanks in a String. (4)

(vii) What is the purpose of the try and catch blocks in exception handling? Give suitable examples. (4)

(viii) Describe the use of the break statement with a suitable example. (3)

Section B

2. (a) Describe any five components of a flow chart. (5)

(b) Write a Python program that takes a sentence as input from the user and performs the following operations: (10)

(i) Counts the total number of words in the sentence.

(ii) Reverses each word in the sentence.

(iii) Converts the entire sentence to uppercase.

3. (a) Write a program that prints the following pattern for input n taken from the user (the pattern for n=7 is given below). (5)

```
   *
  ***
 *****
*******
 *****
  ***
   *
```

(b) Write the output of the following code or give errors if any : (10)

(i)
```
x = 123
for i in x:
    print(i)
```

(ii)
```
for i in [1, 2, 3, 4][: :-1]:
print (i)
```

(iii)
```
temp = dict()
temp['key1'] = {'key1' : 44, 'key2' : 566}
temp['key2'] = [1, 2, 3, 4]
for (key, values) in temp.items():
  print(values, end = " ")
```

(iv)
```
mylist = ['abc', 'def', 'xyz']
for i in mylist:
    i.upper()
print(mylist)
```

(v)
```
i = 1
while True:
    if i % 3 == 0:
        break
    print(i)
    i + = 1
```

4. (a) Consider the given sets: (5)

```
set_A = {1, 2, 3, 4, 5}
set_B = {4, 5, 6, 7, 8}
```

Give Output of :

(i) set_A | set_B

(ii) set_A & set_B

(iii) set_A – set_B

(iv) set_A ^ set_B

(v) set_A.isdisjoint(set_B)

(b) Write a short note on the following with suitable examples : (10)

(i) ValueError

(ii) ZeroDivisionError

(iii) OSError

(iv) NameError

(v) IndexError

5. (a) Differentiate between Positional Arguments and Keyword Arguments in Python with a suitable example. (5)

(b) Write a Python program to find the sum of all odd numbers from 1 to 100. (5)

(c) What is the operator precedence in Python? (5)

6. (a) Write a program to check if two strings are balanced (A balanced string is a string in which all characters of s1 are present in s2 irrespective of their position). (5)

(b) Write various rules for naming an identifier. (5)

(c) Differentiate between mutable and immutable objects with examples. (5)

7. (a) Write a Python program to input two matrices from the user and add these two matrices to print the resultant matrix. (5)

(b) Write output of the following code snippets: (5)

(i)
```
a = 10
b = 20
a, b = b, a + b
print(a, b)
```

(ii)
```
number = 8524783
a, b = 0, 0
while (number > 0) :
    digit = number % 10
    if (digit % 2!= 0):
        a += digit
    else:
        b += digit
    number = int(number/10)
print(a, b)
```

(c) What is the scope of a variable and describe it with a suitable example. (5)

(20)

This question paper contains 5 printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **1460**

Unique Paper Code : **2342572301**

Name of the Paper : **Computer System Architecture**

Name of the Course : **B.A.(Prog.)/B.Sc.(P)/B.Sc.(Maths Sc.)**

Semester : **III**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Section **A** is compulsory.

Attempt any *four* questions from Section **B**.

Parts of a question should be attempted together.

SECTION A

1. (*a*) What is the role of a cache memory in the memory hierarchy ? 3

(*b*) Simplify the following expression using Boolean algebra : 3

(*i*) $AB+A(CD+CD')$

(*ii*) $(BC'+A'D')\ (AB'+CD')$

(*iii*) $A'B+ABC'+ABC$

(*c*) Write down the steps that are required to transfer a new word to be stored in Random Access Memory (RAM). 3

(*d*) What are the values of the two control flip-flops, FGI and FGO used during execution of Input and Output instructions ? Write the required microinstructions needed for the execution of the I/O instructions. 3

P.T.O.

(*e*) What are overflow and underflow conditions in Arithmetic subtraction ? Explain with a suitable example. 3

(*f*) What are flip-flops ? Differentiate between positive and negative edge triggered flip-flops. 3

(*g*) Explain the working of a 4-bit adder circuit with a block diagram. 4

(*h*) Explain Direct Memory Access (DMA) with help of a block diagram. 4

(*i*) Convert the following numbers with the indicated bases to decimal : 4

(*i*) $(431)_5$

(*ii*) $(52.5)_6$

(*iii*) $(246)_8$

(*iv*) $(11011011)_2$

SECTION B

2. (*a*) Explain the working of a Half-Adder with the help of a truth table and draw the logic diagram. 4

(*b*) An instruction at address 065 in a basic computer has I=0, opcode =ADD and address part a 099. The memory word at 099 contains the value of B8F2 and contents of AC are A937. Implement the instruction cycle and determine the contents of PC, AR, DR, IR and AC registers. Repeat the above when the opcode is AND. 5

(*c*) Express the complement of the following functions in sum-of-minterms form : 6

(*i*) $F(A,B,C,D) = \Sigma(3,5,9,11,15)$

(*ii*) $F(A,B,C) = \Pi(2,4,5,7)$.

3. (*a*) Explain how parallel processing is implemented through pipeline. 4

(*b*) Design a combinational circuit with three inputs and one output. The output is 1 when the binary value of the input is less than or equal to 3 and is 0 otherwise. 5

(*c*) Consider a two-word instruction stored in the memory location 400 and 401 as given in the figure below. The first part of the word indicates that this instruction loads a value into AC and the mode field specifies an addressing mode along with the address filed equal to 650. PC has a value 400 and a source register R1 has a value 600. There is also a base register having a value 100. Assume that location 699 contains a value 999, location 700 contains the value 1000. 6

400	Load to AC	Mode
401	650	
202	Next instruction	

Determine the effective address and the operand to be loaded for the following address modes :

(*i*) Direct

(*ii*) Immediate

(*iii*) Indirect

(*iv*) Relative address

(*v*) Register

(*vi*) Autoincrement

4. (*a*) The initial values in 8-bit registers AR, BR, CR and DR are as following : 5

AR=11110010

BR=11111111

CR=10111001

DR=11101010

Determine the 8-bit value in the register after the execution of the following operations :

(*i*) AR ← AR (AND) DR

(*ii*) BR ← BR + 1

(*iii*) CR ← AR - CR

(*iv*) DR ← DR (OR) CR

(*v*) BR ← BR′

(*b*) Draw the block diagram of JK flip-flop along with the characteristic and excitation table. 5

(*c*) What are the main characteristics of a Reduced Instruction Set Computer (RISC) and how are they different from Complex Instruction Set Computer (CISC) ? 5

5. (*a*) Draw the logic diagram and truth table of a 2-to-4 line decoder using only NAND gates with enable input. 5

(*b*) What is a GPU and how is it different from CPU in terms of performance and capability ? Name any *two* applications areas where GPU is more suitable than CPU. 5

(*c*) Draw a flow chart of the interrupt cycle and explain its working. 5

6. (*a*) On the given values of X and Y, 4

$X=(72)_{10}$ and $Y=(89)_{10}$

Perform X–Y using :

(*i*) 10's complement subtraction

(*ii*) 2's complement subtraction.

(*b*) Simplify the following Boolean function F with don't care conditions d in sum-of-minterms form. Also draw the corresponding logic diagram : 5

$F(A,B,C,D)=\sum(0,6,8,13,14)$

$d(A,B,C,D)=\sum(2,4,10)$

(*c*) Explain the working of a control unit of a basic computer with the help of a block diagram. 6

7. (*a*) List the different types of ROM's. How many 128×8 memory chips are needed to provide a memory capacity of 4096×16? 4

(*b*) Determine by means of a truth table the validity of De-Morgan's theorem for three variables : 5

$(ABC)'=A'+B'+C'$

(*c*) Write short notes on the following : 6

(*i*) Indirect memory reference

(*ii*) Fetch cycle of an instruction

(*iii*) Programmed I/O.

(21)

This question paper contains 5 printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **2305**

Unique Paper Code : **2342572301**

Name of the Paper : **Computer System Architecture**

Name of the Course : **B.A.(Prog.)/B.Sc.(P)/B.Sc.(Maths Sc.)**

Semester : **III**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Section A is compulsory.

Attempt any *four* questions from Section B.

Parts of a question should be attempted together.

SECTION A

1. (*a*) Simplify the following expressions using Boolean algebra : 3

(*i*) A'B + ABC' + ABC

(*ii*) (BC' + A'D) (AB' + CD').

(*b*) Draw the logic diagram for the given Boolean function using NAND gates only : 3

F = AB + A'C

(*c*) Convert the following in their indicated bases : 3

(*i*) $(425)_{10}$ = (?)$_2$

(*ii*) $(346)_8$ = (?)$_{16}$.

(*d*) Give any *three* reasons why an input-output interface is required in a computer system ? 3

(*e*) How many 128 × 8 memory chips are needed to provide a memory capacity of 2048 × 16 ? 3

(*f*) Draw the block diagram of a 5 × 32 line decoder by using 2 × 4 and 3 × 8 line decoders. 3

(*g*) A digital computer has a common bus system for 16 registers of 32 bits each. The bus is constructed with multiplexers : 3

(*i*) How many selection inputs are there in each multiplexer ?

(*ii*) What is the size of each multiplexer ?

(*iii*) How many multiplexers are there in the bus ?

(*h*) Write the advantage(s) of DMA over CPU controlled data transfer. 3

(*i*) Write the microoperations required for the Fetch and Decode phase of an instruction starting from timing signal T_0 to T_2 in a basic computer. 3

(*j*) How isolated I/O is different from memory-mapped I/O ? 3

SECTION B

2. (*a*) Draw the characteristic and excitation table for S–R Flip-Flop. 4

(*b*) What is the difference between a direct and an indirect address instruction ? Explain with a suitable example. How many references to memory are needed for each type of instruction to bring an operand into a processor register ? 5

(*c*) For the given Boolean expression $F = x'y + xyz'$: 6

(*i*) Derive an algebraic expression for the complement F'

(*ii*) Show that $F.F' = 0$

(*iii*) Show that $F + F' = 1$.

3. (*a*) Draw the logic diagram of a half-adder with the truth table and derive the Boolean expressions for sum and carry. 4

(*b*) Simplify the following function using K-Map, and draw the logic diagram of the simplified function : 5

$$F(w, x, y, z) = \sum(0, 1, 2, 4, 5, 7, 11, 15)$$

(*c*) Can the following register transfer statements take place in a single clock cycle ? Justify : 6

(*i*) $xT : AR \leftarrow (AR)', AR \leftarrow 0$

(*ii*) $yT : R1 \leftarrow R2, R1 \leftarrow R3$

(*iii*) $zT : PC \leftarrow AR, PC \leftarrow PC + 1$.

4. (*a*) Write the name of the register used for the following purposes : 4

(*i*) Instruction from memory will transfer to this register.

(*ii*) Contains the address of the next instruction to be executed.

(*iii*) Required for CMA operation to be performed.

(*iv*) Holds a memory address.

(*b*) Content of two 8-bit registers are as follows : 5

$$A = (9C)_{16} \text{ and } B = (B7)_{16}.$$

Perform the following operations and represent the result in hexadecimal number :

(*i*) A (AND) B

(*ii*) A (ADD) B.

P.T.O.

(*c*) A two-word instruction is stored in memory at an address designated by the symbol W. The address field of the instruction (stored at W + 1) is designated by the symbol Y. The operand used during the execution of the instruction is stored at an address symbolized by Z. An index register contains the value X. State how Z is calculated from the other addresses if the addressing mode of the instruction is : 6

(*i*) Direct

(*ii*) Indirect

(*iii*) Relative

(*iv*) Indexed.

5. (*a*) What is a bus system ? Highlight the significance of a common bus in multi-register configuration. 4

(*b*) Draw a timing diagram assuming that SC is cleared to 0 at time T_3 if control signal C7 is active : 5

$C7T_3$: SC → 0

C7 is activated with the positive clock transition associated with T_1.

(*c*) Write the characteristics of complex instruction set computer (CISC) and reduced instruction set computer (RISC). 6

6. (*a*) What is the significance of cache memory in a computer system ? Consider the memory capacity of 2G × 32 bits per words, how many address lines, input and output data lines are needed ? 4

(*b*) Draw the block diagram of a 4-to-1 line multiplexer and explain its working by means of a function table. 5

(*c*) The 8-bit registers AR, BR and CR initially have the following values : 6

```
AR = 11110010
BR = 11111111
CR = 10111001
```

Determine the 8-bit values in each register after the execution of the following sequence of microoperations :

```
AR ← AR + BR     ;Add BR to AR
AR ← AR - CR     ;Subtract CR from AR
```

Starting from the initial value of CR = 10011100 determine the register value after an arithmetic shift left, and state whether there is an overflow.

7. (*a*) Justify the statement : To achieve optimized level of performance from a multiprocessor system, application must be concurrent. 6

(*b*) Write short notes on the following : 9

(*i*) Direct Memory Access (DMA)

(*ii*) Interrupt Cycle

(*iii*) Sequential Circuits.

(22)

This question paper contains 6 printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **2374**

Unique Paper Code : **2342202302**

Name of the Paper : **Data Mining–I**

Name of the Course : **B.A. Programme**

Semester : **III**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Section A is compulsory.

Attempt any *four* questions from Section B.

Parts of a question must be answered together.

Use of scientific calculator is allowed.

Section–A

1. (*a*) Explain any *two* strategies for dealing with missing data. 2

(*b*) Define frequent sets and confidence in association rule mining. 2

(*c*) Give the formula for Euclidean distance and calculate the distance between the points (4, 6) and (7, 9) using it. 2

(*d*) Explain any *two* key motivations for the use of data mining in modern data analysis. 2

(*e*) Describe how Sum of Squared Errors (SSE) can be used to determine the optimal number of clusters in a dataset. 2

P.T.O.

(*f*) Differentiate between partial and complete clustering. 2

(*g*) A dataset consists of two classes, C1 and C2. The probability of a randomly selected data point belonging to each class is as follows : 3

$P(C1) = 0.4$ and $P(C2) = 0.6$.

A feature X is observed, and its likelihood given each class is :

$P(X|C1) = 0.7$ and $P(X|C2) = 0.2$.

Using Bayes' theorem for classification, determine the probability that the data point belongs to C1 given the feature X is observed, i.e., compute $P(C1|X)$.

(*h*) What is dimensionality reduction ? Give *two* advantages of dimensionality reduction. 3

(*i*) Explain the types of data mining tasks and their distinguishing features. 4

(*j*) Given the following dataset, classify the new instance X1 = 5 and X2 = 4 using the *k*-Nearest Neighbors algorithm with $k = 3$: 4

X1	X2	Y
2	3	No
3	3	Yes
6	5	Yes
7	8	No
8	9	Yes

(*k*) For the dataset below, calculate the support for the itemsets {A}, {B}, {C}, and {A, B} : 4

T1 : {A, B, C}

T2 : {A, C}

T3 : {B, D, E}

T4 : {A, B, C, E}

T5 : {B, E}

Section–B

2. (*a*) Consider the training examples for a classification problem as shown in the following table : 10

ID	Temperature	Wind	Humidity	Will Play
1	Hot	Strong	High	No
2	Hot	Weak	High	No
3	Mild	Weak	Normal	Yes
4	Cool	Strong	Normal	Yes
5	Cool	Weak	Normal	Yes
6	Cool	Strong	High	No
7	Mild	Weak	High	Yes
8	Mild	Strong	High	Yes
9	Mild	Weak	High	No
10	Hot	Weak	Normal	No

(*i*) Calculate the Entropy for the feature "Temperature" in the dataset.

(*ii*) Compute the Gini Index for the "Humidity" feature.

(*b*) Describe the process of knowledge discovery in knowledge databases with the help of an example. 5

P.T.O.

3. (*a*) Given the following dataset with 5 transactions with a minimum support threshold of 60% and a minimum confidence threshold of 80%. Find all frequent itemsets using Apriori algorithm. List all strong association rules generated using frequent 3-itemsets : 10

TID	Transaction
T1	{A, B, C, E}
T2	{B, C, E}
T3	{A, B, D}
T4	{A, D}
T5	{B, C, E}

(*b*) What is binarization and discretization of continuous attributes ? Explain their significance in the data pre-processing pipeline. 5

4. (*a*) Write short notes on the following : 10

(*i*) Feature subset selection

(*ii*) Stratified sampling

(*iii*) Holdout method

(*iv*) Cross-validation.

(*b*) Classify the following attributes as nominal, ordinal, interval, or ratio. Give a reason for your answer : 5

(*i*) Temperature recorded in Celsius for a week (e.g., 20°C, 25°C, 30°C)

(*ii*) Colors of cars (e.g., Red, Blue, Green)

(*iii*) Ratings for a movie (e.g., 1 star, 2 stars, 3 stars, 4 stars, 5 stars)

(*iv*) Age of individuals in a group (e.g., 18 years, 25 years, 40 years)

(*v*) Types of beverages available in a cafeteria (e.g., Coffee, Tea, Juice).

5. (*a*) Compare and contrast supervised and unsupervised data mining techniques with examples of each. 5

(*b*) Given the confusion matrix for a classification model, identify the True Positive and False Positive. Calculate precision, recall, and F1-Score based on this matrix : 5

		Predicted	
		TRUE	**FALSE**
Actual	**TRUE**	60	40
	FALSE	15	85

(*c*) Define clustering in data mining. Why is it useful ? Give one real-world application of clustering. Differentiate between well-separated and density-based clusters. 5

6. (*a*) Using the Naive Bayes classifier, classify a new instance with features (X1 = Red, X2 = Large, X3 = Full) in the following dataset : 10

X1	X2	X3	Y
Red	Small	Half	No
Red	Large	Full	Yes
Blue	Small	Full	Yes
Red	Small	Full	Yes
Blue	Large	Half	No

(*b*) What is variable transformation in data preprocessing ? Explain any *two* types of variable transformations with examples. 5

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[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2336 **I**

Unique Paper Code : 2342203502

Name of the Paper : Machine Learning

Name of the Course : **B.A. (Prog.)**

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory.
3. Attempt any **FOUR** questions from **Section B.**
4. Parts of a question should be attempted together.
5. Use of Scientific calculator is allowed.

Section A

1. (a) Explain the difference between unsupervised and supervised machine learning techniques. Additionally, provide a real-world example for each. (5)

P.T.O.

(b) Describe the k-fold cross-validation method with a suitable example. What are the ideal choices for the value of k? Can we say that Leave-one-out cross-validation is a special case of k-fold cross-validation? Justify your answer. (5)

(c) A medical test was conducted on 500 individuals, out of which 400 were healthy, and 100 were truly sick. Among the sick individuals, only 70 tested positive test result, while the rest received a negative result. For the healthy individuals, 25 tested positive, and 375 received a negative result. Construct a confusion matrix for the results mentioned above. Calculate the True Positive Rate (TPR), Specificity, and Accuracy of the test. (5)

(d) Given the following Boolean functions, construct decision trees to represent each function. Clearly label the decision nodes and branches to show how each variable contributes to the output.

(i) $F(A,B)=A \wedge B$

(ii) $G(A,B)=A \vee B$ (5)

(e) Apply the K-nearest neighbor algorithm on the following dataset with K=3 to predict the class label for a new data point X with Feature A=3 ad Feature B = 6. (5)

(Use the Euclidean distance metric)

Feature A	Feature B	Class
5	8	Negative
6	5	Negative
2	3	Positive
1	4	Positive

(f) Describe the steps followed to cluster data using k-means algorithm. What is the main drawback of this algorithm? (5)

Section B

2. (a) Define the Naive Bayes Classifier and its mathematical formulation. Enumerate the key assumption underlying the Naive Bayes classifier. (5)

(b) Consider the following table of customer transaction data, with the "Purchase" attribute representing the class label: (10)

Product	Price	Quantity	Day	Purchase
Laptop	high	1	Weekday	Yes
Headphones	low	2	Weekend	No
Mouse	low	3	Weekday	Yes
Keyboard	low	1	Weekend	Yes
Monitor	high	1	Weekday	No
Laptop	high	1	Weekend	Yes
Headphones	low	1	Weekday	No
Mouse	low	2	Weekend	Yes
Keyboard	low	1	Weekday	No
Monitor	high	1	Weekend	Yes

Using this dataset, train a Naive Bayes classifier and predict the class label "Purchase" for a new instance with the following attribute values: Product = Headphones, Price = low, Quantity = 1, Day = Weekday.

3. (a) Explain how changing the tuning parameter (X) in ridge regression affects the model.

(i) What happens if $\lambda \to 0$?

(ii) What happens if $\lambda \to \infty$? (5)

(b) Given the following dataset of ages and test scores for a group of students, fit a linear regression model using the ordinary least squares method. Determine the residual error for the best-fit line. Create a linear regression model for this data and predict the test score for a student with an age of 21. (10)

Age (x)	Test Score (y)
16	85
18	90
20	92
22	88
24	95
26	92

4. (a) What do you understand by Cross-Validation? How is it different from the Hold-out method? (5)

Consider a dataset consisting of 50 instances. In the context of 5-fold cross-validation, answer the following :

(i) How many iterations of training will be conducted?

(ii) What will be the size of the training and testing sets for each iteration?

(iii) Describe how the accuracy of the classifier is calculated during 5-fold cross- validation.

(b) Consider the following dataset representing customer behaviour metrics for an online retail platform : (10)

Customer	Average Order Value	Purchase Frequency
C1	0.85	0.62
C2	0.45	0.78
C3	0.92	0.55
C4	0.38	0.43
C5	0.73	0.81
C6	0.56	0.67

Using the Complete Linkage hierarchical clustering method calculate the distance matrix using Euclidean distance and construct a dendrogram showing the hierarchical clustering process

5. (a) For a maximal margin classifier, which points of the training set are called as support vectors? Discuss the capability of this classifier for data which is not linearly separable. (5)

(b) Describe the structure of a multilayer neural network with a suitable example. What are general strategies employed to prevent a neural network from overfitting? (5)

(c) The provided regression coefficients show a multiple logistic regression model used to predict the risk of sudden death. Using these coefficients calculate the predicted probability of death for a man with Diastolic blood pressure of 130 mmHg, Cholesterol of 280 mg/100mL, and Glucose of 120 mg/100mL. (5)

Risk Factor	Regression Coefficient
Constant term (β_0)	-17.2
Blood Pressure (mm Hg) (β_1)	0.112
Cholesterol (mg/100 mL) (β_2)	0.0071
Glucose (mg/100 mL) (β_3)	0.0075

6. (a) Discuss the importance of feature selection in Machine Learning. Also, describe the various strategies followed for feature selection. (5)

(b) Consider the following customer purchase dataset for an e-commerce platform: (10)

Customer ID	Purchase	Age Group	Income Level	Purchase
1	Yes	Young	High	Yes
2	No	Middle	Low	No
3	Yes	Senior	High	Yes
4	No	Young	Low	No
5	Yes	Middle	High	No
6	No	Senior	Low	Yes
7	Yes	Young	High	Yes
8	No	Middle	Low	No

Using the Entropy criterion construct a decision tree.

7. (a) What do you understand by Principal Component Analysis (PCA)? Enumerate the steps involved in performing PCA. (5)

(b) Explain how SVM can be used for multiclass classification. (5)

(c) Calculate the output of a single-layer neural network with two input neurons and one output neuron. The input feature vector is (x1, x2) = (0.7, 0.3), the weight vector is [w1, w2] = [0.5, -0.2], and the bias is 0.1. Use the sigmoid function as the activation function. (5)

(24)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7120 I

Unique Paper Code : 62343502

Name of the Paper : Open-Source Software

Name of the Course : **B.A. (Prog.) Computer Applications (Skill Enhancement Course under LOCF 2019)**

Semester : V

Duration : 2 Hours Maximum Marks : 25

Instructions for Candidates

1. Write your Roll. No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory.
3. Answer **any three** questions from **Section B.**
4. Parts of the question must be answered together.

P.T.O.

Section A

(10×1=10)

1. (a) The pwd command is used to

(i) Print the current date

(ii) Display the current working directory

(iii) Delete a file

(iv) List all files in a directory

(b) The tool in GNU Image Manipulation Program (GIMP) is used to select an area of similar colors is

(i) Rectangle Select Tool

(ii) Free Select Tool

(iii) Fuzzy Select Tool (Magic Wand)

(iv) Move Tool

(c) The statement that is used to create a new form in Gambas is

(i) CreateForm()

(ii) New Form

(iii) Form = New Form

(iv) Form.Show()

(d) How do you declare a variable in Gambas?

(i) var number =10

(ii) Dim number As Integer

(iii) let number = 10

(iv) int number = 10

(e) The _____ is command to view contents of a file in the terminal.

(i) edit

(ii) read

(iii) cat

(iv) open

(f) Scale option can be used to change _____ of the image.

(i) Size

(ii) Color

(iii) Background

(iv) All of the above

(g) The menu in GIMP that is used to change the color mode of an image (e.g., RGB to Grayscale) is

(i) Edit

(ii) Image

(iii) Layer

(iv) Filters

(h) Using the chmod command we can

(i) Change file permissions

(ii) Modify the file content

(iii) Create a new directory

(iv) Compress a file

(i) Which file format preserves the layers of an image in GIMP?

(i) JPEG

(ii) PNG

(iii) XCF

(iv) BMP

(j) The correct method to create a message box in Gambas to display a simple message is

(i) Alert.Message ("Hello, World!")

(ii) MessageBox.Show("Hello, World!")

(iii) Print "Hello, World!"

(iv) Message ("Hello, World!")

Section B

2. (a) Write any three benefits of using open-source software for both individuals and organizations? (3)

(b) Name one open-source and proprietary word processing software. (2)

(a) Write the function of the following Linux commands with a suitable example. (3)

(i) rm

(ii) cd

(iii) ls

(b) Define the terms: (2)

(i) fair use

(ii) work for hire

(a) Define the terms free distribution, source code and derived works with respect to Open-Source software. (3)

(b) Differentiate between GNU and Apache licens

(

5. (a) How does the open-source community contribu to the development and improvement of softwar

(

(b) Write a program using GAMBAS to calcula Simple interest.

Simple interest= (Principal *rate*time)/100 (

6. (a) Write the steps to insert text on an image usi GIMP. (

(b) Briefly explain the utility of Mozilla Public Licens

(