

B.Sc. Comp. Sci.
1118 V Sem.
① Dec 2023

18 JUN 2024

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1622

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. The paper has **two** sections. **Section A** is compulsory. Each question is of **5** marks.
3. Attempt any **four** questions from **Section B**. Each question is of **15** marks.

P.T.O.

Section - A

1. (a) State the conditions under which a system of linear equations will be consistent? Check consistency for the following system of equations : (5)

$$x_1 + x_2 + x_3 = 7$$

$$3x_1 - 2x_2 - x_3 = 4$$

$$x_1 + 6x_2 + 5x_3 = 24$$

- (b) Show that V_1 as $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, V_2 as $\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$, V_3 as $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ forms

a basis for \mathbb{R}^3 . (5)

- (c) Let Y be the set of vectors in \mathbb{R}^4 of the form $[a, 0, b, 0]$. Prove that Y is a subspace in \mathbb{R}^4 .

(5)



1622

3

(d) Find the rank of the following matrix. (5)

$$\begin{bmatrix} 1 & 1 & 1 \\ 2 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}$$



(e) Prove that $\text{div}(\text{curl } v)=0$, where v is a twice continuously differentiable vector function. (5)

(f) What do you mean by normalizing a vector?
Normalize the vector $[2, 3, 1, 1]$. (5)

Section B

2. (a) What is a positive definite matrix? Is the following matrix positive definite? (7)

$$A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

P.T.O.

- (b) Solve the following system of linear equations using Gauss Elimination Method. (8)

$$5x_1 - 5x_2 - 15x_3 = 40$$

$$4x_1 - 2x_2 - 6x_3 = 19$$

$$3x_1 - 6x_2 - 17x_3 = 41$$

3. (a) Define orthogonality of vectors? Determine whether the vectors a and b are orthogonal or not

where $a = 2\hat{i} + 6\hat{j} + \hat{k}$ and $b = 3\hat{i} - 2\hat{j} + 3\hat{k}$. (7)

- (b) Diagonalize the following matrix (8)

$$\begin{bmatrix} 5 & 2 & 0 \\ 2 & 5 & 0 \\ -3 & 4 & 6 \end{bmatrix}$$



1622

5

4. (a) Suppose $L: \mathbb{R}^3 \rightarrow \mathbb{R}^3$ is a linear operator and $L([1, 0, 0]) = [-2, 1, 0]$, $L([0, 1, 0]) = [3, -2, 1]$ and $L([0, 0, 1]) = [0, -1, 3]$, Find $L([-3, 2, 4])$. Also, give formula for $L([x, y, z])$ for $[x, y, z] \in \mathbb{R}^3$. (7)

- (b) Apply Gram Schmidt orthonormalization process to obtain an orthonormal basis for the subspace of \mathbb{R}^4 generated by the vectors : (8)

$$V_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} \quad V_2 = \begin{bmatrix} 1 \\ 1 \\ -1 \\ -1 \end{bmatrix} \quad V_3 = \begin{bmatrix} 0 \\ -1 \\ 2 \\ 1 \end{bmatrix}$$

5. (a) Find gradient and curl of V for

$$V = (x^2 + y^2 + z^2)^{-3/2} (x\hat{i} + y\hat{j} - z\hat{k}). \quad (7)$$



P.T.O.

- (b) State Cayley-Hamilton theorem and verify it for the following matrix A. (8)

$$A = \begin{bmatrix} -2 & -4 & 2 \\ -2 & 1 & 2 \\ 4 & 2 & 5 \end{bmatrix}$$

6. (a) Find the inverse of the following matrix using elementary row operations (7)

$$\begin{bmatrix} 1 & -4 & 1 \\ 1 & 1 & -2 \\ -1 & 1 & 1 \end{bmatrix}$$

- (b) Solve the following system of homogeneous equations by matrix method. (8)

$$5x_1 - 2x_3 = 0$$

$$-15x_1 - 16x_2 - 9x_3 = 0$$

$$10x_1 + 12x_2 + 7x_3 = 0$$



1622

7

7. (a) Find the directional derivative of

$$F(x,y,z) = 2x^2 + 3y^2 + z^2 \text{ at } P(2, 1, 3) \text{ in the direction } 3\hat{i} + 4\hat{k}. \quad (7)$$

- (b) Suppose that 3 banks in certain town are competing for investors. Currently bank A has 40% of the investors, Bank B has 10% and Bank C has remaining 50%. Suppose the townsfolk are tempted by various promotional campaigns to switch banks. Records show that each year Bank A keeps half of its investors, with the remainder switching equally to Bank B and C. However, Bank B keeps $\frac{2}{3}$ of its investors, with the remainder switching equally to Bank A and C. Finally, Bank C keeps



P.T.O.

1622

8

half of its investors, with the remainder switching
equally to Bank A and B. Find the distribution of
investors after two years. (8)



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18 JUN 2024

3

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4361

Unique Paper Code : 32341101

Name of the Paper : Programming Fundamentals
Using C++

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

Semester : I

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. Question Number 1 is compulsory in Section A.
3. Attempt any 4 questions from Section B.
4. Parts of a question should be attempted together.

Section A

1. (a) Give the C++ declarations for the following :
(5)

P.T.O.

- (i) Array of type double that holds 10 values.
- (ii) Opening a file val.txt in write mode.
- (iii) Pointer to character variable x initialised to 'A'.
- (iv) Function prototype that accepts variables x and y where x is of type double and y is an array of integer.
- (v) Declare a variable t of type integer, initialised to value 13 and use suitable manipulators to display the value in octal format.

(b) Identify all the syntax errors (if any) in the given code and rewrite the correct code:

(i) `for (i=0, j<10; i++)` (2)

```
    {  
        cout<<"Square is: ", i*2, "\n";  
    }
```

(ii) `void area(int length=8, int breadth)` (2)

```
    {  
        return length*breadth;  
    }  
    cout<<"Area of the rectangle is:  
    "<<area (8, 20);
```



4361

3

```
(iii) class AA { (3)
    public:
        void print(int x);
        int AA(int);
    private
        int size;
        int max;
}
```

(c) Give the output of the following. Assume all necessary header files have been included. (2)

```
(i) void main () {
    int a = 10;
    int b = (a%2)? 10: 100;
    cout << b;
}
```

```
(ii) void main() { (3)
    int x = -1;
    try {
        cout << "Inside try n";
        if (x < 0)
        {
            throw x;
            cout << "After throw n";
        }
    }
}
```



P.T.O.

```
catch (int x) {  
    cout << "Exception Caught n";  
}  
cout << "After catch n";  
}
```

(iii) char val = 'a'; (3)

```
switch(val) {  
    case 'a':  
        cout<<"case a executed ";  
    case 'b':  
        cout<<"case b executed ";  
        break;  
    default:  
        cout<<"Default block executed";  
}
```

(iv) void passing(int &a, int b){ (3)

```
    a = a+b;  
    b = b-a; }  
  
void main() {  
    int a = 7, b = 6;  
    passing(a,b);  
    cout<<"a = "<<a;  
    cout<<"b = "<<b;  
}
```



4361

5

```
(v) class base { (5)
public:
    base() {
        cout<<"In base"<<"\n";
    }
    ~base(){
        cout<<"Base destructor\n";
    }
};
class derived: public base {
public:
    derived () {
        cout<<"In derived"<<"\n";
    }
    ~derived() {
        cout<<"Derived destructor\n";
    }
};
void main() {
    derived d;
    cout<<fixed<<setprecision(2)<<13.4546<<" \n";
}
```



P.T.O.

4361

6

- (d) Give the output with justification. Assume memory address of val to be 1024, memory address of ptr1 to be 1078 and memory address of ptr2 to be 1154: (3)

```
#include <iostream>
int main()
{
    int val =5;
    int *ptr1 = &val;
    int **ptr2 = &ptr1;
    cout<<"*ptr1 = "<<*ptr1<<"\n";
    cout<<"*ptr2 = "<<*ptr2<<"\n";
    cout<<"**ptr2 = "<<**ptr2<<"\n";
    return 0;
}
```

- (e) Convert the following for-loop to equivalent do-while loop: (4)

```
for(int i =0; i<100; i= i*3)
{
    for (int j = 10; j<100; j++)
        cout<<i*j;
    cout<<"\n";
}
```



4361

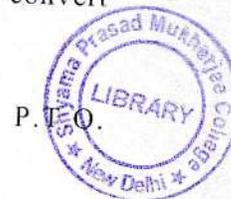
7

Section B

2. (a) Define a class in C++ weightConverter with the following features : (6)

1kg = 2.2 pounds

- (i) Declare the Data Members: weightKG, weightPounds of type double
- (ii) Define the parameterised constructor to initialize weightKG.
- (iii) Define the member functions with appropriate prototypes for the following task:
 1. Converting WeightKG to WeightPounds
 2. Write an inline function averageWeight() that accepts one weight in Kilograms and another in Pounds and returns the average weight of both (in the same units)
- (iv) Define the main function to initialize the object of weightConverter and call the appropriate member function to convert weight of 50 kgs in pounds.



4361

9

(b) Consider the following C++ class:

(8)

```
class location
{
int latitude, longitude;
}
```



where latitude and longitude are the geographic coordinates of a location. For the above class, provide the definition of the following member functions :

(i) Parameterised Constructor

(ii) Overload the "-" Operator to subtract two locations.

(iii) Display Function.

Define the main function. Use operator overloading to create two locations and store the difference between these two locations and display the result. For example, two locations, 10 latitude, 15 longitude, and 6 latitude, 9 longitude will give the result 4 latitude, 6 longitude when subtracted.

P.T.O.

5. (a) Write a function in C++ that takes a given number n and displays the square root if the number is positive otherwise throw an exception with a message - "Negative number found". (4)
- (b) Explain copy constructor with the help of an example. (3)
- (c) Give the output of the following C++ code snippet. Assume all the header files have been included (3)

```
int foo(float a) {  
    return a/2;  
}  
int foo(int a) {  
    return a*2;  
}  
void main() {  
    float a = 3.5;  
    cout<<foo(a);  
}
```

6. (a) Create the following hierarchy in C++ and implement the functions as mentioned below : (6)





```
class Vehicle {
    int max_speed;
public:
    Vehicle() {
        max_speed = 10;
    }
    virtual void display_speed() {
        cout<<"Maximum speed of vehicle is: "<<max_speed;
    };
class Bike: public Vehicle {
public:
    Bike () {
        max_speed = 60;
    }
};

class Car: public Vehicle {
public:
    Car() {
        max_speed =100;
    }
    .....
};
```

4361

12

Replace ellipses ... with proper code to override method `display_speed()` in class `Bike` and `Car`. Use runtime polymorphism to display the contents of objects of classes `Vehicle`, `Car`, and `Bike`.

(b) Differentiate between call by value and call by reference using an appropriate example. (4)

7. (a) Write a program in C++ to read a file `info.txt` and display the number of words in the file. (5)

(b) Consider the example given below. The weather department records the rainfall (in cms) for 4 weeks in a 2D matrix. Write a code to calculate the average rainfall for each week. (5)

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Week 1	2.2	3	5	1	0.9	1.1	1.2
Week 2	1.6	2.1	1.7	2.6	5.1	0.8	1.2
Week 3	1.7	1.9	1.5	3.7	3.9	1.5	4.1
Week 4	0.6	0.5	1.3	3.3	1.5	1.9	2.5



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27/12
18 JUN 2024

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Your Roll No.....

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Sr. No. of Question Paper : 1527

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Unique Paper Code : 2342012301

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Name of the Paper : Data Structures

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

Semester : III (DSC)

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. All questions in Section A are compulsory.
3. Attempt any four questions out of six in Section B.

Section - A

1. (a) What will be the maximum number of nodes in a Binary tree with depth d ? (2)

(b) What would be the output after the following code segment is executed on the following linked list

10 → 30 → 20 → 90 → 100

```
node *p;
```

```
p = head;
```

```
while (p->next->next)
```

```
{
```

```
    p=p->next;
```

```
    cout<< p->data;
```

(2)

(c) For the given queue - a, b, c, d, List the sequence of enqueue and dequeue operation to obtain the following queue : d, c, b, a

(2)



1527-

3

- (d) Store the following univariate polynomial in a singly linked list

$$5x^3 - 6x^2 - 3x + 2 \quad (3)$$

- (e) Solve the following recurrence relation using Master's theorem-

$$T(n) = 2T(n/2) + n \log n \quad (3)$$

- (f) Write a function for finding the minimum element in a Binary Search tree (3)

- (g) void fun(int x)

if (x > 0)

{

fun(x-1);

cout << x;

fun(x-1);



P.T.O.

Binary tree with depth d?

(2)

1527

4

```
    }  
    }  
  
void main()  
{  
    fun(3);  
}
```

What will be the output for the above snippet? Create a recursion tree for the same.

(h) Convert the following expression to postfix a stack. Show the status of stack after operation _____

$(A+B) * (C-D) / F - X*Y / Z$

(i) Given a two dimensional array $A[5][10]$ stored at address is 1000 and each element size 4. Find the address of $A[3][5]$ using both row major and column major order.



1527

5

Section - B



2. (a) What is the advantage of using a doubly linked list over a singly linked list? Write a function to remove duplicate elements from a sorted doubly linked list. (2+6)

(b) Draw a binary tree T such that (5+2)

- Each node of T stores a single character

- A preorder traversal of T yields *mnopxyz*

- An inorder traversal of T yields *npomyzx*

code

ne.

(5)

using

each

Also give the post-order traversal of T

3. (a) Write a function to count all the occurrences of an element in an integer type array. (5)

(5)

(b) Evaluate the following postfix expression using a stack. Show every step.

. A is

it is of

both row

$43 * 2 / 182^{^+} + 2 - 3 +$

(5)

(^ operator depicts exponent)

(5)

P.T.O.

(c) Draw the expression tree for the following : (5)

$$2 + 5 * 3 ^ 2 + 9 + ((1+8) * 3)$$

4. (a) For a given set of values, write a program for printing the Next Greater Element (NGE) for every element. Use stack data structure. Write the NGE for the following elements 4,5,2,25. Also, explain the time complexity of the code. (6+2+2)

(b) Write a recursive function for computing nth Fibonacci number via binary recursion. (5)

5. (a) Create a class to implement ADT queue using two stacks. Write functions - enqueue, dequeue and empty. (3+5)

(b) Let $f(n) = 3n^2 + 4n \log n + 5n$. Show that $f(n) \in O(n^2)$. (3)



1527

7

(c) Sort the following array using insertion sort

10, 9, 11, 7, 8, 5

Show the status of array after each iteration.



(4)

6. (a) Create an AVL tree by inserting the following items successively. Show the status of tree after each insertion

10, 15, 50, 12, 11, 30, 40, 60, 7

Delete 15 from the above tree. (6+4)

(b) Write a function to return the i^{th} element of a singly linked list. Compare the time complexity of accessing an element in an array and a linked list. (3+2)

7. (a) Consider a max heap with following values-

50, 30, 20, 15, 10, 8, 16

(i) Insert a new node with value 60.

(ii) Delete a node with value 50. (5)

P.T.O.

Binary tree with depth d ?

(2)

1527

8

(b) Write a function to delete the element pointed by the cursor in a circular linked list.

(c) Write a recursive function to find the total number of nodes in a Binary Search Tree.



18 JUN 2024

[This question paper contains 12 printed pages.]

Your Roll No.



Sr. No. of Question Paper : 1565

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

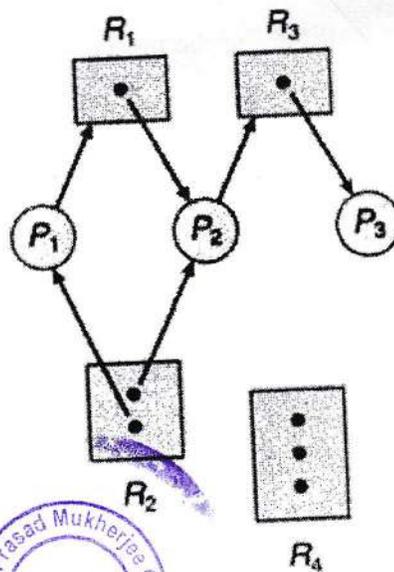
1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. 1 (Section-A) is compulsory.
3. Attempt any **four** questions from **Section-B**.
4. Parts of a question should be attempted together.

(Section A)

1. (a) Briefly explain how an operating system provide efficiency to the system and convenience to the end user. (2)

P.T.O.

- (b) A bit, called the _____ bit, is added to the hardware of the computer to indicate the current mode: _____ (0) or _____ (1). (2)
- (c) For a given set of I/O requests, argue that C-LOOK algorithm will perform more efficiently than LOOK algorithm. (2)
- (d) List any two forms of user interface for an operating system? (2)
- (e) Consider the following resource allocation graph



1565

3

Identify the following :



- (i) Processes
 - (ii) Resources
 - (ii) Assignment and Request edges (3)
- (f) Give any three differences between paging and segmentation schemes of memory management. (3)
- (g) Consider following statements executing processes P1 and P2:
- P1 : counter++
- P2 : counter--
- (Assume that Initial value of counter=10.)
- Discuss the problem that can occur due to race condition in concurrent execution of these processes? (3)

P.T.O.

- (h) What is the Belady's anomaly in context of FIFO page replacement algorithm? (3)
- (i) Consider a file "fl.txt" in Unix system with permission bits 072 (in 3 octal system). For this file, find the access permissions allowed for owner, group and others. (3)
- (j) What will be the output of the given code segment? Briefly give reasons for your answer. (3)

```
int q = fork();  
  
if (q == 0)  
  
    cout<< "\n Inside the child";  
  
else  
  
    {  
  
        wait (NULL);  
  
        cout<< "\n Inside the parent";
```



(k) Differentiate between the following : (2+2)

(i) Data Parallelism and Task Parallelism

(ii) Turnaround Time and Waiting Time

(Section B)

2. (a) Under what condition will a child process become an orphan process? What is the role of init() process in the life cycle of an orphan process?

(2+2)

(b) Give any two reasons due to which a parent process may terminate the execution of one of its child processes? Explain the phenomenon of cascading termination with respect to parent and child processes. Under what condition(s) will a terminated child process be known as a zombie process.

(2+2+1)



P.T.O.

(c) Consider the following page reference string

3 0 1 7 5 7 6 4 7 2 2 7 0

Assume that three frames are available. All frames are initially empty. How many page faults would occur for the following algorithms? Show the steps.

(i) FCFS page replacement algorithm

(ii) Optimal page replacement algorithm

(3+3)

3. (a) Mention any one limitation each of Monolithic and Microkernel approaches of Operating System design? How can the modular approach overcome each of these limitations? (2+2)

(b) Consider the following segment table :



<u>Segment</u>	<u>Base</u>	<u>Length</u>
0	250	100
1	350	40
2	1345	350
3	1673	600

What are the physical addresses corresponding to the following logical addresses?

(i) 0, 120

(ii) 1, 25

(iii) 2, 140

(iv) 3, 329

(4)

- (c) Suppose there is a system with 128KB of memory with no memory initially allocated. Given the following sequence of requests by the processes, show the memory layout at intermediate stages that is, after allocation/deallocation of memory for each process. Assume that the system uses a best-fit allocation algorithm. (7)



P.T.O.

Process Number	Nature of Request	Amount of memory requested (in KB)
P0	Allocation	20
P1	Allocation	30
P2	Allocation	22
P0	Deallocation	
P1	Deallocation	
P3	Allocation	50
P4	Allocation	20

4. (a) For a given queue of I/O requests 98, 183, 37, 122, 14, 124, 65, 67 find total number of head movements using

(i) SCAN algorithm

(ii) C-SCAN algorithm

Assume that the head starts at 57 and starts moving towards left end. (6)



- (b) Under what conditions the SCAN and C-SCAN algorithms perform better than other disk scheduling algorithms. (3)
- (c) Mention any three challenges that may be faced by a software developer in a multicore system. (3)
- (d) In a file system, path names for a file can be of two types: absolute and relative. Differentiate giving an appropriate example. (3)
5. (a) Consider a 40-bit logical address. Find the number of bits required to represent the page number and page offset fields. It is given that the page size is 4 KB. (4)
- (b) Modern operating systems are interrupt driven. Briefly explain how interrupts are signalled by the operating system. (2)



P.T.O.

(c) Identify any two advantages of a multiprogramming system over a single programming system?

(2)

(d) What is external fragmentation? Does contiguous memory organization scheme suffer from external fragmentation? Give arguments to support your answer. (3+4)

6. (a) Consider the following set of processes, with the length of CPU burst time given in milliseconds:

Process	Arrival Time	Burst Time	Priority
P1	0	3	2
P2	2	5	1 (Highest)
P3	3	3	3
P4	5	1	4

(i) Draw Gantt chart for Shortest Job First algorithm and calculate turnaround time for every process.



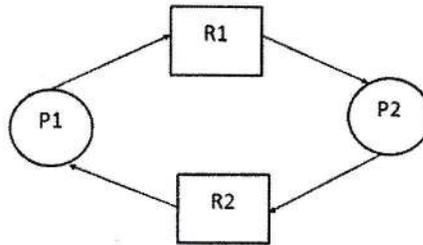
- (ii) Draw Gantt chart for Priority based (preemptive) algorithm and calculate waiting time for every process. (4+4)
- (b) Consider a demand paging system with the page table stored in memory. What should be the maximum page fault rate to achieve an effective access time of 200 nanoseconds if the time taken for a memory reference is 100 nanoseconds. Assume that a page fault is serviced in 10 ms. (2+3)
- (c) Which scheduler controls the degree of multiprogramming? How? (2)
7. (a) What are the four necessary conditions for deadlock to occur? For the following resource allocation graph, find if the system is in a deadlock state. Justify your answer. (4+4)



P.T.O.

1565

12



(b) Consider two processes p1 and p2. Write the structure of process p1 to solve the critical section problem using Peterson's solution? Justify that progress requirement is satisfied in this solution.

(4+3)



(1000)

18 JUN 2024

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1673

G

Unique Paper Code : 2343012002

Name of the Paper : Data Analysis and Visualization

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. **Section A** is compulsory.
3. Attempt any **four** questions from **Section B**.
4. Parts of a question must be answered together.

Section A

Assume that the following libraries have already been imported :

```
import numpy as np
```

```
import pandas as pd
```



P.T.O.

1. (a) Given rainfall = [5, 2, 7, 8, 2] captured for 5 days of a month, days = [1, 3, 5, 7, 9]. Write code in Python to plot a line with days and rainfall as x and y axis respectively. Mark each point with a red circle of size 20. Add a title to the graph. (Make use of appropriate libraries.) (5)
- (b) Consider the following dataframe, company, having details of employees of an organization : (5)

	Name	Age
0	Sangeeta	18
1	Sarika	30
2	Sangeeta	45
3	Babita	50
4	Sarika	32

Using appropriate libraries, write Python statements to do the following and also show the output :

- (i) Display the total number of distinct names of the employees.
- (ii) Compute the average age of the employees with the same name.
- (c) Consider the following tables named section1 and section2, each having details viz. RollNo and Name of students in each class : (5)



RollNo	Name
1	Abhav
2	Vihaan
3	Chitra
4	Devansh

section1

RollNo	Name
1	Roni
5	Kabeer
3	Ishani
2	Vihaan

section2

Write Python statements to do the following :

- (i) Create a dataframe named section1 for the table section 1.
 - (ii) Display details of all students of section 2 along with details of students of section 1 with the same Name.
 - (iii) Display details of students with the same Name and RollNo in both sections.
- (d) Find the output that will be produced on the execution of the following code snippet: (5)

```
a1 = np.zeros((2, 3))
print(a1)
a2 = [[3, 4, 5], [7, 8, 9]]
print(np.add(a1, a2))
a1 = np.append(a1, a2, axis = 0)
print(a1)
print('Shape of array:', a1.shape)
```



P.T.O.

(e) Consider a NumPy array, empSalary, containing salary of 10 employees. Write Python statements to do the following : (5)

(i) Find total number of employees earning salary > 5000.

(ii) Create a new array, incentive, to store incentives given to each employee where incentive is 10% of the salary.

(f) Find the output that will be produced on the execution of the following code snippet : (5)

```
data = pd.DataFrame([[2, 4, 6], [np.NaN, 8, 10],  
                    [np.NaN, 12, np.NaN], [np.NaN, np.NaN, np.NaN]])  
print(data)  
print(data.dropna(thresh = 2))  
print(data.fillna(method = 'ffill', limit = 2))
```

Section B



Assume that the following libraries have already been imported

```
import numpy as np
```

```
import pandas as pd
```

2. (a) Consider the following dataframe, df : (6)

```
df = pd.DataFrame(np.arange(12).reshape(4, 3),
                  index = [['North', 'North', 'South', 'South'],
                           [1, 2, 1, 2]],
                  columns = [['Delhi', 'Delhi', 'Chandigarh'],
                             ['Green', 'Red', 'Green']])
```

Find the output that will be produced on the execution of the following code snippet :

(i) `print(df)`

(ii) `df.index.names = ['key1', 'key2']`
`print(df)`
`df1=df.swaplevel('key1', 'key2')`
`print(df1)`

(iii) `df 2=df1.sort_index (level=0)`
`print(df2)`



(b) Construct a NumPy array, `markSheet`, to store marks obtained by 2 students in 3 subjects, where marks are between 60 and 100. Write Python statements to display the data type, shape and dimension of `markSheet`. (5)

(c) Consider the following dataframe, `itemRate` : (4)

	Item	Rate
0	Apples	220
1	Oranges	90

P.T.O.

Write Python statements to do the following :

- (i) Double the value of the column Rate of each item.
 - (ii) Display the type of item with minimum rate.
3. (a) Consider the following dataframe, df Student, consisting of student details : (8)

	Name	Hours_studied	Marks_obtained
0	Mohan	2.5	40
1	Sohan	4.0	52
2	Rajeev	6.0	64
3	Jeevan	8.0	70
4	Gita	10.0	90
5	Meenu	1.0	10
6	Gopal	5.0	60

Write Python code to answer the following. (Make use of appropriate libraries.) :

- (i) Find names of students who got maximum marks.

- (ii) Find the average number of hours studied by the students.

- (iii) Compute the correlation and covariance



	person	sales	quarter	country
0	A	1000	1	US
1	B	300	1	Japan
2	C	400	1	Brazil
3	D	500	1	UK
4	E	800	1	US
5	A	1000	2	Brazil
6	B	500	2	Japan
7	C	700	2	Brazil
8	D	50	2	US

Write Python statements to do the following :

- (i) Find the maximum and minimum sales for Brazil.
- (ii) Display total sales for each country.
- (iii) Display the name of the salesperson with maximum average sales.
- (iv) Display statistical summary of the numerical attributes only.
- (v) Draw a boxplot of the sales.

5. (a) Find the output that will be produced on the execution of the following code snippet: (5)



```
c1 = np.arange(0, 24, 2)
c2 = c1.reshape((2, 6))
print(c1, c2, sep = '\n')
print(c2.reshape((3,4)))
arr2[:3, 3:] = 0
print(c2)
print(c1 * 2)
```

- (b) Assume that the data given below is saved in an excel file 'data.xlsx' (with 4 columns Employee_id, Department, Salary and Age) : (10)

Employee_id	Department	Salary	Age
101	Computer Science	2000	23
102	Computer Science	2002	34
103	Computer Science	2040	39
104	English	2045	43
105	English	2030	34
106	English	2006	53

Write Python statements to do the following (Make use of appropriate libraries.) :

- (i) Read data from the given excel file 'data.xlsx' into a dataframe, df1. Set Employee_id as the index of the df1.



P.T.O.

(ii) Create a figure and add two subplots in it. In the first subplot, create a scatter plot between Salary and Age. Give labels to the x-axis as Salary and the y-axis as Age. Also, give a title to this plot. Discretize Salary into 3 equal bins. In the second subplot, draw a figure to visualize the count of the number of employees in each of these bins.

(iii) Save the plotted figure to a file named 'Employees.png'.

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

```
(i) s1 = pd.Series([5, 0, -4, 8])           (2)
    print(s1)
    print(s1.rank())
```

```
(ii) data1 = pd.DataFrame({              (3)
    'One': ['a', 'b'] * 2 + ['b'],
    'Two': [21, 22, 21, 23, 24]})
    print(data1)
    data2 = data1.drop_duplicates(['One', 'Two'],
    keep='last')
    print(data1)
    print(data2)
```



```
(iii) df1 = pd.DataFrame({'A': [21, 32],           (5)
                          'B': [27, 30]})
df2 = pd.DataFrame({'A': [23, 41]})
print(df1)
print(df2)
df2['A'][1] = df1['A'][1] + 10
print(df2)
print(df2 > df1['B'].min())
```

(b) Consider an array, ages, consisting of age of 12 people [20, 22, 25, 27, 21, 23, 37, 31, 61, 45, 41, 32].

Using appropriate libraries, write code to :

(i) Create four bins of the array ages, using right side closed intervals (18–25], (25–35], (35–60], (60–100]. Name the categories as 'Youth', 'YoungAdult', 'MiddleAged' and 'Senior' respectively. Display the number of values in each category.

(ii) Create four equal-sized categories of the array ages. (5)

7. Given the following CSV file 'employee.csv' consisting of details of employees :



Gender	Role	Experience	Salary
Male	Data Analyst	1	48000
Male	Data Analyst	1	42000
Male	Data Analyst	3	51000
Male	Data Scientist	5	62000
Female	Data Scientist	6	71000
Female	Data Scientist	8	73000
Male	Manager	10	82000
Female	Manager	11	87000
Female	Manager	12	91000

Write Python statement(s) to do the following. (Make use of appropriate libraries.) :

- (a) Read data from the given CSV file 'employee.csv' into a dataframe empData.
- (b) Calculate and display the total salary for each role.
- (c) Display the total number of females along with their average salary.
- (d) Compare the highest and lowest salary for each gender using bar plot.
- (e) Delete records with salary less than the average salary of all employees. (15)



(500)

18 JUN 2024

3

28 M

[This question paper contains 8 printed pages.]

Your Roll No.

Sr. No. of Question Paper : 4343

Unique Paper Code : 32341301

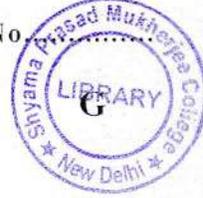
Name of the Paper : Data Structures

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

Semester : III

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. Question No. 1 of 35 marks is compulsory.
3. Attempt any **Four** questions from Q. No. 2 to Q. No. 7.

1. (a) An application requires frequent insertions and deletions to store and maintain its data items. Which data structure is appropriate: a linked list or an array? Justify the answer.

(1000)

P.T.O.

(ii) Can the efficiency of these operations be improved using any alternate implementation strategy using a singly Linked List? Justify your answer by comparing running times.

(d) Create a Multiway Search Tree of order two and show all the steps involved :

50, 35, 40, 24, 65, 56

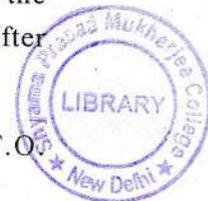
Write a function to find the inorder successor of the root node of the above tree. (5)

(e) Consider a scenario where every node of a doubly linked list stores a character with given head and tail pointers. Write a function that visits each node of the list exactly once to check whether the contents of the doubly linked list form a palindrome or not. The function should also report the number of characters in the list without using any further traversal.

A palindrome is a string that reads the same backward as forwards. For example, 'madam' and 'ABBA' are palindromes. (5)

(f) Consider a circular 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 :

P.T.O.



Enqueue(4), dequeue(), dequeue(), enqueue(5),
enqueue(6), enqueue(8), enqueue(10), enqueue(9),
dequeue (), enqueue(11)

If the above queue was linear, show the final
contents of the queue after performing all the
above operations. (5)

- (g) A lottery game generates 10-digit ticket numbers.
These tickets are to be stored in a square matrix
(5X5) based on the ticket number. The summation
of the first five digits of a ticket number (modulo
the number of rows in the square matrix) is used
to identify the row number and the summation
of the last five digits of the ticket number (modulo
the number of columns in the square matrix)
is used to identify the column number of the square
matrix to store that ticket. Two tickets may have
the same location in the square matrix, in which
case, the location becomes a bucket that can hold
multiple tickets. Demonstrate the working of
the above game on the following ticket numbers:

1234567890, 0123456789, 0234516789, 0134526789,
0124536789, 0123546789, 0123465789, 9012345



4343

5



2. (a) Consider a scenario where the students are submitting their answer scripts one by one to a teacher. The teacher is maintaining the collected answer sheets in order always. Suggest the algorithm that can be used by the teacher. Use this algorithm to arrange the following 5 answer scripts that are numbered as follows and show all the steps :

23, 14, 56, 2, 10

Compute the number of comparisons that the teacher must have performed. (5)

- (b) Find the preorder traversal of a Binary Search Tree (BST) if its postorder traversal is given below. Show all the steps performed.

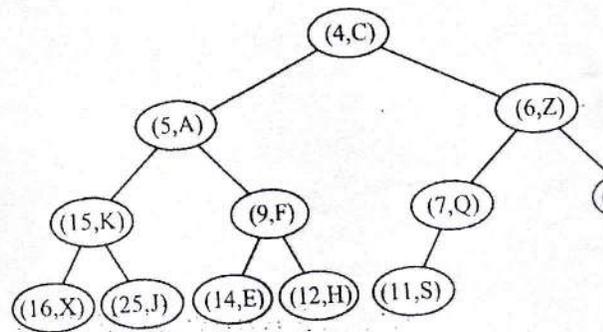
2 20 17 25 15 48 45 50 40 (5)

3. (a) An upper triangular integer matrix A with $n \times n$ dimension is to be stored as a one-dimensional array B in column-major order. If the base address of the array B is 200 and each integer takes 4 bytes of memory, find the address of $A[1][2]$. Also, give the formula to map the $A[i][j]$ element of array A into array B . Assume that the indexing for array A starts with 1 and that of B from 0. (6)

P.T.O.

(b) Assuming a class is already defined for a singly linked list, write a member function to display the middle node of the list by traversing the list exactly once.

4. (a) For the given Priority Queue implemented as a Heap, illustrate the following operations one by one:



(i) insert new element (3, T)

(ii) removeMin()

(b) Insert the given keys one by one in a binary search tree of order 5 such that the search is always logarithmic. Show all the steps in the insertion. Thereafter, delete the key 16 and show the resulting tree.

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



4343

7

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the
ctly
(4)

5. (a) Give a class definition for an ordered singly linked list. Write a member function to insert a node in this linked list such that the list remains in order. (6)

sing
after
(6)

- (b) Write a recursive function to find the maximum key value in a Binary Search Tree. (4)

6. (a) Consider an array with the following elements:

102, 280, 405, 513, 632, 746, 910, 958, 1000

Which searching technique (linear/binary) is better suited and why? Will this technique be appropriate if the given data is stored using a linked list? Why/Why not? (5)

20.B)

- (b) Discuss the minimum and maximum height of a Binary Search Tree having n nodes. State the advantage of using a height-balanced tree like an AVL Tree over a Binary Search Tree. (5)

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7. Consider an electronic calculating device named FastCal. On receiving a mathematical expression, A, as input, FastCal converts that expression into a parenthesis-free notation and evaluates it using some suitable data structures. Answer the following : (4)

P.T.O.

4343

8

- (i) Which data structures FastCal must use for the conversion and evaluation of the expression?
- (ii) Give the complete algorithm for the above mentioned functioning of FastCal. (1)



18 JUN 2024

11505

[This question paper contains 8 printed pages.]

Your Roll No.

Sr. No. of Question Paper : 4397

Unique Paper Code : 32341302

Name of the Paper : Operating Systems

Name of the Course : B.Sc. (H) CS

Semester : III

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** is compulsory.
3. Attempt any 4 questions from **Section B**.
4. Parts of a question must be answered together.

SECTION A

1. (a) Which of the CPU scheduler affects the degree of multiprogramming? (1)

P.T.O.

18 JUN 2024

27/12 M

[This question paper contains 8 printed pages.]

Your Roll No.....



Sr. No. of Question Paper : 4325

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. **Section A** is compulsory.
3. Attempt any **FOUR** questions from **Section B**.

SECTION A

1. (a) Describe port address translation in Network Address Translation with the help of an example.
(2)

P.T.O.



(b) Explain stub network with the help of an example. Give a situation where stub networks are beneficial. (2+1)

(c) What is the output of the following code: (3)

```
var regularFunc = function (arg) {  
  arg = arg || "Hello";  
  return arg.toUpperCase();  
}  
document.write(regularFunc('Hello World'));  
document.write(regularFunc());
```

(d) What is the output of the following code: (5)

```
<html>  
<head>  
<script>  
$(document).ready(function() {  
  $("button").click(function() {  
    $("h1").before('<h1>This is new heading</h1>');  
  });  
  $("button").click(function() {  
    var $newItem=$("<p>New paragraph added</p>");  
    $("h1").after($newItem);  
  });  
});  
</script>
```



```
</head>
<body>
<h1>This is a heading</h1>
<p>This is a paragraph.</p>
<button>Click Me</button>
</body>
</html>
```

- (e) Write JQuery and HTML code to create a form accepting car name, car model and car manufacture year from the user. When the user clicks on Submit button, the data from the form is sent to Register.php. (5)
- (f) Write HTML and Javascript code to create a form that accepts two numbers, num1 and num2. The form also has two buttons, Sum and Maximum. On clicking buttons, Sum should display the sum of num1 and num2, and Maximum should display the maximum of the two numbers, respectively. (5)
- (g) Explain the following : (2×6)
- (i) ping
 - (ii) netstat
 - (iii) Cookies

4325

5

3. Consider you are using the subnet mask of 255.255.255.240 to subnet your class C network with IP address as 192.168.1.0.

Write the following :

- (i) Number of subnets
- (ii) Number of hosts per subnet
- (iii) Network address and broadcast address of first three networks
- (iv) First usable IP address and last usable IP address of first three networks (2+2+3+3)

4. (a) Create an HTML file, order.html, to accept choices from the user : (2+1+3+1)

Username: [Textbox]

Order details:

Starters: French fries or Kebabs [List with respective prices]

Beverages: Cola or Juice [List with respective prices]

Main: Burger or Pizza [List with respective prices]

ORDER NOW [Button]



P.T.O.



- (iv) VOIP
- (v) Proxy server
- (vi) Search engine

SECTION B

2. (a) What is the importance of Network Address Translation? Consider the following scenario :

Host A ----- 10.1.1.1—NAT Router—192.168.1.1 ----- Host B
10.1.1.10 192.168.1.5

Give the following addresses for the above scenario :

- (i) Inside local
 - (ii) Inside global
 - (iii) Outside local
 - (iv) Outside global (4)
- (b) Differentiate between static and dynamic routing.
Explain the following with the help of an example :
- (i) Default static route
 - (ii) Floating static route (2+4)

4325

5

3. Consider you are using the subnet mask of 255.255.255.240 to subnet your class C network with IP address as 192.168.1.0.

Write the following :

- (i) Number of subnets
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- (iii) Network address and broadcast address of first three networks
- (iv) First usable IP address and last usable IP address of first three networks (2+2+3+3)

4. (a) Create an HTML file, order.html, to accept choices from the user : (2+1+3+1)

Username: [Textbox]

Order details:

Starters: French fries or Kebabs [List with respective prices]

Beverages: Cola or Juice [List with respective prices]

Main: Burger or Pizza [List with respective prices]

ORDER NOW [Button]

P.T.O.



Your order details are: [div element]

Create Javascript file, getVal.js, to perform the following :



- (i) Access the value of user entered data and the div element.
 - (ii) Using function calc_order, calculate the order value based on the user input.
 - (iii) Invoke the function calcorder when the user clicks on ORDER NOW button and the order details are displayed on the div element.
- (b) Explain Immediately Invoked Function Expression with the help of an example. (3)
5. (a) Design the following form using HTML : (2+4)

Candidate Name: [Textbox]

Candidate Qualification: Undergraduate with id "one"
Postgraduate with id "two" [Unordered list]

Click to view. [Button]

Div element with id "tag"

Using `.each()` function in JQuery, get access to all the list elements of the unordered list "Candidate Qualification". Insert a new entry to the end of this list with the ids of each list element, that is, the last two entries should be "one" and "two", respectively.

- (b) What is the difference between `getElementById()` and `getElementByName()` functions? Give an example of each. (2+2)
6. (a) Illustrate the importance of `serialize()` function in AJAX with the help of any example. (5)
- (b) What are the benefits of using BOOTSTRAP in web development? Describe BOOTSTRAP Grid system. (2+3)
7. (a) Explain each line of the following Node .js code: (5)

```
const express = require('express')
const app = express()
app.get('/', (req, res) => {
  res.send('Hi!')
})
```



P.T.O.

```
const server = app.listen(3000, () => console.log  
( 'Server ready'))  
  
process.on('SIGTERM', () => {  
  server.close() => {  
    console.log('Process terminated')  
  }  
})  
})
```

(b) What is the use of following methods in AJAX?

- (i) \$.get()
- (ii) \$.post()
- (iii) \$.getJSON()
- (iv) \$.getScript()
- (v) \$.ajax() (5)



18 JUN 2024

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4511

Unique Paper Code : 32341303

Name of the Paper : Computer Networks

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

Semester : III

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** is compulsory and carries 35 marks.
3. Attempt **any 4** Questions from Section B.

Section A

1. (a) What is telecommunication? Assume six devices are arranged in a mesh topology. How many cables are needed? How many ports are needed for each device?

(1+2)

P.T.O.



(b) What is QPSK? Give a constellation diagram for 4-QAM. (1+1)

(c) Give any two services provided by the following layers :

(1) Physical Layer

(2) Application Layer (4)

(d) Given a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with two signal levels, calculate the maximum bit rate. (2)

(e) Consider a synchronous TDM system with n input lines. Given that the duration of input frame is T , explain the working of this system with a diagram. (2+1)

(f) Draw the digital waveforms to represent the following encoding schemes for the data 10101011. Assume that the last signal level is positive.



'4511'

3



- (1) NRZ-I
- (2) Manchester Encoding (4)
- (g) Explain the principle behind the working of optical fiber cable? (2)
- (h) What is Flow Control? (1)
- (i) Differentiate between packet switching and circuit switching. Give one application of each. (2+1)
- (j) Briefly describe piggybacking? What happens if the receiver wants to acknowledge a frame without any data to be sent to the original sender? (1+1)
- (k) What is the result of applying zero compression on the following IPv6 address FE80:0000:0000:0000:0000:BC21:0000:FFFF (1)
- (l) Distance vector routing suffers from "count to infinity problem". Briefly discuss the count to infinity problem with an example. (2)

P.T.O.

- (m) Enumerate the three parts of a Uniform Resource Locator? Give a suitable example. (3)
- (n) What is the purpose of MF and DF flag bits with respect to IP header? (2)
- (o) What is the significance of using guard bands? (1)



Section B

2. (a) A bit string, 11101111011111011111101 is to be transmitted at Data Link Layer, what is the string actually transmitted after bit stuffing? (2)
- (b) What is subnetting? A router in an organization receives a packet with the destination address 190.240.34.95. If the subnet mask is / 19. Find the subnet address. (3)
- (c) Give any three differences between virtual circuit and datagram subnet. (3)

(d) State the optimality principle. (2)

3. (a) Differentiate between:

(i) Microwave and Infrared (3)

(ii) FSK and PSK (2)

(iii) Gateway and Router (2)

(b) What are the three address categories to which an IPv6 address may belong? Explain each of them briefly. (3)

4. (a) Generate even parity Hamming Code for data bits 1100100. Show the steps. (3)

(b) Differentiate between Static and Dynamic Routing Algorithms with the help of an example. (3)

(c) Explain the working of the Selective Repeat Protocol with the help of a flow diagram for the following scenarios.

P.T.O.



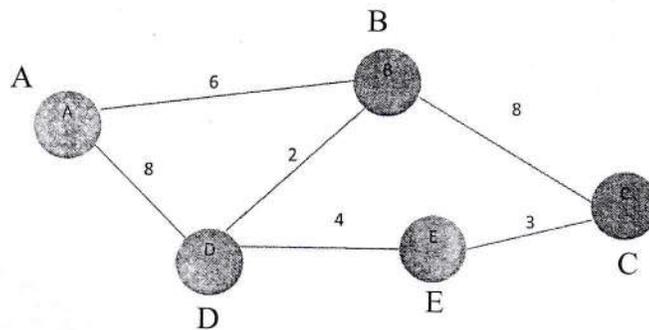
4511

6

- (i) Successful communication
- (ii) Lost acknowledgment (2+2)
5. (a) Describe the User Datagram Protocol header with the help of a diagram. (5)
- (b) Briefly describe the one persistent, non-persistent and p-persistent CSMA protocols. (3)
- (c) Name the protocols associated with the following port numbers:
- (i) 80
- (ii) 23 (2)
6. (a) Differentiate between Bit Rate and Baud Rate with a suitable example. (2)
- (b) What is the significance of ARP and RARP protocols? (2)



- (c) In reference to digital signals, baseline wandering makes it difficult for the receiver to decode the signal correctly. Justify. (2)
- (d) A given network was built with the routers in the network represented as nodes A, B, C, D and E. The edges in the graph represent the communication link between the routers. Each edge is labelled by the cost of traversing the link. Using Dijkstra's shortest path algorithm, find shortest path from A to C.



(4)



P.T.O.

7. (a) Explain the process of connection establishment and connection release process used for Transmission Control Protocol. (3+2)
- (b) To detect a d-bit error you need a distance d+1 code. Justify the statement. (3)
- (c) What is the use of options field in the Internet Protocol Header? Explain with the help of an example (2)



18 JUN 2024

2542

B

3

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4379

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. Question No. 1 is compulsory.
3. Attempt any **four** of Question nos. 2 to 7.
4. Parts of a Question must be answered together.
5. Consider $\Sigma = \{a, b\}$ for all the questions unless specified otherwise.

P.T.O.

1. (a) Let $S = \{ab, bb\}$ and $T = \{ab, bb, bbbb\}$.

• Is $S^* \subset T^*$?

• Is $S^* = T^*$?

Explain. (3)

(b) Write a regular expression for the language, having words with exactly one double letter in them.

(3)

(c) Show that the language $\text{PRIME} = \{a^p, \text{ where } p \text{ is a prime}\}$ is non-regular. (3)

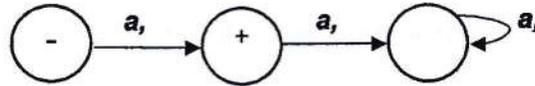
(d) Prove that the complement of a context-free language may not be context-free. (3)

(e) (i) What are recursive languages?

(ii) State the Church-Turing thesis. (3)



- (f) For the following Finite Automata that accepts the language L , draw a deterministic FA that accepts (i) L' (ii) L^* (4)



- (g) Determine whether the following CFG is ambiguous or not. Justify.

$$S \rightarrow aSX \mid \Lambda$$

$$X \rightarrow aX \mid a$$



(4)

- (h) Convert the following CFG to Chomsky Normal Form :

$$E \rightarrow E + E$$

$$E \rightarrow E * E$$

$$E \rightarrow (E)$$

$$E \rightarrow 7$$

The terminals are $+$, $*$, $($), 7 (4)

P.T.O.

- (i) Design a deterministic PDA for the following language: $a^n b^{n+1}$, $n \geq 1$ (4)
- (j) Design a deterministic finite automata that accepts a string defined over the English alphabet $\{a-z\}$ and ending with 'ied'. For instance, "died" would be accepted, but not "dead". (4)

2. Consider the following languages

L_{11} : the language of all words that do not contain a double a

L_{12} : the language of all words that do not contain a double b and end in a

- (a) Write a regular expression for each of L_{11} and L_{12} . Hence write a regular expression for

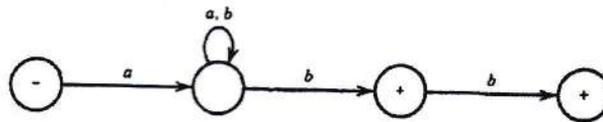
$$L_{11} \cup L_{12}. \quad (4)$$



- (b) Draw a finite automata for each of L_{11} and L_{12} .
Hence, systematically find a finite automata for
 $L_{11} \cap L_{12}$.

(6)

3. (a) Convert the following non-deterministic finite automata to deterministic finite automata : (4)



- (b) Design a Turing Machine that decides the language
 $L = \{a^n b^n c^{n+2} : n \geq 0\}$. (6)

4. (a) Find a CFG for the language $L_4 = a(bb)^*$. Also, find a CFG for L_4^* . (4)

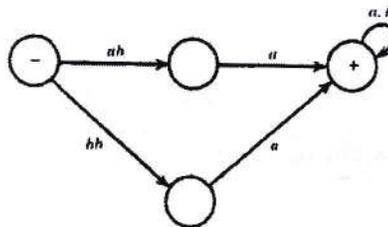
- (b) Construct a deterministic PDA for the language L given below :

$$L = \{a^m b^n \mid n \geq 1, m \geq 1, m > n+2\} \quad (6)$$

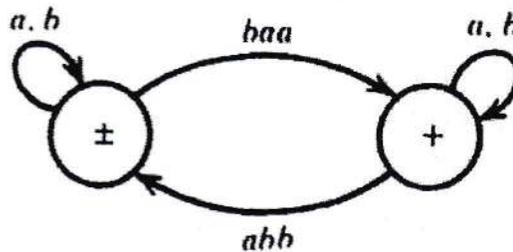


P.T.O.

5. (a) (i) Convert the following Transition graph into a regular expression : (3)



- (ii) Construct a TG for L^* if L is defined by the following TG: (3)

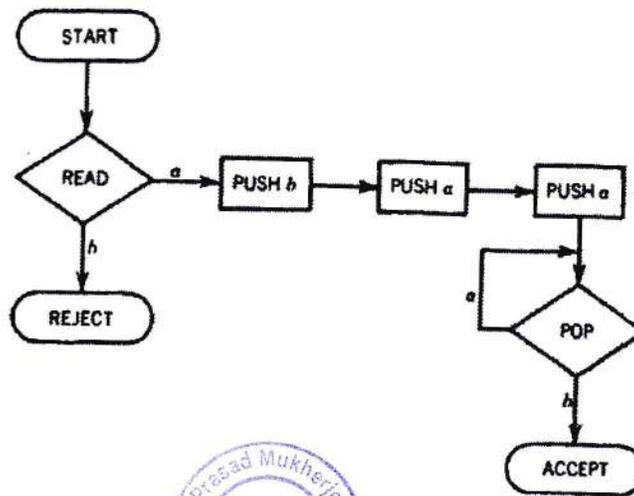


- (b) Show that the following language defined over the alphabet $\{a, b\}$ is not context free :

$$a^n b^n a^n b^n \quad (4)$$



6. (a) Build a finite automata that accepts the language of words having a double letter in them. (4)
- (b) Prove that recursively enumerable languages are not closed under complementation. (4)
- (c) What would be the length of the shortest string in the language mentioned in part (a) above? List the shortest strings. (2)
7. (a) Describe the language accepted by the following PDA and give its regular expression. (4)



P.T.O.

4379

8

(b) Consider the following CFG :

$S \rightarrow aAS$, $S \rightarrow a$, $A \rightarrow SbA$, $A \rightarrow SS$, $A \rightarrow ba$

For the input string 'aabbaa', find

(i) leftmost derivation

(ii) parse tree (6)



(1000)

18 JUN 2024

[This question paper contains 16 printed pages.]

Your Roll No.

Sr. No. of Question Paper : 4432

Unique Paper Code : 32347507

Name of the Paper : Data Analysis and
Visualization

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

Semester : V

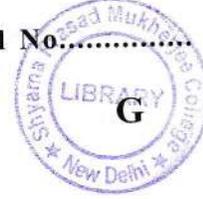
Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

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

P.T.O.



1. (a) Provide code to create a time-series with two index labels- 2011/9/01 and 2011/9/02. Assign random values. (2)

(b) What will be the output of the following codes?

(i) (2)

```
import numpy as np
arr = np.array([[1,2,3,4,5],[6,7,8,9,10]])
print(arr[1,-1], arr[-1:])
```

(ii) (2)

```
List = [str[::-1] for str in ('happy','go','lucky')]
print(List)
```

(c) Reshape the following array to dimension (2,6)

[[3,4,5,6], [7,8,9,10], [11,12,13,14]] (2)

(d) Python is a strongly “typed” language. Comment. (2)



- (e) Give the output of the following code and identify the role of *is_unique* attribute in the code. (2)

```
import pandas as pd
series = pd.Series([4,5,1,2,3,3,4,5,6])
print(series)
print("Is Unique: ",series.is_unique)
```

- (f) Differentiate between mutable and immutable objects. (2)

- (g) Write a program to create the given dataframe. (3)

	id	value
0	1	a
1	1	a
2	2	b
3	3	None
4	3	a
5	4	a
6	4	None
7	4	b



Further, split it into groups and count unique values of 'value' column.

(h) Provide the output of the following code : (3)

```
from datetime import datetime, date, time
dt = datetime(2011, 10, 29, 20, 30, 21)
dt2 = datetime(2011, 11, 15, 22, 30)
delta = dt2 - dt
```

```
print(delta)
print(type(delta))
print(dt.replace(minute=0, second=0))
```

(i) Consider the given dataframe *df* containing data of students admitted in the college. (3)

Id	Name	Age	Section	City	Gender	Marks
S0	Anit	10	A	Gurgaon	M	60
S1	Alka	22	B	Delhi	F	80
S2	Sid	13	C	Mumbai	M	60
S3	Ruhi	21	B	Delhi	F	55
S4	Nehu	12	B	Mumbai	F	60
S5	Geet	11	A	Delhi	F	56
S6	Om	17	A	Mumbai	M	45



Set the first column 'Id' as the row index of the given dataframe *df*. Create a pivot table of *df* to display the total number of admissions as per 'Section' and 'Gender'.

(j) (i) Provide the output of the following code :

(4)

```
df = pd.DataFrame({
    'a':np.arange(1,7),
    'b':np.arange(7,13),
    'c':np.arange(12,18),
    'd':np.arange(17,23),
    'e':np.arange(23,29),
    'f':np.arange(29,35)},
    columns=['a', 'b', 'c', 'd', 'e', 'f'],
    index=['Svaksh', 'Sarah', 'Svaraj', 'Rivika',
    'Rahul', 'Geet'])
print(df)
df.iloc[2:4, [1,2]]=np.NaN
print(df)

mapping = {'a': 'red', 'b': 'red', 'c': 'blue', 'd':
'blue', 'e': 'red', 'f': 'orange'}
```



(ii) Using the above dataframe, group *df* by mapping and find the sum.

P.T.O.

(k) Consider the following dataset to perform the following operations : (4)

	Age	Section	City	Gender	Favourite_color
0	10	A	Gurgaon	M	red
1	22	B	Delhi	F	NaN
2	13	C	Mumbai	F	yellow
3	21	B	Delhi	M	NaN
4	12	B	Mumbai	M	black
5	11	A	Delhi	M	green
6	17	A	Mumbai	F	red

(i) Find all the rows Where Age is greater than or equal to 12 and the Gender is male.

(ii) If Age is greater than 20, then use the loc function to update Section with "S" and City with Pune.

(iii) Select rows 1 to 2 with columns 2 to 3



using iloc.

(L) What is the output of the following code : (4)

```
import pandas as pd
fruits=['apple', 'orange', 'apple', 'apple']*2
N=len(fruits)

print(N)
df=pd.DataFrame({'fruit':fruits, 'basket_ID':
np.arange(N), 'count' :
np.random.randint(3,15, size=N), 'weight':
np.random.uniform(0,4, size=N)})
print(df)
Fruit_cat=df['fruit'].astype('category')
print(Fruit_cat)
print(df.dtypes)
```

2. (a) Differentiate between :

(i) qcut and cut methods

(ii) Pandas.merge and pandas.concat (2)



P.T.O.

- (b) Consider the following numeric grades (out of 4).
Formulate bins for the given grades as per the
following condition : (3)

Below 2.5	Very bad
Between 2.5 to 3	Bad
Between 3 to 3.25	Average
Between 3.25 to 3.5	Good
Between 3.5 to 3.75	Very good
Between 3.75 to 4	Excellent

- (c) Given the following dataframe, provide the output
for the following commands : (5)

	<u>ord no</u>	<u>purch amt</u>	<u>ord date</u>	<u>customer_id</u>
0	NaN	NaN	NaN	NaN
1	NaN	270.65	2012-09-10	3001.0
2	70002.0	65.26	NaN	3001.0
3	NaN	NaN	NaN	NaN
4	NaN	948.50	2012-09-10	3002.0
5	70005.0	2400.60	2012-07-27	3001.0
6	NaN	5760.00	2012-09-10	3001.0
7	70010.0	1983.43	2012-10-10	3004.0
8	70003.0	2480.40	2012-10-10	3003.0
9	70012.0	250.45	2012-06-27	3002.0
10	NaN	75.29	2012-08-17	3001.0
11	NaN	NaN	NaN	NaN



4. (a) Consider following dataframe.

ord_no	purch_amt	ord_date	customer_id	salesman_id
70009.0	890.00	2012-09-11	3004.0	5001
70002.0	270.65	2012-09-10	3001.0	5006
70007.0	65.26	2012-09-11	3001.0	5005
70008.0	78.00	2012-09-10	3002.0	5003
70006.0	948.50	2012-09-17	3002.0	5002
70005.0	2400.60	2012-07-27	3001.0	5001
70004.0	5760.00	2012-09-10	3001.0	5003
70010.0	1983.43	2012-10-10	3004.0	5006
70003.0	2480.40	2012-10-10	3003.0	5005
70012.0	250.45	2012-06-27	3002.0	5002
70034.0	75.29	2012-08-17	3001.0	5004
70022.0	56.90	2012-06-27	3003.0	5005

With respect to the above dataframe, write the code for the following :

- (i) Group the data on the column *ord_date* and calculate the total purchase amount *purch_amt* year wise and month wise.

(2)



- (ii) Group the data on the column *customer_Id* and create a list of order date *ord_date* for each group. (2)
- (iii) Group on the columns *customer_id*, *salesman_id* and then sort sum of *purch_amt* within the groups. (2)
- (b) (i) Write a generator function to print Fibonacci numbers. (4)
- (ii) What is the output of the following code :

```
def simpleGeneratorFunc():  
    yield 1  
    yield 2  
x = simpleGeneratorFunc()  
  
print(next(x))  
print(next(x))
```



P.T.O.

5. (a) Give output of the following code. Justify your answer. (2)

```
var=(1, 2, (3,4))
var[1]='geet'
print(var)
```

- (b) Write the code to merge the two given datasets using key1, key2. (4)

data1:

	key1	key2	P	Q
0	K0	K0	P0	Q0
1	K0	K1	P1	Q1
2	K1	K0	P2	Q2
3	K2	K1	P3	Q3

data2:

	key1	key2	R	S
0	K0	K0	R0	S0
1	K1	K0	R1	S1
2	K1	K0	R2	S2
3	K2	K0	R3	S3



- (c) Write the code to split the given dataset into groups based on *customer_id* and create a list of order date *ord_date* for each group.

(4)

	<u>ord_no</u>	<u>purch_amt</u>	<u>ord_date</u>	<u>customer_id</u>
0	70009.0	890.00	2012-09-11	3004.0
1	70002.0	270.65	2012-09-10	3001.0
2	70007.0	65.26	2012-09-11	3001.0
3	70008.0	78.00	2012-09-10	3002.0
4	70006.0	948.50	2012-09-17	3002.0
5	70005.0	2400.60	2012-07-27	3001.0
6	70004.0	5760.00	2012-09-10	3001.0
7	70010.0	1983.43	2012-10-10	3004.0
8	70003.0	2480.40	2012-10-10	3003.0
9	70012.0	250.45	2012-06-27	3002.0
10	70034.0	75.29	2012-08-17	3001.0
11	70022.0	56.90	2012-06-27	3003.0

6. (a) Create a Timeseries Dataframe with date range 01-02-2022 to 30-02-2022 with 1 min frequency interval. The dataframe has two columns populated with random values.

(3)



P.T.O.



(b) Identify the need to resample Timeseries data. (2)

(c) Consider following dataset.

Datetime	value1	value2	value3
2020-01.01 00:00:00	2	92	56
2020-01.01 00:01:00	9	78	80
2020-01.01 00:02:00	69	83	43
2020-01.01 00:03:00	47	62	45
2020-01.01 00:04:00	47	90	13
...
2020-02.27 23:56:00	73	81	35
2020-02.27 23:57:00	20	66	58
2020-02.27 23:58:00	42	16	48
2020-02.27 23:59:00	32	40	19
2020-02.28 00:00:00	37	63	95
83521 rows x 3 columns			

(i) Resample for 10min with sum function for value1, mean for value2 and max for value 3. (3)

4432

16

(ii) Add title "Delhi AQI for last ten days".

(1)

(iii) Set label for x-axis "Date" and y-axis
"AQI".

(1)

(iv) Show grids in the background.

(1)

(v) Set marker as '*'.
(1)

(1)



(1000)

18 JUN 2024

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4548

Unique Paper Code : 32347504

Name of the Paper : Microprocessor

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

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. Attempt all questions from **Section-A**.
3. Attempt any **four** questions from **Section-B**.
4. Attempt all parts of a question together.

SECTION A

1. (a) Consider the segment and offset addressing scheme. Find the unknown values for each of the following physical addresses :

P.T.O.

- (i) $F000H : ABCDH = ?$
- (ii) $? : FFFFH = D0FFFH$ (2)
- (b) What are the default segment registers assigned to DI and BP registers? (2)
- (c) In 8086 microprocessor, in which memory bank odd addresses are stored? Which 8086 pin is used to enable this bank of memory? (3)
- (d) Why the demultiplexing of the buses (address and data bus) are required on 8086/8088 microprocessor? Why not leave the buses multiplexed? (3)
- (e) What is the purpose of Auxiliary carry flag bit? Name the arithmetic operations that set this flag bit. (3)
- (f) Given $DS = 1211H$, $SS=1000H$, $BX = 0140H$, $DI = 3000H$, $ARRAY = 1110H$. Determine the



data addressing mode and the effective address for each of the following instructions assuming real mode memory addressing :

(i) MOV BX, [2200H]

(ii) MOV CX, [BL+4]

(iii) MOV CX, [EBX+2*EDI]

(iv) MOV DX, [BP-100H] (4)

(g) Explain the four types of Bit Test instructions:

BT, BTC, BTR, and BTS. (4)

(h) Explain following string instructions, with an

example : (4)

(i) MOVSD

(ii) LODSW



P.T.O.

- (i) Develop a far procedure that copies contents of the word sized memory location CS : DATA1 into AX,BX,CX,DX and SI. (5)
- (j) Name the Type of Interrupt for the following cases : (5)
- (i) Two interrupts occur at the same time.
 - (ii) A logic 1 placed on NMI input pin of the microprocessor.
 - (iii) When an instruction mentions an invalid opcode?
 - (iv) When the overflow condition exists?
 - (v) The protected mode P bit ($P = 0$) in a descriptor indicates that the segment is not present or not valid.



SECTION B

2. (a) Draw the descriptor format of 80386 microprocessor and explain. (5)
- (b) Given the contents of sources as TEMP = 01H, BX = 0011H, EAX = 09876543H; find the content of destination register after executing each of the following commands : (5)
- (i) MOVZX EBX, TEMP
 - (ii) MOVSX CX, BL
 - (iii) BSWAP EAX
 - (iv) MOV ECX, 44H
 - (v) XCHG AX, BX
3. (a) Explain the function of the following pins of 8086 microprocessor. (4)



P.T.O.

(i) ALE

(ii) DT/\overline{R}

(iii) M/\overline{IO}

(iv) \overline{TEST}



(b) How does the CALL instruction differ from the JMP instruction? Explain the working of Far JMP instructions using an example. (6)

4. (a) Design a decoder circuit to map F0000H-FFFFFH on $8K \times 8$ memory. (4)

(b) Explain the following Data addressing mode with an example

(i) Base-plus-index addressing

(ii) Scaled-index addressing (6)

5. (a) List any four conditional jump instructions which follow the comparison of unsigned numbers. (4)
- (b) Explain operation of the 8255 programmable peripheral interface. (6)
6. (a) Draw and explain the format of Command Register of DMA Controller. (5)
- (b) Describe the initialization control words (ICW's) of Programmable Interrupt Controller 8259A. (5)
7. (a) Describe the operation of the following units of Pentium Pro microprocessors with the help of diagram :
- (i) Retire Unit
- (ii) Dispatch and Execute Unit (4)



P.T.O.

4548

8

(b) Differentiate between memory mapped and isolated
I/O of the microprocessor. (6)



(1000)