```
ax.add_patch(triangle)
ax.set_aspect('equal', 'box')
ax.set_xlim(0, 1)
ax.set_ylim(0, 1)
plt.show()
```

(b) State differences between following by giving appropriate examples : (9)

(i) Simple random sampling and Stratified sampling

(ii) rand( ), randint( ) functions in NumPy.

(iii) Deep and shallow copy in NumPy array.

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5325 **J**

Unique Paper Code : 2344001201

Name of the Paper : Data Analysis and Visualization using Python

Name of the Course : **Generic Elective (G.E.)**

Semester : II

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. Paper has **two** sections. **All** the questions in **Section A** are compulsory.
3. Answer any **four** questions from **Section B**.
4. Parts of question must be answered together.
5. Use of simple calculator is permitted.

Section A
(Compulsory)

1. (a) What is the purpose of using Matplotlib in Python? Describe briefly any three types of plots that can be created using Matplotlib. (1+3=4)

(b) What is the output of following code, give reasons : (2+2=4)

```
import pandas as pd
import numpy as np
df = pd.DataFramc({
    'key1': ['a', 'a', 'b', 'b', 'a'],
    'key2': ['one', 'two', 'one', 'two', 'one'],
    'data1': np.arange(5),
    'data2': np.random.randn(5)
})
print(df)
mean data = df['data1'].groupby([df['key1'], df['key2']]).mean()
print(mean_data)
```


(iv) Using pd.crosstab(), display a frequency table showing the count of students for each course and device combination. Add totals using margins=True.

7. (a) Find the output of the following Python code. Illustrate the shapes along with their dimensions and colour that will be displayed on the plot. (6)

```
import matplotlib.pyplot as pit
import matplotlib.patches as patches
fig, ax = plt.subplots()
rectangle = patchcs.Rectangle((0.1, 0.1), 0.3, 0.4, linewidth=2,
edgecolor = 'blue', facecolor='lightblue')
ax.add patch(rectangle)
circle = patches.Circle((0.7, 0.7), 0.2, linewidth=2, edgecolor='green',
facecolor='lightgreen')
ax. add_patch(circlc)
triangle = patches.Polygon([(0.5, 0.1), (0.9, 0.5), (0.1, 0.5)],
closed=True, linewidth=2, edgecolor='red', facecolor='lightcoral')
```

student_id	course	gender	day	device	score	attempts
S101	Python	Female	Monday	Mobile	78	2
S102	Java	Male	Tuesday	Laptop	85	1
S103	Python	Male	Monday	Laptop	74	3
S104	DataSci	Female	Wednesday	Mobile	90	2
S105	Java	Male	Monday	Tablet	68	1
S106	Python	Female	Tuesday	Laptop	88	2
S107	DataSci	Male	Wednesday	Mobile	76	2
S108	Java	Female	Monday	Laptop	92	1

(i) Create a DataFrame in Python using the above data.

(ii) Add a new column score_pct to store the percentage score (i.e., score / 100).

(iii) Using Pandas pivot_table() method:

(a) Display the average score_pct and average attempts

(b) Use gender and day as row indices and device as columns

(c) Use margins = True to include row and column totals

(d) Round the result to 2 decimal places

(c) A data analyst is working with a survey dataset that includes fields like **gender, age, income, education level,** and **satisfaction rating.**

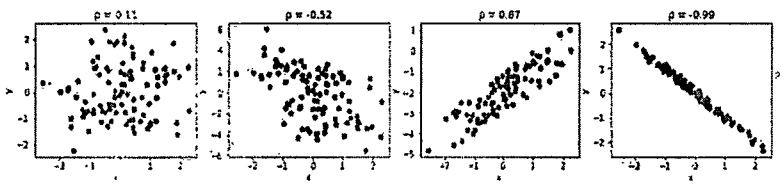
Classify each field as either qualitative or quantitative, and identify the type of data (Nominal, Ordinal, Interval or Ratio) associated with each. (5)

(d) What is a NumPy ndarray? How does it differ from a Python list? Consider the following code snippet. Predict the output and explain the reason behind the result:

```
import numpy as np
arr = np.arangc(10)
sliced = arr[2:6]
sliced):] = 99
print(arr)
```

(1+2+2=5)

(e) What is correlation? How does it help in understanding relationships between two variables? Based on the scatter plots shown below, estimate the type and strength of correlation for each plot (e.g., strong positive, weak negative, no correlation, etc.). Justify your answer. (1+1+4=6)



(f) Create a Pandas DataFrame that holds employee data with the columns : (2+2+2=6)

Name, Age, and Salary, including some missing values.

Then, perform the following actions :

(i) Drop all rows that contain missing values.

(ii) Filter and display the employee records where the Salary is greater than ₹50,000.

Section B

2. (a) Describe the key stages in the data analysis process. For each step, explain its purpose and significance using relevant examples. (5)

(ii) import numpy as np

```
arr = np.arange(1, 10).reshape(3, 3)
print(arr)
print(arr[1:, 1:])
```

(iii) import pandas as pd

```
data = [1, 5, 9, 12, 15, 18, 22, 25, 30]
bins = [0, 10, 20, 30]
output = pd.cut(data, bins)
print(output)
```

6. (a) Given the dataset [12, 18, 20, 25, 30], perform Min-Max. scaling to the range [0, 1]. Show the minimum and maximum values, the scaling formula used, and the resulting scaled dataset. (3)

(b) You are given the following dataset of student enrollments in various online courses: (2+2+4+4=12)

5. (a) Write a Python program to plot a quadratic function using NumPy and Matplotlib. (1+1+1+2+1=6)

(i) Generate a list of integer values from –10 to 10 using a suitable NunrPy function

(ii) Compute the corresponding values of the function $y = x^2 - 4x + 3$

(iii) Plot the function using a blue dotted line

(iv) Add suitable labels for the X and Y axes and a meaningful title

(v) Display the plot

(b) What will be the output of the following? Explain your answer. (9)

(i) import numpy as np

```
a = np.array([1, 2, 3, 4])
b = np.array([5, 6, 7, 8])
print(a + b)
print(a * b)
```


(b) The IRIS dataset is a well-known multivariate dataset that contains 150 records of iris flowers, with the following four features (attributes): (2+2+3+3=10)

sepal length (cm), sepal width (cm), petal length (cm), petal width (cm).

Each flower sample belongs to one of three species (class labels): *Setosa, Versicolor,* or *Virginica.*

Write a Python program to perform the following operations on the IRIS dataset:

(i) Load the IRIS dataset using sklearn.datasets.

(ii) Display the feature names and target (class) names.

(iii) Compute and display the mean, median, and standard deviation for each feature.

(iv) Plot a correlation heatmap for the features.

3. (a) Explain what hierarchical indexing is in pandas. How do you create and access data using hierarchical indexing? (2+3=5)

(b) You are given Sales Data as following : (2+2+2+2+2=10)

```
import pandas as pd

data = {'Month': ['Jan', 'Feb', 'Mar', 'Apr',
'May', 'Jun'], 'Sales_A': [100, 120, 130,90, 110,
150], 'Sales_'B': [80, 95, 100, 70, 85, 120]
}

df = pd.DataFrame(data)
```

From above dataset containing monthly sales data for two products —

Product A and Product B, write the code for the following :

(i) Create a line plot showing monthly sales of both products on the same chart.

(ii) Add labels for the x-axis (Month) and y-axis (Sales).

(iii) Add a legend to distinguish between Product A and Product B.

(iv) Create a bar chart to compare total sales for each product across the 6-month period.

(v) Add a title to each plot and display them clearly.

4. Write a Python program using NunrPy to perform the following tasks : (2+2+1+2+2+6=15)

(i) Create a 3×4 NumPy array containing random integers between 10 and 50.

(ii) Slice and display the first two rows of the array.

(iii) Replace the last column of the array with zeros.

(iv) Transpose the modified array and display its shape.

(v) Compute and display the mean and standard deviation along each column of the original (modified) array.

(vi) Explain the use of the following ndarray attributes with suitable Python code examples:

.shape, .ndim and .dtype

5326

Your Roll No. .....

Unique Paper Code	:	2344001202
Name of the Paper	:	Data Analysis & Visualization Using Spreadsheet
Name of the Course	:	Generic Elective
Semester	:	II[nd]
Duration	:	03 Hours
Maximum Marks	:	90 Marks

Instruction for Candidates

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

Section A
(Compulsory)

1.

a. Explain the different types of operators used in Excel formulas with examples. (3)

b. Match the following shortcuts with their actions: (3)

a) Control + 1	i) Undo the last action
b) Control + A	ii) Enters the current time
c) Control + F	iii) Repeat last action
d) Control + Shift + :	iv) Change the format of selected cell
e) Control + Z	v) Select all contents of a worksheet
f) F4	vi) Search current sheet

c. What is Lookup function in Excel? Write the syntax of lookup by array and lookup by vector. (3)

d. Write a short note on the following (**Any four**): (8)

i) Descriptive Statistics
ii) Inferential Statistics
iii) Cell Referencing
iv) Naming of Cell
v) Averaging

vi) Quartile Deviation

e. What is naming of cell? What are advantages of naming cell? (2)
f. What is the key difference between normal and advanced filters? (3)
g. What is the transpose function in special paste tab. Explain with suitable example (3)
h. Differentiate between: (3)

i) COUNT () and COUNTIF ()
ii) ROUND () and ROUNDUP ()
iii) Cell formula and Array formula

i. How can you remove duplicate values in Excel? (2)

Section B

2.

a. Find the following table of employees of Horticulture department. Give the formula to calculate following : (10)

Id	Name	Fruits	Production Cost	Selling Price
P001	Ravi	Apple	1113	1288
P002	Mohit	Eggplant	1096	1251
P003	Ramesh	Potato	1121	1295
P004	Vivek	Mango	1510	1688
P005	Poonam	Milk	1235	1412

i) Profit of "Ravi.
ii) The sale of total employees
iii) To count the total numbers of employees.
iv) Employee is having maximum sale.
v) Employee is having minimum production cost.

b. Compare INDEX-MATCH with VLOOKUP. Why INDEX-MATCH is considered better in many cases? Explain with example. (5)

3

a. Give the syntax and example of following given functions in MS Excel: (10)
   i) TRIM
   ii) MAX
   iii) RANDBETWEEN
   iv) COUNT
   v) SUMIF

b. Calculate the correlation coefficient for the following variables X and Y: (5)

X	1	3	5	7

Y	4	9	15	18

4.

a. Describe COUNTA and COUNTBLANK. (2)
b. What is difference between FIND and REPLACE? (2)
c. How does INDEX/MATCH improve over VLOOKUP in terms of flexibility? (3)
d. Describe any four DAX arithmetic functions. (8)

5.

a. What is the role of named ranges in data analysis and visualization? Justify with suitable example. (5)
b. A student scored the following marks in the exam {40, 45, 50, 55, 60}. Find mode , mean, median, average and standard deviation. (5)
c. Calculate the regression equation of Y on X from the data given in the following table: (5)

X	1	2	3	4	5
Y	2	5	11	8	14

6.

a. Describe the steps to create a chart in Excel and explain the types of charts available. (5)
b. What is conditional formatting? How can it be applied in Excel? Explain advantages in data analysis. (5)
c. Describe how to create a drop-down list in Excel. (5)

7.

a. Define Primary and Secondary Data. How do they differ from each other? Illustrate with examples. (10)
b. Discuss the different types of averages used in statistics with their advantages and disadvantages. (5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5960 **J**

Unique Paper Code : 2342571201

Name of the Paper : Data Structures

Name of the Course : **B.A. Prog. With CS As Minor/Non-Major & B.Sc. (Phy. Sc. & MS) With CS**

Semester : II

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) Draw all possible binary search trees for the three elements *A, B,* and *C.* 3

   (b) Explain the operation performed by the following code on a singly linked list. 3

```
void func(int x)
{
    head = new node (x, head);
    if (tail == 0)
        tail = head;
}
```

P.T.O.

(c) 'Stack data structure plays an important role in the implementation of recursion'. Justify the statement with suitable example. 3

(d) Where in a max-heap might the smallest element reside, assuming that all elements are distinct? Justify your answer. 3

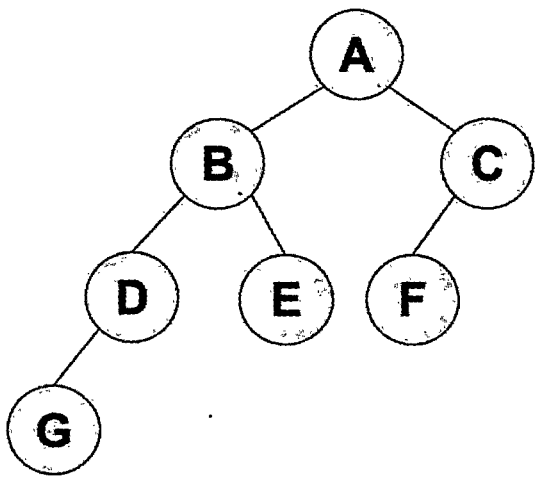
(e) Consider the following list of numbers: 3

`3, 28, 45, 23, 12, 26, 90, 56, 76`

To search a given number in the above list, which of the searching techniques (linear/binary) is best suited in terms of time complexity? What is the time complexity of the suggested technique?

(f) What will happen if we attempt to remove a node from an empty queue? Give one way to solve this problem. 3

(g) In the balanced binary tree given below, how many nodes will become unbalanced when a node is inserted as a child of the node "G"? Justify your answer. 3



(h) Explain the meaning of the following expressions: 4

i. $f(n)$ is $O(1)$.

ii. $f(n)$ is $\Theta(1)$.

(i) Consider the following sequence of operations on an empty stack: 5

```
push(54); push(52); pop(); push(55); push(62); s=pop();
```

Consider the following sequence of operations on an empty queue:

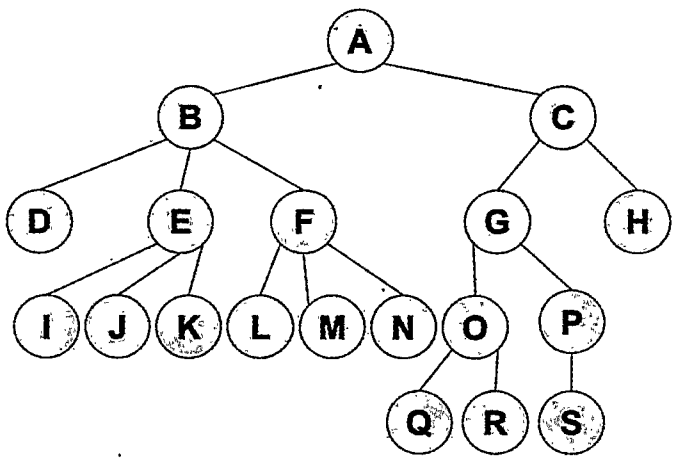
```
enqueue(21); enqueue(24); dequeue(); enqueue(28);
enqueue(32); q=dequeue();
```

After performing these operations, what would be the value of the expression (s+q) ? Also show the contents of stack and queue.

Section B

2. (a) Differentiate between Binary Search Tree and Balanced Search Tree. 4

(b) Consider the following tree: 5



i. Name the internal nodes.

ii. How many descendants and ancestors does node B have?

iii. What are the siblings of node E?

iv. What is the depth of node O?

v. What is the height of the tree?

(c) Write member functions to perform the following operations on Queue using array: 6

i. `isEmpty()`

ii. `isFull()`

iii. `enqueue(x)`

iv. `dequeue()`

3. (a) Differentiate between min-heap and max-heap. 4

(b) Sort the following set of elements using insertion sort: 5

`29, 10, 14, 37, 13, 25, 7, 18, 5, 33`

Show the content of array after every iteration.

(c) Consider the following recursive function: 6

```
int myFunc(int n) {
  if (n >= 0 && n <= 9)
    return n;
  return (n % 10) + myFunc(n/10);
}
```

i. What will be the output of `myFunc(234)` ?

ii. How many recursive calls will be performed to compute `myFunc(234)` ?

iii. Write the iterative version of the above function.

4. (a) Convert the following infix notations to postfix notations: 4

A*((B+C)/D)

Show the contents of stack at each step.

(b) i. Calculate the asymptotic time complexity of the following code: 5

```
for(i=0;i<n;i++)
{     for(j=0;j<n;j++)
      {          Statement;
      }
}
```

ii. Prove that $5n^2+3n\log n+2n+5$ is $O(n^2)$. Find the values of the constants n_0 and c.

(c) Explain how Master's theorem can be used for solving recurrences giving suitable example. 6

5 (a) Consider the following recursive function: 4

```
void fun(int x)
{
    if(x > 0)
    {
        fun(x-1);
        cout << x <<" ";
        fun(x-1);
    }
}
```

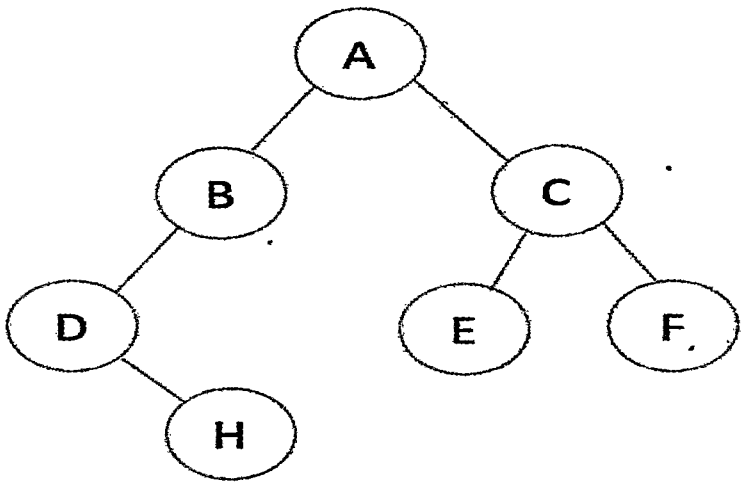
Draw the recursion tree when `fun(4)` is called.

(b) Create a Binary search tree with the keys inserted in following order: 5

`50, 30, 70, 20, 40, 60, 80, 10, 25, 35`

Draw the tree after each insertion.

(c) Determine the preorder, inorder and postorder traversals of the following tree: 6



6 (a) Compare and contrast priority queue and deque. Also, give one real life application of priority queue. 4

(b) Consider the following array-based queue of characters, where queue is allocated n=6 memory cells: 5

Queue: `b, d, a, g, _, _`

(where "_" means empty memory cell)

Perform the following sequence of operations on the given queue:

i. `enqueue('p')`

ii. `dequeue()`

iii. `enqueue('c')`

iv. `enqueue('z')`

v. `front()`

After every operation, show the contents of the queue with `front` and `rear` pointers.

(c) Write member functions to perform the following operations on Doubly Linked List: 6

i. Insertion at head

ii. Deletion from head

iii. Search an element 'x' in linked list

7 (a) Consider a circular linked queue: `(9,8,7,6,5,4,3,2)` such that the cursor points to 5. After performing following operations on this queue, what would be the `front` and `rear` elements of the queue? 4

`Enqueue(1), Dequeue(), Dequeue(), Enqueue(12), Dequeue(), Dequeue()`

Also draw the resultant queue.

(b) Write a program to implement the following operations for stack using linked list: 5

i. `isEmpty()`
ii. `size()`
iii. `push()`
iv. `pop()`

(c) Build a max heap from the following array of numbers: 6

4, 10, 3, 5, 1, 12, 7, 9

Draw the heap after each insertion.

This question paper contains 4 printed pages]

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

S. No. of Question Paper : **2668**

Unique Paper Code : **42344403**

Name of the Course : **B.Sc. Programme**

Name of the Paper : **Computer System Architecture**

Semester : **IV**

Duration : **3 Hours** Maximum Marks : **75**

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

Attempt *all* questions from Section A. Attempt any **5** questions from Section B.

All the parts of a question must be answered together.

Section–A

1. (*a*) Obtain the 2's complements of the following binary numbers : 2

10101110; 10000001

(*b*) Differentiate between Combinational Circuit and Sequential Circuit. 2

(*c*) Represent diagrammatically D flip-flop and JK flip-flop and give their characteristic tables. 4

(*d*) For a 16 K × 32-bit computer what will be the size of Accumulator, Address register and Program Counter, Instruction register ? 4

(*e*) What is a binary counter ? How many flip-flops are required for a *n*-bit binary counter ? 2

P.T.O.

(*f*) Draw diagram of basic computer registers connected to a common bus showing all registers and all the inputs/signals required. 4

(*g*) Differentiate between : 3

(*i*) Memory mapped I/O and Isolated I/O

(*ii*) Synchronous and Asynchronous Data transfer.

(*h*) Simplify the following expressions using Boolean algebra : 4

(*i*) AB + AB'

(*ii*) (BC' + A'D) (AB' + CD').

Section–B

2. (*a*) Simplify the following Boolean function F(w, x, y, z) = $\sum(0,1,2,5,8,9,10)$ using K-map. 4

(*b*) Using De Morgan's theorem, show that : 2

$$A + A'B + A'B' = 1$$

(*c*) Design a 3-input combinational circuit to implement a Majority function. The Majority function generates a 1 in the output if the input variables have more 1's than 0's, otherwise the output is 0. 4

3. (*a*) Convert the following decimal numbers to the number system as indicated in each part : 6

(*i*) 7562 to Octal

(*ii*) 1938 to Hexadecimal

(*iii*) 175 to Binary.

(*b*) Given that the contents of Register A are 1010 and contents of Register B are 1100. Perform the selective set and selective complement operations and show final contents of the registers. 4

4. (*a*) Draw a diagram of a 4-bit adder-subtractor and explain its working. 6

(*b*) Perform the arithmetic operations (+42) + (–13) and (–42) – (–13) in binary using signed-2's complement representation for negative numbers. 4

5. (*a*) The memory unit of a computer system is 256 K × 32 bits. A binary instruction occupies one word of the memory. The instruction format of this computer has four parts–Direct/Indirect bit, an operation code, register code to specify one of the 64 registers and an address part.

Draw the instruction format, clearly indicating bits for each of the above mentioned four parts. 4

(*b*) Write the complete set of microinstructions needed to fetch, decode and execute the following operations : 6

(*i*) ADD contents of memory location to AC

(*ii*) STORE contents of AC to a memory address.

6. (*a*) Write a program to evaluate the following arithmetic exprssion : 6

$$X = (A - B + C^* (D * E - F))/G + H * K)$$

(*i*) Using a two-address machine

(*ii*) Using a zero-address machine.

P.T.O.

(*b*) Explain with examples what will be the EA (Effective Address) in case of Register Direct, Register Indirect, Relative and Indexed addressing modes. 4

7. (*a*) The following memory units are specified by the number of words x the number of bits per word. How many address lines and input-output data lines are needed in each case ? 6

(*a*) 2K × 16;

(*b*) 64K × 8;

(*c*) 16M × 32.

(*b*) Draw block diagram of a 3 × 8 decoder using two 2 × 4 decoders. 4

This question paper contains **8+4** printed pages]

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

S. No. of Question Paper : **8080**

Unique Paper Code : **2343012009**

Name of the Paper : **Data Exploration and Visualization**

Name of the Course : **Common Prog Group (DSE/GE)**

Semester : **IV**

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.

Assume numpy has been imported as np and pandas has been imported as pd.

Section-A

(Compulsory)

1. (*a*) Consider the following DataFrame : 2

```
data = {'state': ['UP', 'UP', 'UP', 'MP', 'MP', 'MP'],
'year': [2020, 2021, 2022, 2021, 2022, 2023],
'pop': [1.5, 1.7, 3.6, 2.4, 2.9, 3.2]}
```

P.T.O.

What will be the output on the execution of the following Python commands ?

```
frame = pd.DataFrame(data)
print(frame)
frame['northern'] = frame.state == 'UP'
print(frame)
```

(*b*) Given the series `S1` : 2

```
S1 = pd.Series([1, 3, np.nan, 5, 2, np.nan],
index = ['a', 'b', 'a', 'b', 'a', 'b'])
```

What will be the output produced when the following Python codes are executed ?

(*i*) `print(S1)`

(*ii*) `print(S1[S1.notnull()])`

(*c*) Differentiate between the `bar()` and `barh()` functions with the help of suitable examples. 2

(*d*) What will be the output produced when the following Python codes are executed ? 2

(*i*)
```
arr = np.arange(10)
ar1= arr[3:7]
ar1[:]  = 11
print(arr)
```

(*ii*)
```
arr = np.arange(10)
ar2 = arr[3:7].copy()
ar2[:] = 12
print(arr)
```

(*e*) Consider the following Python snippet : 2

```
data = pd.Series(np.arange(9), index = [['Ohio', 'Ohio',
'Ohio', 'Nevada', 'Nevada', 'California', 'California', 'LA',
'LA'], [1,2,3,1,3,1,2,2,3]])
```

What will be the output on the execution of the following Python commands ?

(*i*)
```
print(data.unstack())
```

(*ii*)
```
print(data.unstack().stack())
```

(*f*) Write a code in Python to create a scatter plot with 10 random points. Import necessary libraries. 3

(*g*) Consider the following DataFrame `df` having the average temperatures recorded in different cities during March : 3

Temperature	City
16	Shimla
20	Srinagar
25	Delhi
28	Jaipur

(*i*) Plot a line graph showing the `Temperature` for each `City`.

(*ii*) Set the title of the graph as `'Average March Temperatures across Indian Cities'`.

(*iii*) Display the Y-axis ticks as: 15, 20, 25, 30, and 35.

(*h*) Write Python commands to create a Series named `'S1'` with values 5, 6, 7, 8 and index 1, 2, 3, 4 and then rename index 1 to `'one'`. 3

(*i*) Explain `groupby()` function in Pandas with the help of an example. 3

(*j*) Plot the graph generated by the code below : 4

```
import matplotlib.pyplot as plt
plt.plot([2, 3, 4, 5])
```

Show the change in the above plot, if any, when the code is modified to

```
plt.plot([2, 3, 4, 5], 'o--')
```

(*k*) Consider the following data about four individuals living in different cities : 4

ID	Name	Age	City	Experience
1	Alice	24	New York	1
2	Bob	30	Los Angeles	5
3	Charlie	28	Chicago	3
4	Diana	22	Houston	1

Write commands in Python to :

(*i*) Create a DataFrame `df` to store the above data.

(*ii*) Compute the correlation between columns `Age` and `Experience`.

(*iii*) Print last two rows of `df`.

Section B

2. (*a*) Given the following arrays : 3

```
ar_x = np.array([[2, 4, 6], [3, 5, 7]])
ar_y = np.array([[1, 2, 3], [4, 5, 6]])
```

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

(*i*) `ar_x ** 2`

(*ii*) `ar_x * ar_y`

(*iii*) `ar_y > ar_x`

(*b*) Consider the following file having 4 columns with the first column being the row index : 5

Alice#24#F#Engineer

Bob#30#M#Designer

Charlie#28#M#Doctor

Diana#22#F#Artist

Write Python statement to read the above-mentioned file into a DataFrame `df`. Also display the contents of DataFrame `df`.

(*c*) Write a code in Python using the plotly library to draw a line graph for the following function : 7

```
y = cos(x)
```

for `x` in the range `0` to `pi`.

3. (*a*) Consider the following series `ser1`: 7

ser1

P	NaN
Q	24
R	29
S	NaN
T	11

Write Python statements to :

(*i*) Create the series `ser1` using Pandas library.

(*ii*) Print only non-null values of `ser1`.

(*iii*) Replace the missing value in `ser1` with the average of the series.

(*iv*) Change the value of index Q in `ser1` to 20.

(*v*) Replace all the null values with 0.

(*vi*) Count the number of non-null values in `ser1`.

(*vii*) Reduce every value of `ser1` by 5.

(*b*) Given the following DataFrame : 8

```
data = pd.DataFrame({
    'Course': ['X', 'X', 'Y', 'Y', 'X'],
    'Age': [19, 21, 23, 21, 20],
    'Year': ['I', 'II', 'I', 'II', 'I'],
    'Marks': [850, 900, 754, 540, 789]
})
```

Write Python statements to :

(*i*) Group the data by `Course` and find the number of students per course.

(*ii*) Print the row with the maximum value of `Marks`.

(*iii*) Print the average `Marks` for each `Course`.

(*iv*) Generate a cross-tabulation to summarize the data by `Course` and `Year`.

4. (*a*) Consider the given DataFrame `df1`: 5

	Age	**Height**
1	24	157
2	31	152
3	29	160

Write the Python statements to perform the following operations :

(*i*) Set the name of the row index to `'SNo'`.

(*ii*) Add a column named `'BMI'` with the following values : `22.5, 21,` and `27.`

(*iii*) Drop the row corresponding to index `3`.

(*iv*) Print the values of the second row.

(*v*) Reindex the DataFrame in the order `3, 1, 2`.

(*b*) How does Pandas represent missing values ? Describe the methods used to identify, remove, and replace missing values using appropriate Pandas functions. 4

(*c*) Consider the following DataFrame `df`: 6

OrderID	Region	SalesPerson	Product	Units	UnitPrice
101	East	Alice	Laptop	5	700
102	West	Bob	Tablet	3	300
103	East	Alice	Laptop	2	700
104	North	Carol	Mobile	10	200
105	West	Bob	Laptop	4	700
106	East	David	Mobile	6	200
107	North	Carol	Tablet	10	300

What will be the output produced when the following Python code is executed ?

(*i*)
```
df.groupby('SalesPerson')['Units'].sum()
```

(*ii*)
```
df.groupby(['SalesPerson', 'Product']).agg({'Units':
'sum', 'UnitPrice': 'mean'})
```

5. (*a*) Write Python statements to create the given 3 × 3 NumPy array using `arange()` function and print its column-wise and row-wise sum. 4

$$A = \begin{matrix} 2 & 4 & 6 \\ 8 & 10 & 12 \\ 14 & 16 & 18 \end{matrix}$$

(*b*) Write Python commands to plot a 1 × 2 grid using matplotlib's figure such that : 6

(*i*) Plot 1 is a histogram with 50 randomly generated numbers plotted in 10 bins.

(*ii*) Plot 2 is a line plot with 5 points in decreasing order.

(*c*) Consider the DataFrames `One` and `Two` given below : 5

`One`

C1	C2
5	A
8	E
4	C
9	G

`Two`

C1	C2
5	E
6	F
4	G
8	H

P.T.O.

Consider the following Python code segments and write their output :

(*i*)
```
df1 = pd.merge(One, Two, on='C2')
print(df1)
```

(*ii*)
```
df2 = pd.merge(Two, One, how='right', on='C1')
print(df2)
```

6. (*a*) Given the array arr: 5

```
arr = np.array([[[5,-11],[-6,12]], [[15,-47], [1,2]]])
```

Write Python commands to perform the following operations :

(*i*) Create an array of zeros with the same shape as arr.

(*ii*) Print the elements of arr which are less than 0.

(*iii*) Print the datatype of elements stored in arr.

(*iv*) Print the dimension of arr.

(*v*) Print the shape of arr.

(*b*) Consider the following Python DataFrame : 10

```
data = pd.DataFrame({

'x': ['apple', 'banana']*4 + [np.nan, 'apple'],
'y': [10, 10, 20, np.nan, np.nan, 40, np.nan,
      50, np.nan, np.nan]})
```

What will be the output on the execution of the following Python commands ?

(*i*) `print(data)`

(*ii*) `print(data.drop_duplicates())`

(*iii*) `print(data.dropna())`

(*iv*) `print(data.dropna(axis = 0, how = 'all'))`

(*v*) `print(data.fillna(method = 'ffill'))`

7. (*a*) Consider the following DataFrame `Student_Performance` given below : 6

Student_ID	Name	Age	Course	Marks
S101	Ananya	19	Physics	89
S102	Raj	20	Mathematics	92

Write Python commands to perform the following operations :

(*i*) Display the rows having values greater than the median `'Marks'`.

(*ii*) Calculate the total number of students and the average age.

(*iii*) Set `'Student_ID'` as index for the DataFrame.

(*b*) Differentiate between the use of the following Python functions with the help of suitable examples : 5

(*i*) `crosstab()` and `pivot_table()`

(*ii*) `randint()` and `randn()`

(c) Consider the following Numpy array : 4

```
arr1 = np.arange(20).reshape(5,4)

bool_a = [True, False, False, True, False]
```

What will be the output on the execution of the following Python commands ?

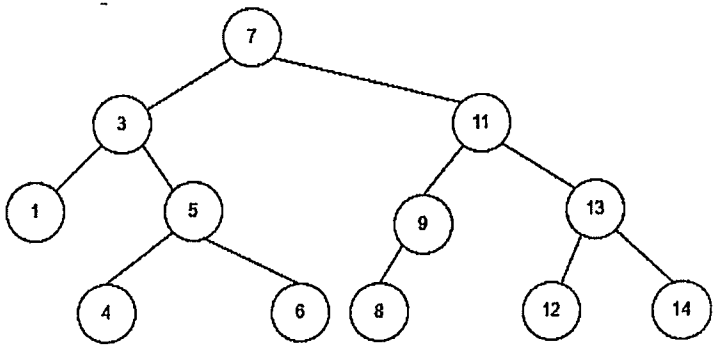
(*i*) `print(arr1[[-1,-3,-4]])`

(*ii*) `print(arr1[bool_a])`

(*iii*) `print(arr1[[1, 3, 2, 0], [0, 3, 1, 2]])`

(*iv*) `print(arr1[[4, 3, 0, 1]])`

7. Consider the following Binary Search Tree and answer the following:



(a) Write the breadth-first traversal of the above BST (4)

(b) Draw the tree after inserting the node with key 10 in above BST. (5)

(c) Write the post-order traversal and in-order traversal of the resultant tree. Is the resultant tree height-balanced tree? Justify your answer. (6)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4659 **J**

Unique Paper Code : 2344000024

Name of the Paper : Data Structures Using Python

Name of the Course : **Generic Elective**

Semester : IV/VI

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 4** questions from **Section B.**
4. Parts of the question must be answered together.

SECTION A

1. State True/False for the following statements and justify your answer (3)

(i) Stack uses FIFO access method.

(ii) A doubly linked list uses more memory than the circular linked list.

(iii) In-order traversal of Binary Search Tree gives a sorted sequence.

Which is the most appropriate data structure that can be used in following situations: (3)

(i) When you need to implement a browser's back and forward navigation.

(ii) When you need to store data with hierarchical relationships.

(iii) When you need to store data in Last-In-First-Out manner.

What is AVL tree? Explain with the help of suitable example Give one application. (3)

How a priority queue is different from a normal queue? Write one application of priority queue. (3)

Write a code snippet in Python to insert an element at the front of an already existing singly linked list. (3)

(b) Write a program in Python to compute the sum of 'n' numbers of a list using recursive function. (5)

(c) Arrange the following functions in the increasing order of their asymptotic complexity: (4)

$f_1(n) = 2^n$
$f_2(n) = n^{2/3}$
$f_3(n) = n \log n$
$f_4(n) = \log n$

6. (a) Use recurrence tree method to solve the following recurrence relation: (4)

$T(n)\ T\ (n\text{-}1) + n$

(b) Solve the following recurrence relation: (5)

$T(n) = 2T\ (n/4)+n^2$

(c) Explain what Big O notation represents. Show the function $8n+5$ is O(n) (6)

4. (a) Consider a heap of height h. What will be the maximum and minimum number of elements in the heap? (4)

(b) Create a binary tree whose following traversals are given: (5)

Inorder: x y z a p q r

Preorder: a y x z q p r

(c) Construct the max-heap for the given array A given as (6)

A = [4,1,3,2,16,9,10,14,8,7]

Show all the steps clearly.

5. (a) Convert the given iterative function to recursive function: (4)

```
def power (base, exponent):
        result = 1
        for i in range(exponent):
            result *= base
        return result
```


Explain any two properties of binary heap. How is it different from a binary search tree? (3)

Implement a Python function that counts the number of nodes in a circular linked list. (4)

Write a program in Python to print Fibonacci numbers via Binary recursion. (4)

Differentiate between Big Oh, Big Ω (Omega) and Big θ (theta) notations. (4)

2. (a) Convert the following infix expression to a postfix expression. A* (B+D)/E – F* (G+H/K)

Show all the steps clearly. (4)

(b) Consider the following sequence of operations performed on a stack S of size 5. Show the return value and contents of stack after each operation: (5)

S.push(5)

S.push(3)

S.pop( )

S.is_empty()

S.pop()

S.push(9)

S.top( )

S.push(4)

S.push(15)

len (S)

(c) What is an abstract data type? (6)

Write the time-complexity for the following operations:

(i) The push operation of stack implemented using linked list.

(i) The pop operation of stack implemented using linked list.

(iii) To delete all the elements from the end in a singly linked list with n elements.

(iv) To search an element in Balanced Binary Search Tree (BST) in best case scenario.

3. (a) Suppose an initial empty queue Q has executed a total of 32 enqueue operations, 10 first operations and 15 dequeue operations, 5 of which raised Empty errors that were caught and ignored. What is the current size of Q? (4)

(b) What are the drawbacks of using linear queue? How can it be resolved through circular queue? (5)

(c) Consider an initially empty circular queue of the size 4 implemented using arrays. Perform the sequence of operations and show the position of front and rear after each operation. (6)

enqueue (14)

dequeue( )

dequeue( )

enqueue (3)

enqueue (7)

enqueue (9)

enqueue (0)

enqueue (2)

8. Create a Website for your department. Incorporate event descriptions, faculty details and department strengths.

9. Draft a code of conduct for a community of Delhi University students on Facebook. As the administrator of the community you must ensure inclusive and respectful participation.

10. You are organising your annual college festival and want to publicize the event while ensuring safety for all participants :

    (i) Compose a brief X post announcing the festival and its name and encouraging students to attend.

    (ii) Draft a press release for the event. Include details like date, time, location, entrance eligibility and rules, prizes, registration process, and events. Keep it under 500 words.

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4679 **J**

Unique Paper Code : 2035002002

Name of the Paper : DIGITAL COMMUNICATION-II

Name of the Course : **COMMON PROG GROUP: G.E.**

Semester : IV

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

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

PART – A

Attempt **ANY three** from the section. Each question carries **ten** marks.

1. Write short notes on any **two** of the following : (2×5)

(a) Podcasts

(b) Vlogs

(c) Blogs

2. What is a Website? Highlight any three purposes it serves for an institution.

3. What are the key principles of web accessibility , and how can they be implemented while developing a website?

4. Critically analyse the following email and make three observations about the message from the perspective of the principles of communication:

Subject: I'm Taking a Break

Dear Sumita,

I'm writing to inform you that I'll be taking a leave of absence from work for the next two weeks. I've been feeling really overwhelmed and need some time to recharge. I've got a bunch of personal stuff going on and I don't really feel like dealing with it right now.

I'm not really sure when I'll be back, but I'll let you know when I am. In the meantime, I'll make sure to catch up on any work I miss when I return. Or maybe not. I'm not really sure.

Thanks for understanding.

Best,

Pankaj

5. Why is coherence important in maintaining online presence? Discuss.

PART – B

Attempt **ANY three** from the section. Each question carries **twenty** marks.

6. Describe strategies for maintaining personal and professional boundaries in digital communication. Illustrate with relevant examples.

7. Write a blog on the topic "Ethical uses of AI in digital communication".

- Add one cup of cold water to the lemon juice.
- Stir in the sugar (optional) until fully dissolved.
- Mix well and add ice cubes if desired.
- Stir again and enjoy your refreshing lemon juice!

3. *Additional Information:*

- **Serving Size:**

  1 glass

- **Calories:**

  Approximately 40 calories per serving (without sugar).

- **Preparation Time:**

  5 minutes

- **Storage:**

  Best served fresh, but can be stored in the fridge for up to 24 hours.

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4665 **J**

Unique Paper Code : 2344002004

Name of the Paper : Introduction to Web Programming

Name of the Course : **Computer Science Generic Elective**

Semester : IV

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.

Section – A

1. (a) Which text color will be applied to each paragraph in the HTML/CSS document given below? (3)

```
<html>
    <head>
        <style>
            p     {color:green;}
            #p3   {color:blue;}
            .p3   {color:brown;}
        </style>
    </head>
<body>
    <p>Welcome to paragraph 1</p>
    <p style="color:red;">Here goes paragraph 2</p>
    <p id="p3" class="p3">This is the last para</p>
</body>
</html>
```

(b) What will be the output of the following JavaScript code? Give reason. (2)

7. (a) Write the HTML code to create the table given below : (4)

A			M
C	D	E	
H	I	J	N

(b) Design a feedback form using HTML with input fields name, email, and message. Using jQuery, validate the form to check that all fields are filled before submission. Display a suitable error message next to the fields left blank. Print a success message if all fields are filled. (5)

(c) Write HTML code to create a web page showing a recipe as shown below. Using all three types of list elements. (6)

1. Ingredients

- 1 fresh lemon
- 1 cup of cold water
- 1 tablespoon sugar (optional)
- Ice cubes (optional)

2. Cooking Steps

- Cut the lemon in half and squeeze out the juice into a glass.

6. (a) What is a sitemap? Briefly describe any two website structures. (5)

(b) Design a web form with a paragraph and drop-down list that lets the user choose a font style for the paragraph. The available options in drop-down are :

Arial, Times New Roman, and Courier New. Write JavaScript code to apply the font selected by the user to the paragraph. (5)

(c) Create an HTML page that includes a navigation bar with an unordered list of links. Use internal CSS to do the following : (5)

- Apply a border to the navigation bar using the ID selector.
- Use the element selector to remove the bullet point from the list.
- Style the hyperlinks inside the list items to have a hover effect.
- Use a combined selector to apply a common style to both <li> and <a> tags.


```
<script>
    let x = 10;
    let y = ++x + 5;
    document.writeln(x + " and " +y)
</script>
```

(c) Which is more secure: Intranet or Internet? Justify your answer. (2)

(d) Which of the following HTML element is inline or block : (2)

(i)

(ii)

(e) Using HTML, create a button and a element. Write jQuery statements to hide the element when the button is clicked. (3)

(f) How do GET and POST methods differ in web development? (3)

(g) What is the CSS box model? Explain its components. (4)

(h) Write HTML statement to define a element and using the inline CSS set the background colour, font style, and text alignment. (4)

(i) What is the purpose of <video> tag? Write HTML code to embed a video abc/gt. mp4 in your webpage. (3)

(j) Define a function print_even() in JavaScript to print all even numbers between 1 and 20. Write the statement to call this function. (4)

Section – B

2. (a) What is JSON? How is it different from JavaScript objects? Write the output of the code snippet given below : (4)

```
let person = {
    name: "Bob",
    age: 30,
    city: "Delhi"
};
let jsonData = JSON.stringify(person);
document.write(jsonData);
```


(ii)
```
for (let i = 0; i < 5; i--)
{
    document.writeln(i)
}
```

(b) Design a web page containing a paragraph element and a button. When the button is clicked for the first time, the paragraph should slide up and hide, and the button text should change to "Show". When the button is clicked again, the paragraph should slide down and show, and the button text should change back to "Hide". Write the complete HTML and jQuery code. (5)

(c) Briefly describe DOM (Document Object Model). (2+4)

Write a JavaScript function to :

- Change the background colour of a element when a button is clicked.
- Update the text of a paragraph inside the to "Colour Changed!" when the background colour changes.

(c) Design an HTML page with embedded CSS to create a table with 3 rows and 2 columns with formatting as given below : (6)

- Background color of the header row is "blue".
- Header text color is "white".
- The table border color is "black" and should be "2px" thick.
- Alternate rows should have a light gray background color.

5. (a) Identify the error(s) in the code snippets given below. Give reasons. (4)

(i)
```
var x = 10;
let y = 20;
const z = 30;

x = 40;
y = 50;
z = 60;
document.write(x, y, z);
```


(b) Differentiate between following : (6)

(i) Radio button and Checkbox

(ii) id and class attribute

(iii) <hr> and

(c) Write the output of the following JavaScript code : (2+3)

(i)
```
<!DOCTYPE html>
<html>
<body>
    <h2>JavaScript Output Example</h2>
    <p id="demo"></p>
    <script>
    function outer() {
        let x = 5;
        function inner() {
            let y = 10;
document.getElementByld("demo").innerHTML = x + y;
        }
        inner();
    }
```

```
        outer();
        </script>
    </body>
    </html>
```

(ii)
```
<script>
    function test()
    {
        var x = 20
        let y = 40
        const z = 30
        {
            var x = 10
            let y = 20
            const z = 100
            document.writeln(x)
            document.writeln(y+z)
        }
        document.writeln(x+y+z)
        }
        test()
</script>
```


3. (a) Explain the difference between absolute and relative URLs. Give an example for each. (4)

   (b) Write HTML and JavaScript code to design a webpage with one button and one paragraph element. When the button is clicked, the paragraph text should toggle between "Hello, World!" and "Goodbye, World!". (5)

   (c) What is an external style sheet? Mention any two advantages of using external style sheet? (3)

   (d) Define an external style sheet darkmode.css which sets background color of entire document as black, text color as white and hyperlinks in yellow color.

   Write the statement to include the style sheet darkmode.css in a HTML document. (3)

4. (a) Write a jQuery function to change the text color of a heading when the mouse hovers over it. (4)

   (b) Design a webpage using HTML and JavaScript that takes a number as input from user and displays whether the number is even or odd. (5)

(c) Consider the following page reference string:

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.

Assuming demand paging with four frames, how many page faults would occur, if optimal replacement algorithm is applied. Consider that all frames are initially empty. (5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5859 **J**

Unique Paper Code : 2342572401

Name of the Paper : Operating Systems

Name of the Course : **B.A. Prog. / B.Sc. (Phy. Sc. & MS)**

Semester : IV

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.

Section – A

1. (a) What is a multiprocessor system? Give one advantage of it. (3)

(b) List various file operations in file system. (3)

(c) Explain briefly the task of a dispatcher. (3)

(d) Give any three services of an operating system. (3)

(e) Describe the information contained in an open-file table and its use. (3)

(f) Assume that the system takes 120 nanoseconds to reference the main memory. If number of hits is 75%, then calculate effective access time for a paging scheme. (3)

(g) What is race condition in critical section problem? (3)

(h) Explain circular wait condition in deadlock. (3)

(i) What is a system call? Name the system call used for creating a process. (3)

(j) Write the three main operations performed by an operating system to deal with page fault. (3)

Process ID	Arrival Time	Burst Time	Priority
P1	0	8	2
P2	1	10	4
P3	2	5	3
P4	3	2	1

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

(ii) Draw Gantt chart for Priority based (preemptive) algorithm and calculate waiting time for every process.

7. (a) Explain tree-structured directories with the help of a diagram. (5)

(b) Describe the issue involved in swapping In/Out a process and how it can be resolved? (5)

(ii) Rotational latency

(iii) Bandwidth

(b) Distinguish between sequential and direct file access methods. (4)

(c) Consider a disk queue with requests for I/O to blocks on cylinders as follows : (5)

98, 183, 37, 122, 14, 124, 65, 67

The drive is currently serving a request at cylinder 58. Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending request for FCFS (First come First serve) scheduling algorithms?

6. (a) What are the three necessary' conditions required for solution of the critical section problem? (5)

(b) Consider the following set of processes, with the length of CPU burst time given in milliseconds : (10)

Section – B

2. (a) Describe design objectives of an operating system from system point of view. (5)

(b) Explain the following terms : (2+3)

(i) Trap

(ii) Dual Mode operation

(c) For the given sets P (processes), R (resources) and E (edges) (5)

P = {P1, P2, P3)

R = {R1, R2, R3}

E = {P1→R1, R1→P2, P3→R2, R1→P3, R3→P3, R2→P1, R2→P2}

There are two instances each of resources R1 and R2 and 3 instances of resource R3. Draw Resource allocation graph. Is the given system in deadlock state? Justify your answer.

P.T.O.

3. (a) Explain process control block and its content with the help of a diagram. (6)

(b) Consider the following change of state of process : (4)

(i) Process moves from wait state to ready state

(ii) Process moves from running to wait state

(iii) Process moves from running to ready state

(iv) Process terminates

State the choice of preemptive and non preemptive CPU scheduling algorithm in each of above cases.

(c) 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. (5)

4. (a) Describe first-fit and best-fit memory allocation strategies. (5)

(b) Give examples of software applications that run as multi-threaded process. (4)

(c) Consider a program consists of five segments: S_0 = 500 KB, S_1 = 18 KB, S_2= 120 KB, S_3 = 670 KB, and S_4 = 85 KB. Assume at that time, the available free space partitions of memory are 900-1850, 40-130, 280-400, and 2100-2600.

Answer the following :

(i) Allocate space for each of 5 segments S_0, S_1, S_2, S_3, S_4 in memory using segmentation method.

(ii) Will the allocation done in part (i) result in fragmentation? If yes, give type and size of fragmentations. (6)

5. (a) Define the following : (6)

(i) Seek time

4. (a) Write a program that checks whether a number entered by the user is a prime number or not. (3)

   (b) What are default arguments in C++? Illustrate with an example. (2)

5. (a) What are the common file stream classes in C++? (1)

   (b) Write a C++ program to create a text file notes.text, write a sentence into it, and read it back to display on the screen. (4)

6. (a) What is constructor overloading? Illustrate with a class Circle having overloaded constructors. (3)

   (b) What will be the output of the following code? (2)

```
#include <iostream>
using namespace std;
void change(int &a) {
        a = a + 10;
}
int main() {
        int x = 5;
        change(x);
        cout << x;
        return 0;
}
```


[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 432 **J**

Unique Paper Code : 42343409

Name of the Paper : Programming in C++

Name of the Course : **BSc. (Prog.) Physical Science/ Mathematical Science**

Semester : IV

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. Question No. **1 (Section A)** is compulsory.
3. Attempt any **three** questions from Question No. **2** to Question No. **6.**
4. Marks are indicated against each question.
5. Parts of the question must be answered together.

Section A

1. (a) What is abstraction in Object Oriented Programming? Give a real-world example. (2)

(b) Rewrite the following code using a do-while loop : (2)

```
for (int i = 5; i >= 1; i--)
    cout << i << " ";
```

(c) Write the output of the following code: (2)

```
#include <iostream>
using namespace std;
int main() {
    int a = 5;
    int b- = 10;
    cout << a++ << ", " << --b;
    return 0;
}
```

(d) Define a class student with data members name, roll_no, and marks. Include a member function display() to print the values. (2)

(e) What will be the output of this code segment: (2)

```
#include <iostream>
using namespace std;
int main() {
    int arr[] = {1, 3, 5, 7, 9};
    int sum = 0;
    for (int i = 0; i < 5; i++) {
```



```
        if (i == 2)
            continue;
        sum += arr[i];
    }
    cout << "Sum = " << sum;
    return 0;
}
```

Section B

Attempt any **3** *Questions from* **Q. 2** *to* **Q. 6.**

2. (a) Write a function fibonacci (int n) to print the first n Fibonacci numbers. (3)

   (b) Define the main() function to call fibonacci(6). (1)

   (c) What is the difference between recursion and iteration? Give an example. (1)

3. (a) Create a class Rectangle with private data members length and breadth, a default constructor, a parameterized constructor, and a member function area() to return the area. (3)

   (b) Write a main() function to create an object and display its area. (2)

(iii) WWW

(iv) Router

(v) DNS

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5056 **J**

Unique Paper Code : 2344000020

Name of the Paper : Computer Networks

Name of the Course : **GE (Common Program)**

Semester : VI

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** (Question No. **1**) is compulsory.
3. Attempt any **four** questions from **Section B** (Questions **2** to **7**).
4. Parts of a question must be answered together.

Section A

(Compulsory)

1. (a) Which layer(s) in OSI Model performs the following operations?

I. Flow Control

II. Raw bit transfer

III. Routing (3)

(b) Determine the number of cables and connections required to connect 10 computers in a full mesh topology. (3)

(c) A link uses Frequency Division Multiplexing (FDM) for 10 channels, each with a 2kHz bandwidth and a 20 Hz guard band. Find the minimum total bandwidth required. (3)

(d) Give any three differences between the OSI model and the TCP/IP model. (3)

(c) Briefly explain the following CSMA protocols :

(i) 1-persistent

(ii) p-persistent (7)

6. (a) Describe the format and function of each field in an IPv4 header. (7)

(b) State the significance of the following special IP addresses. (8)

(i) 0.0.0.0

(ii) 255.255.255.255

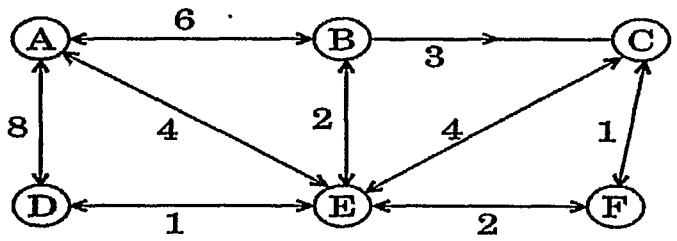
(iii) 127.0.0.0

(iv) 224.0.0.0

7. Write short notes on the following : (3×5=15)

(i) HTTP

(ii) SMTP



(b) Describe the following protocols :– (7)

(i) Internet Message control protocol

(i) Address Resolution Protocol

5. (a) Consider an extremely noisy channel in which the value of the signal-to-noise ratio is 63. Compute the bit rate if the bandwidth of the channel is 2 kHz. (4)

(b) Distinguish between virtual-circuit and datagram networks. (4)

(e) State the advantages and disadvantages of using optical fiber as a transmission medium. (3)

(f) Define Simplex, Half Duplex, and Full Duplex mode of transmission with one example each. (3)

(g) Define the term 'subnetting' and explain its importance in IP addressing. (3)

(h) A bit stream 1011101 is transmitted using CRC method. Generator polynomial is $x^3 + x + 1$. Find the transmitted frame. (3)

(i) Explain, in brief, connection-oriented and connectionless services with examples. (3)

(j) Give any two differences between IPv4 and IPv6. (3)

Section B

2. (a) A 12-bit odd-parity Hamming code whose binary value is 111001001111 arrives at a receiver. Identify the original value of the message. Assume that not more than 1 bit is in error. (7)

(b) The following character encoding is used in a data link protocol: (8)

A: 01000111; B: 11100011; Flag: 01111110; ESC: 11100000

show the bit sequence transmitted (in binary) for the four-character frame:

A B ESC FLAG A ESC

when each of the following framing methods are used:

(i) Character Count

(ii) Flag bytes with Byte Stuffing

(iii) Starting and ending flag bytes, with bit stuffing

3. (a) Brief explain UDP and TCP. Explain the TCP Segment header with diagram. (8)

(b) State the functionality of following networking devices Repeaters, Hubs, switches and Bridges with respect to ISO-OSI model. Name the layers in which these devices operate. (7)

4. (a) Consider the following network with the indicated link cost. Using shortest path algorithm, find the shortest path from source node A to all other nodes: (8)

(ii) Show the bit pattern transmitted for the message 1010110011. Assume that even parity is used in the Hamming code.

7. (a) What are the advantages and disadvantages of using satellite as a communication medium? (5)

(b) Write short notes on the following: (2*5=10)

(i) Hub

(ii) ICMP

(iii) Bridge

(iv) WWW

(v) SMTP

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5853 **J**

Unique Paper Code : 2342573601

Name of the Paper : Computer Networks

Name of the Course : **B.A. (Prog.) /B.Sc. (Phy. Sc.) /B.Sc. Maths. Sc. (NEP-UGCF)**

Semester : VI

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 (Question No. 1)** is compulsory.
3. Attempt any **four** questions from Section B (Questions 2 to 7).
4. All questions in **Section B** carry equal marks.
5. Parts of a question must be answered together.

Section A

1. (a) For each of the following three networks, discuss the consequences if a connection fails: (3)

   (i) Four devices arranged in a mesh topology

   (ii) Four devices arranged in a bus topology

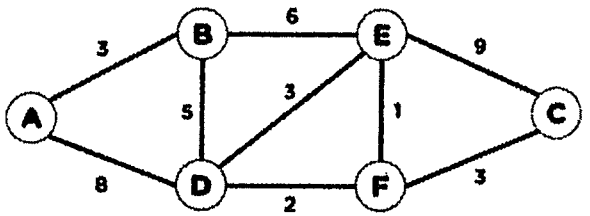
   (iii) Four devices arranged in a ring topology

   (b) Assume that a voice channel occupies a bandwidth of 2 kHz. We need to multiplex 7 voice channels with guard bands of 250 Hz using FDM. Calculate the minimum required bandwidth. (3)

   (c) Describe simplex, half-duplex, and full-duplex modes of communication. (3)

   (d) What are the purposes of the URG, SYN, and PSH flags in a TCP header? (3)

   (e) Discuss the purpose of cladding in Optical Fibers. (3)



6. (a) What is a Subnet Mask? If you were given a subnet mask of 255.255.255.192, how many hosts could each subnet accommodate? (2+2=4)

   (b) Describe the UDP header format with the help of a diagram. Give one example of a scenario where UDP packets are used for data transmission. (5)

   (c) Ten-bit messages are transmitted using a Hamming code. (3+3=6)

   (i) How many check bits are needed to ensure that the receiver can detect and correct single-bit errors?

$x^4 + x + 1$. Compute the bit stream transmitted, which includes the message and CRC. Suppose that the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end. (3+2=5)

(c) What are the key characteristics of radio waves and microwaves? (6)

5. (a) Discuss the basic difference between a switch, repeater, router, and gateway. (4)

(b) What is the CSMA/CD protocol? What is the minimum frame size required to ensure collision detection in the CSMA/CD protocol? (3+2=5)

(c) Consider the following network with the indicated link cost. Using the shortest path Algorithm, find the shortest path from source node A to F and from A to C. (6)

(f) What is the function of the IP protocol in routing data across networks? (3)

(g) What are the main roles of the Data Link Layer in network communication? (3)

(h) Using Nyquist's theorem, calculate the maximum bit rate for a noiseless channel with a bandwidth of 4 kHz transmitting a signal with four distinct signal levels. (3)

(i) HTTP is a stateless protocol. Justify. (3)

(j) Find the class of the following IP addresses. (3)

(i) 208.34.54.12

(ii) 238.34.2.1

(iii) 129.14.6.8

P.T.O.

Section B

2. (a) What is the use of checksum in data communication, and how does it help in detecting errors during data transmission? (1+2=3)

   (b) What are the key differences between virtual-circuit and datagram networks? (5)

   (c) List different layers of the TCP/IP reference model and briefly describe the responsibility of the Transport layer in TCP/IP. (3+4=7)

3. (a) Consider an extremely noisy channel in which the value of the signal- to-noise ratio is 31.Compute the bit rate if the bandwidth of the channel is 1 kHz. (4)

   (b) What is the need for multiplexing in computer networks? Discuss the types of multiplexing. (2+3=5)

   (c) The following character encoding is used in a data link protocol: A: 01000111 B: 11100011 FLAG: 01111110 ESC: 11100000

   Show the bit sequence transmitted (in binary) for the Six-character frame

   A B ESC FLAG FLAG B

   When each of the following framing methods is used:

   (i) Flag bytes with byte stuffing.

   (ii) Starting and ending flag bytes with bit stuffing. (2*3=6)

4. (a) Define HDLC protocol. Which OSI layer does it belong to, and how does it work? (1+1+2=4)

   (b) A message M(x) 10110010 is transmitted using the CRC method. The generator polynomial is

This question paper contains 4 printed pages]

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

S. No. of Question Paper : **2672**

Unique Paper Code : **42347610**

Name of the Paper : **Computer Networks**

Name of the Course : **B.Sc. (Programme) DSE**

Semester : **VI**

Duration : **3 Hours** Maximum Marks : **75**

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

The paper has *two* sections. 'Section A' is compulsory.

Attempt any *five* questions from 'Section B'.

Parts of a question must be answered together.

Section–A

(Compulsory)

1. (*a*) List any *two* advantages of a multipoint connection over a point-to-point connection. 2

   (*b*) Consider *four* computers connected using an Ethernet hub across different branches of an organization within a city. Will this network be classified as LAN, MAN or WAN ? Give reasons. 2

   (*c*) Name the layer of the OSI model responsible for the following : 2

   (*i*) Error detection and correction

   (*ii*) Logical addressing

   (*iii*) Encoding and decoding of signals

   (*iv*) Dialog control between devices.

   (*d*) What is the significance of *cladding* in fiber optic cables ? 2

P.T.O.

(*e*) Is a *walkie-talkie* system a simplex, a half-duplex or a full-duplex system ? Justify your answer. 2

(*f*) Define *bit stuffing* in data transmission. A bit string, 0111101111101111110, needs to be transmitted at the data link layer. What is the string actually transmitted after bit stuffing ? 3

(*g*) Differentiate between single-bit error, two-bit error and burst error ? Give *one* example of each. 3

(*h*) What is the significance of Guard bands in FDM ? If six channels each with a 200-kHz bandwidth are to be multiplexed together, what is the minimum bandwidth of the link if there is a need for a guard band of 10 kHz between the channels ? 3

(*i*) Differentiate between coaxial cable and twisted-pair cable with respect to bandwidth and resistance to electromagnetic interference. 3

(*j*) What is an URL ? Give an example to explain its parts. 3

Section–B

Attempt any *five* questions from this section.

2. (*a*) Seven-bit messages are transmitted using a Hamming code. How many check bits are needed to ensure that the receiver can detect and correct single bit errors ? Show the bit pattern transmitted for the message 1001101. Assume that even parity is used in the Hamming Code. 6

(*b*) Differentiate the following (any *two*) : 4

(*i*) Packet switching and Circuit switching

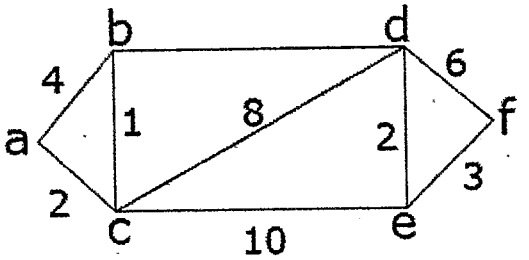
(*ii*) Flow control and Error control

(*iii*) Hub and Switch.

3. (*a*) What is data communication ? Explain the components of data communication. 6

(*b*) List *four* differences between UDP and TCP. 4

4. (*a*) Using Dijkstra's shortest path algorithm, find the route from Router "a" to Router "f" given the following configuration. Show the working steps : 6



(*b*) Write the *class* and *subnet mask* of the following IP addresses : 4

(*i*) 195.1.1.0

(*ii*) 1.1.1.1

(*iii*) 192.168.178.1

(*iv*) 10.10.10.1

5. (*a*) What is meant by pipelining in the context of the sliding window protocol? Consider a 100 Kbps wireless link with a propagation delay of 250 ms. The sender uses a Go-Back-N ARQ mechanism with a window size of 5. If each frame is 150 bytes in size, compute the efficiency of the protocol. 6

(*b*) Explain FDM, WDM and TDM multiplexing techniques. Which multiplexing technique is used for the following : 4

(*i*) Television signal transmission (analog or digital)

(*ii*) High-speed internet data transmission over fiber optic cables.

6. (*a*) What are the differences between a *connection oriented service* and a *connectionless service* ? For each of the following write whether it is a connection oriented service, connectionless service, both or neither : 6

   (*i*) Video call using Zoom

   (*ii*) Sending a message via SMS

   (*iii*) Downloading a file from a server

   (*iv*) Sending a voice message on WhatsApp.

   (*b*) A bit stream of 1100101 is to be transmitted using the standard CRC method. The generator polynomial is $x^3 + 1$. Show the actual bit string transmitted. Suppose that the second bit from the left is inverted during transmission. 4

7. (*a*) What is a bridge ? A bridge connects a LAN segment with computers P, Q and R to another LAN segment with computers M, N and O. Show how the bridge learns the segment to which each computer is connected if the following sequence of frames is transmitted over the network : 6

   (*i*) P sends to Q

   (*ii*) Q sends to P

   (*iii*) M broadcasts

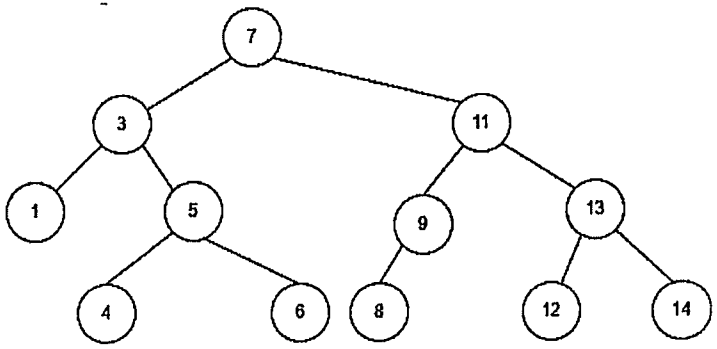
   (*iv*) N sends to O

   (*v*) R sends to T.

   (*b*) How does the networking metrices *throughput* and *delay* help in calculating the performance of a network ? 2

   (*c*) Identify the number of labels and level of hierarchy in the DNS domain name in "*my.computerdeptt.edu*". 2

7. Consider the following Binary Search Tree and answer the following:



(a) Write the breadth-first traversal of the above BST (4)

(b) Draw the tree after inserting the node with key 10 in above BST. (5)

(c) Write the post-order traversal and in-order traversal of the resultant tree. Is the resultant tree height-balanced tree? Justify your answer. (6)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4659 **J**

Unique Paper Code : 2344000024

Name of the Paper : Data Structures Using Python

Name of the Course : **Generic Elective**

Semester : IV/VI

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 4** questions from **Section B.**
4. Parts of the question must be answered together.

SECTION A

1. State True/False for the following statements and justify your answer (3)

(i) Stack uses FIFO access method.

(ii) A doubly linked list uses more memory than the circular linked list.

(iii) In-order traversal of Binary Search Tree gives a sorted sequence.

Which is the most appropriate data structure that can be used in following situations: (3)

(i) When you need to implement a browser's back and forward navigation.

(ii) When you need to store data with hierarchical relationships.

(iii) When you need to store data in Last-In-First-Out manner.

What is AVL tree? Explain with the help of suitable example Give one application. (3)

How a priority queue is different from a normal queue? Write one application of priority queue. (3)

Write a code snippet in Python to insert an element at the front of an already existing singly linked list. (3)

(b) Write a program in Python to compute the sum of 'n' numbers of a list using recursive function. (5)

(c) Arrange the following functions in the increasing order of their asymptotic complexity: (4)

$f_1(n) = 2^n$
$f_2(n) = n^{2/3}$
$f_3(n) = n \log n$
$f_4(n) = \log n$

6. (a) Use recurrence tree method to solve the following recurrence relation: (4)

$T(n)\ T\ (n\text{-}1) + n$

(b) Solve the following recurrence relation: (5)

$T(n) = 2T\ (n/4)+n^2$

(c) Explain what Big O notation represents. Show the function $8n+5$ is O(n) (6)

4. (a) Consider a heap of height h. What will be the maximum and minimum number of elements in the heap? (4)

(b) Create a binary tree whose following traversals are given: (5)

Inorder: x y z a p q r

Preorder: a y x z q p r

(c) Construct the max-heap for the given array A given as (6)

A = [4,1,3,2,16,9,10,14,8,7]

Show all the steps clearly.

5. (a) Convert the given iterative function to recursive function: (4)

```
def power (base, exponent):
        result = 1
        for i in range(exponent):
            result *= base
        return result
```


Explain any two properties of binary heap. How is it different from a binary search tree? (3)

Implement a Python function that counts the number of nodes in a circular linked list. (4)

Write a program in Python to print Fibonacci numbers via Binary recursion. (4)

Differentiate between Big Oh, Big Ω (Omega) and Big θ (theta) notations. (4)

2. (a) Convert the following infix expression to a postfix expression. A* (B+D)/E – F* (G+H/K)

Show all the steps clearly. (4)

(b) Consider the following sequence of operations performed on a stack S of size 5. Show the return value and contents of stack after each operation: (5)

S.push(5)

S.push(3)

S.pop( )

S.is_empty()

S.pop()

S.push(9)

S.top( )

S.push(4)

S.push(15)

len (S)

(c) What is an abstract data type? (6)

Write the time-complexity for the following operations:

(i) The push operation of stack implemented using linked list.

(i) The pop operation of stack implemented using linked list.

(iii) To delete all the elements from the end in a singly linked list with n elements.

(iv) To search an element in Balanced Binary Search Tree (BST) in best case scenario.

3. (a) Suppose an initial empty queue Q has executed a total of 32 enqueue operations, 10 first operations and 15 dequeue operations, 5 of which raised Empty errors that were caught and ignored. What is the current size of Q? (4)

(b) What are the drawbacks of using linear queue? How can it be resolved through circular queue? (5)

(c) Consider an initially empty circular queue of the size 4 implemented using arrays. Perform the sequence of operations and show the position of front and rear after each operation. (6)

enqueue (14)

dequeue( )

dequeue( )

enqueue (3)

enqueue (7)

enqueue (9)

enqueue (0)

enqueue (2)

[This question paper contains 8 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **8078** **I**

Unique Paper Code : 2343010020

Name of the Paper : Research Methodology (Computer Science)

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

Semester : VI

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) All Parts of Question No. **1** (Section A) are compulsory.

(c) Attempts any four questions from Section B.

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

(e) Use of scientific calculator is allowed.

Section - A

1. (a) What do you mean by Research ? Explain its significance. 3

P.T.O.

(b) What is difference between deductive and inductive research ? 3

(c) What is a citation-index ? Explain the significance of SCI and SCIE indexing in academic publishing. 3

(d) Give any **three** reasons on the basis of which a paper might be rejected by the journal. 3

(e) Name any **six** general tools of research. 3

(f) The marks obtained by 5 students in a test are : 45, 50, 55, 60, 65. Calculate the Standard Deviation (SD) of the marks. 3

(g) A student has a Z-score of 4.5 : 4

(i) Calculate its IQ score.

(ii) Calculate its stanine score.

(h) Identify whether the following statements are **True** or **False** : 4

(i) Intellectual property is often divided into two categories-industrial property and copyright and related rights.

(ii) Research methodology and research methods are exactly the same.

(iii) The research problem should be stated after the data collection.

(iv) Plagiarism can occur even if the source is cited incorrectly.

(v) WoS indexed articles are considered credible in academic research.

(vi) Impact factor is used to measure author's research impact.

(vii) Bibliography is always placed at the end of the research article.

(viii) Exploratory research is conducted when the problem is not clearly defined.

(i) Select the most appropriate answer for the following multiple-choice questions : 4

1. Which of the following is **not** a characteristic of research ?
   (a) Systematic approach
   (b) Objective analysis
   (c) Random guesswork
   (d) Logical reasoning
2. In research, a hypothesis is :
   (a) a proven fact
   (b) a temporary assumption
   (c) a statistical error
   (d) a variable
3. Which of the following is an example of primary data ?
   (a) Census reports
   (b) Research articles
   (c) Data from experiments
   (d) Textbooks

4. The first step in the research process is :
   (a) Data collection
   (b) Hypothesis formulation
   (c) Identifying the research problem
   (d) Literature review
5. Quantitative research deals with :
   (a) Feelings and emotions
   (b) Descriptive data
   (c) Numerical data
   (d) Visual interpretation
6. Which research design is best for studying cause-effect relationships ?
   (a) Exploratory research
   (b) Descriptive research
   (c) Experimental research
   (d) Qualitative research
7. A literature review is used to :
   (a) Publish new results
   (b) Identify gaps in existing research
   (c) Create statistical models
   (d) Eliminate errors in experiments
8. Patent is an intellectual right related to :
   (a) Inventions
   (b) Watermark
   (c) Rights of authors
   (d) Geographical indication

Section - B

2. (a) What is plagiarism ? Name any **two** plagiarism tools. Mention **three** ways to avoid plagiarism. 5

(b) The following data gives the number of hours studies and marks obtained by 5 students : 10

Hours Studied (X)	Marks Obtained (Y)
2	40
4	50
6	60
8	70
10	80

(i) Compute the average deviation of marks obtained.

(ii) Compute geometric mean of hours studied.

(iii) Compute the standard deviation of marks obtained.

(iv) Find Z-score of marks 65.

(v) Pearson correlation coefficient (r) is 1 and Coefficient of determination (r^2) is 1. Interpret the relation between X and Y.

3. (a) Consider the following propositions : 5

Case 1 : Proposition : All humans are mortal.

Socrates is a human.

Conclusion : Therefore, Socrates is mortal.

Case 2 : Observation: All humans lived and died.

Pattern : All observed humans have eventually died implies they are mortal.

Which research method – deductive or inductive – is demonstrated in Case 1 and Case 2 respectively ? Justify your answer.

(b) You are given the number of days taken to complete each of 11 different tasks. Use the data below to compute the mean, median, mode, second quartile and IQR of tasks completion times. 10

Tasks	**No. of Days**
Task 1	2
Task 2	6
Task 3	11
Task 4	14
Task 5	20
Task 6	20
Task 7	8
Task 8	7
Task 9	6
Task 10	3
Task 11	2

4. (a) Calculate and interpret the difference in the variance of marks obtained by a student in nine subjects in semester I (S1) and Semester II (S2). 5

S1	45	46	49	25	17	18	13	56	58
S2	47	49	43	27	29	38	37	60	50

(b) Differentiate between the following using examples : 10

(i) Basic and Applied Research

(ii) Evaluation Research and Development Research

(iii) Quantitative and Qualitative Research

5. (a) What do you understand by peer-review ? Who all are considered as the peers in the peer-review process ? 5

(b) In a standard normal distribution, what percentage of data falls within each of the following intervals : 10

(i) within 1 standard deviation of the mean (-1σ to $+1\sigma$)

(ii) within 2 standard deviation of the mean (-2σ to $+2\sigma$)

(iii) within 3 standard deviation of the mean (-3σ to $+3\sigma$)

Represent the same using a graph. Show the change in the graph :

(i) if the data is positively skewed ?

(ii) if the data is negatively skewed ?

6. (a) What does TRIPS stand for ? Identify and briefly explain any **four** key areas of intellectual property that are covered under the TRIPS Agreement. 5

(b) Explain Nominal, Ordinal, Interval and Ratio data with examples. 10

7. (a) What is a hypothesis ? What are the steps involved in hypothesis testing ? 5

(b) (i) A researcher has published 7 papers, and the citation counts for each paper are : 21, 18, 12, 9, 7, 4, 2. Calculate the h-index and i10 index for this researcher. 5

(ii) A journal cites 1220 articles in 2024, and publishes 100 articles in 2023, 150 articles in 2022, 310 articles in 2021. Calculate its impact factor and CiteScore for the year 2024. 5

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