

[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 2908**

**H**

Unique Paper Code : 32341201

Name of the Paper : Programming in JAVA

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

Semester : II

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) Write the output(s) of the following Java code snippets : (3×2)

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```
(i) class SumBytes {  
    public static void main (String [] args) {  
        System.out.println("Adding bytes");  
        byte b1 = 10, b2 = 10;  
        System.out.println("b1 + b2 = " + (b1 + b2));  
        b2 = 20;  
        System.out.println("b1 + b2 = " + b1 + b2);  
    }  
}
```

```
(ii) public class test {  
    public static void main(String[] args){  
        String str = "javaprogram";  
        System.out.println(str.substring(1,5)); } }
```

(b) public class test { (3)

```
    public static void main(String[] args){  
        int[] x = {50,60,70,80,90};  
        for(int i = 0; i < x.length; i=i+2){  
            System.out.print(x[i]);  
        }  
    }
```

(c) What will be the output of the following Java program (3×2)

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```
(i) public class Demo {  
    static {  
        System.out.println("Seema in the first static block");  
    }  
    public static void main(String[]args)  
    {  
        System.out.println ("Samita is in the main method");  
    }  
    Static {  
        System.out.println("Meena is in the second static  
block");  
    }  
}
```

```
(ii) int sum=0;  
    int b[]={ 1,2,3,4};  
    for(int i:b)  
        sum=sum+i;  
    System.out.println("Sum is"+sum);
```

(d) class Demo { (5)

```
    public static void main(String[] args) {  
        int a = 5;  
        int b = 9;  
        System.out.println(a | b);  
        System.out.println(a & b);  
        System.out.println(a ^ b);  
        System.out.println(~a);  
        System.out.println(~a & 0x0f);  
    }  
}
```

(e) What is the result after execution of following expression in Java? (2\*2)

(i) int a = 4, b = 6 and c = 5;

a += b/c + 2;

(ii) int m = 2, n = 4;

int k = n%m+2;

(f) Name event listener interface that is notified when the following event occurs : (5)

- (i) When a mouse is clicked.
- (ii) When a component gains focus.
- (iii) When Key is pressed.
- (iv) When mouse is dragged.
- (v) When text value is changed.

(g) Given the following hierarchy of classes (3)

Class A {...}

Class B extends A {...}

Class C extends B {...}

In what order, the constructors are called when an object of class "C" is instantiated?

(h) How is the class prevented from being inherited?  
Give an example. (3)

### Section – B

2. (a) How is exception handling managed in Java? Is it possible to use multiple catch with a single try? Explain with an example. (6)
- (b) Rewrite the following code segment to handle the Exception that will occur on executing the following codes segments : (2×2)

```
(i) public static void main(String[]args)
{
    int a = 98, b = 0;
    int c =a/b;
    System.out.println(c);
}
```

```
(ii) int z[ ] = new int[10];
      z[10] = 10;
```

3. (a) Using Java AWT, write a program that does the following : (5)

Creates a frame titled "New Frame" having two fields to add Userid and Password. If the user types in correct user id and correct password, display a message "Successful" inside the frame otherwise display "Invalid Credentials".

- (b) Using appropriate adapter class to display the message "Typed character is: "<typed Character>" in the frame window when user types any key. (5)

4. (a) Given an integer variable `int a = 2`, what is the output for `a >> 1` and `a << 1`? (3)

- (b) Find the Error in the following code segment. Also rewrite the correct code after making suitable changes. (4)

```
class Box{
private int width; int height; int length ;
}
class mainclass {
public static void main(String[] args)
{
Box obj=new Box();
obj.width = 10; obj. height =2; obj.length=10;
int y = Obj.width *obj. height* obj.length;
System.out.println (y);
}
}
```

- (c) What is the output of the following Java program? (3)

```
class Show{
public static void main(String[] args)
{
int x = 9, y = 0;
if(++x == 1 && ++y ==1)
{
System.out.println(x);
System.out.println(y);
}
}
}
```

5. (a) Explain the term polymorphism. How does Java support run time polymorphism? Illustrate with an example. (6)
- (b) What is Method overriding in Java? Explain with the help of an example. (4)
6. (a) Write a program in Java to read a file "SourceFile.txt" and copy only those lines that contain both the characters '#' and '@' to another file "DestFile.txt". (6)
- (b) Differentiate between paint() and repaint() methods defined by AWT. (4)
7. (a) Differentiate : (2×3)
- (i) Byte Stream and Character Stream
  - (ii) == and equals
  - (iii) String and StringBuffer class
- (b) Write a program in Java to read multiple strings from the command line and display the length of each string? (4)



[This question paper contains 12 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4076**

**H**

**Unique Paper Code : 2342011201**

**Name of the Paper : Object Oriented Programming  
with C++ (DSC-04)**

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

**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. **Section A** is compulsory (Question 1).
3. Attempt any 4 questions from **Section B** (Questions 2 to 6).
4. Parts of a question must be answered together.

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**Section A****(Compulsory Question)**

1. (a) Write a code snippet to do the following : (3)

- Declare str, a pointer to char and initialized to the value "NITIN".
- Display the ASCII value of each character of the pointer str.

(b) What will be the output after executing the following code segments? Assume all the required header files have been included. (3×6=18)

(i) 

```
double sal[]={3415.5, 6718.8, 7911.5};
double total=0;
for (int k=0; k<3; k++)
    total+=sal[k];
cout << "The total salary is" << total;
```

(ii) 

```
for (int j=1; j<=4; j++)
{
    for(int k=1; k<=j; k=k+2)
        cout<<(j+k);
    cout<<endl;
}
```

```
(iii) char A[]={'R','G','Y','P','\0'};
      for(int k=0;A[k];k++)
      {
          switch(A[k])
          {
              case 'R': cout<<"It is red color";
                        break;
              case 'G': cout<<"It is green color";
                        break;
              case 'Y': cout<<"It is yellow color";
                        break;
              default: cout<<"No color";
          }
      }
```

```
(iv) class Frt
    {
        int x,y;
    public:
        Frt(int x,int y)
        {
            cout<<"Inside Frt"<<endl;
            this->x=x;
            this->y=y;
            cout<<this->x<<this->y<<endl;
        }
    };

    class S_Frt: public Frt
    {
        int k;
    public:
        S_Frt(int i,int j,int k1):Frt(i,j)
        {
            cout<<"Inside S_Frt"<<endl;
            k=k1;
            cout<<k;
        }
    };

    void main()
    {
        S_Frt obj(2,3,4);
    }
```

(v) void fl(int& I, int& m)

```
{  
    I=I+10;  
  
    m=m+15;  
}
```

int main()

```
{  
    int x=40, y=50;  
    cout << x << y << endl;  
    fl(x,y);  
    cout<<x<<y<<endl;  
    return 0;  
}
```

(vi) void excl(int i)

```
{  
    try  
    {  
        if(i%2==0)  
            throw 1;  
        else  
            throw 'y';  
    }  
    catch(int i)  
    {  
        cout<<"Caught"<<i<<endl;  
    }  
}
```

int main()

```
{  
    try  
    {
```

```
        excl(4);  
        excl(5);  
    }  
    catch(...)  
    {  
        cout<<"all caught";  
    }  
    return 0;  
}
```

- (c) Write the definition for the following function  
prototype : (3)

`void concatenate(char a[], char b[], int n, int m)`

where n and m are the sizes of the arrays a and b respectively. The function, concatenate appends elements of array b at the end of array a.

- (d) Assume all relevant header files are included.  
Write the main function for the following code to  
show runtime polymorphism. (3)

```
class Base  
{  
public:  
    virtual void show()  
    {  
        cout<<"Inside base B1";  
    }  
};
```

```

class Derived: public Base
{
public:
void show()
{
cout<<"Inside derived";
}
};
void main()
{
....
....
}

```

- (e) Write a program to copy the content of the file "A1.txt" to another file "A2.txt", word by word. Also, display the number of words copied.

(3)

### Section B

2. (a) Write a program that accepts  $x$  and  $n$  as input from the command line to compute the following series.

$$s = x - x^3/3! + x^5/5! - x^7/7! + \dots$$

where  $n$  is the number of terms in the above series.

(9)

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- (b) Rewrite the following code using for and switch statements. Also, give the output of the code. (6)

```
char *ch="hello world";
int countv=0, countalp=0;
int i=0;
while(ch[i])
{
    if(ch[i]=='a' || ch[i]=='e' || ch[i]=='i' ||
ch[i]=='o' || ch[i]=='u')
        countv++;
    else
        countalp++;
    i++;
}
cout<<countv<<endl;
cout<<countalp;
```

3. Consider the following class : (15)

```
class Bankaccount
{
.....
};
```

Declare data members name, accno and balance of appropriate data types for the class Bankaccount. Define its member functions to perform the task mentioned below :

- (i) Default and parameterized constructors to initialize data members of the class Bankaccount.

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- (ii) void input() : This function reads values for name, accno and balance from the user.
- (iii) void withdraw (double x): This function debits (subtracts) x from the balance only if the (balance-x)  $\geq 500$  else the message, "unable to debit, the minimum balance should be 500" is printed.
- (iv) void deposit (double x) : This function credits (adds) x to the balance.
- (v) void display() : This function prints all account details of a given bank account object.

Write a main function to create the Bankaccount objects and illustrate the usage of the above functions.

4. (a) Give the output of the following code : (5)

```
class Figure
{
    protected:
        double area;
    public :
        Figure()
        {
```

```
        cout<<"Figure Constructor";
        area=0;
    }
    virtual void display()=0;
};

class circle: public Figure
{
    double radius;
public:
    circle(double r)
    {
        cout<<"Inside Circle Constructor"<<endl;
        radius=r;
    }
    void display()
    {
        area=3.14*radius*radius;
        cout<<"The area of circle is"<<area<<endl;
    }
};

class rectangle: public Figure
{
    double length, breadth;
public:
    rectangle(double l, double b)
    {
        cout<<"Inside Rectangle Constructor"<<endl;
        length=l;
        breadth=b;
    }
    void display()
    {
        area=length*breadth;
        cout<<"The area of rectangle is"<<area<<endl;
    }
};

int main()
{
    circle c1(4.5);
    rectangle r1(5,6);
    c1.display();
    r1.display();
    return 0;
}
```

- (b) Consider the following declaration of the Vector class : (10)

```
class Vector
{
    int a[20];
    int n;
    ...
};
```

Rewrite the above class using templates suitably. Also, define the following member functions in the class :

- (i) Default and Copy constructor.
  - (ii) void input (int n): This function reads n values in an array.
  - (iii) Vector add(...) : This function adds two vector objects element-wise, stores the result in a new vector object, and returns the new vector object.
  - (iv) void display() : This function prints elements of the vector.
5. (a) Identify an error in the following code and give reasons for the same. (6)

```
class first_c
{
    int p;
protected:
    char s;
public:
    float q;
    first_c(int p1, char s1, float q1):p(p1), s(s1),
    q(q1){}

};

class second_c: public first_c
{
    double t1;
public:
    second_c(int i, float j, char l, double p):
    first_c(i,l,j)
    {
        t1=p;
    }

};

void main()
{
    first_c t1(4, 's', 4.6f);

    cout<<t1.p;
    cout<<t1.s;
    cout<<t1.q;
    second_c t2(1, 3.4f, 'y', 56.7);
    cout<<t2.p;
    cout<<t2.s;
    cout<<t2.q;
    cout<<t2.t1;
}
```

(b) Consider the following function declaration: (9)

```
void sort(int a[], int n)
{
```

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Define the function sort to sort an array of integers. Show step-by-step execution of the above sort function for the following data.

34, 56, 71, 1, 2

6. (a) Write C++ declarations/code for the following :

(i) A function f sum takes three arguments as follows: x, an array of integers, constant y of datatype double, and chi a character reference variable. The return type of the function is void.

(ii) Declare a function fx, that accepts two parameters: A: a pointer to double, B: a 2-dimensional array of integers, and returns a void datatype.

(iii) An array of float B initialized to values 3.4, 5.6, 7.8, 9.1.

(iv) Declare two pointer variables p and q initialized to the address of two float variables x and y. Write statements to increment the value of x and y using p and q.

(v) Write a statement to find the maximum of two numbers, pvalue and rvalue using the ternary operator. (10)

(b) Create a class Box with a static data member, count. Write the class definition that displays the number of objects created and destroyed. (5)

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**Your Roll No.....**

**Sr. No. of Question Paper : 4114**

**H**

**Unique Paper Code : 2342011202**

**Name of the Paper : Discrete Mathematical Structures**

**Name of the Course : B.Sc. (Hons.) Computer  
Science (NEP-UGCF-2022)**

**Semester : II**

**Duration : 3 Hours**

**Maximum Marks : 90**

**(For admissions of 2022)**

**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.
5. Use of simple calculator is allowed.

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(b) (i) Give the bit strings for the sets  $A = \{2, 3, 4, 5\}$  and  $B = \{1, 6, 7\}$ , with universal set as  $U = \{1, 2, 3, 4, 5, 6, 7, 8\}$ . (8)

(ii) Use bit strings to find the union, intersection and difference of the sets A and B.

3. (a) Prove that a tree with  $n$  vertices has  $n - 1$  edges. (7)

(b) In how many ways can 22 different books be distributed among eight students, so that

(i) Six students would have 2 books each and the other two students would have 5 books each.

(ii) Two particular students would get exactly 1 book each.

(iii) Two particular students do not get any book. (8)

4. (a) In a batch of class 11, there are 250 students. A total of 52 students have taken a course in Computer Science, 140 have taken a course in Mathematics, and 56 have taken a course in Economics. Further, 25 have taken courses in both Computer Science and Mathematics, 20 have taken courses in both Computer Science and Economics, and 15 have taken courses in both Mathematics and Economics. There are 120 students that have taken at least one of Computer Science, Mathematics, and Economics.

- (i) How many students have taken a course in all three subjects?
- (ii) How many students have not taken a course in any of these three subjects?
- (iii) How many students opted for Computer Science but not for Mathematics? (7)

(b) Let  $a$  be a numeric function such that :

$$a_r = \begin{cases} 2 & 0 \leq r \leq 2 \\ r & r \geq 3 \end{cases}$$

Find  $\Delta a$ ,  $\nabla a$  and  $S^2 a$ . (8)

5. (a) Using truth table, show that  $(p \rightarrow (q \rightarrow r))$  and  $((p \wedge q) \rightarrow r)$  are logically equivalent. (7)

(b) Find the sum and product of the numbers  $(102)_3$  and  $(201)_3$  in base 3, without converting them into decimal system. (8)

6. (a) Show that the following argument is valid:

*If Mehek is an architect, then she is ambitious. If Mehek wakes up early, then she does not like paranthas. If Mehek is ambitious, then she wakes up early. Then, if Mehek is an architect, she does not like parathas.* (7)

(b) Let  $A = \{1, 3, 6, 8, 21, 25\}$  be a non-empty set and  $R$  be the partial order relation of divisibility defined on  $A$ , i.e., if  $(a, b) \in A$ , then  $a$  divides  $b$

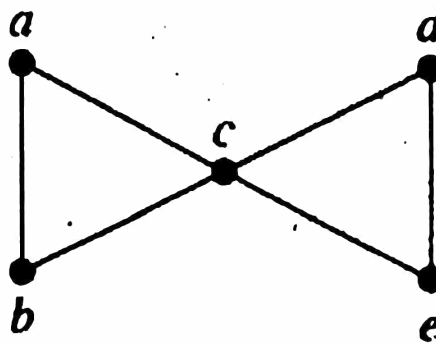
(i) Draw the Hasse diagram of  $R$ .

(ii) Find the maximal and minimal elements in  $A$ . (8)

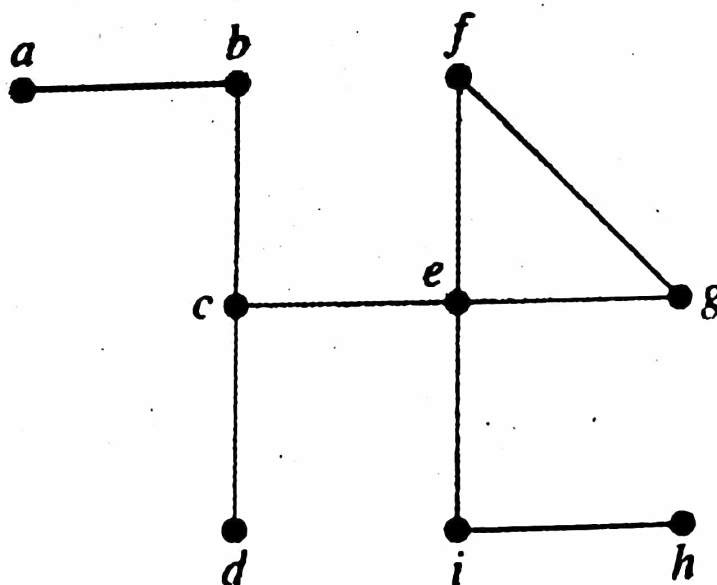
7. (a) What is a planar graph?

Draw a planar graph with at least 3 regions. Verify its planarity using Euler Formula. (3)

(b) Consider the graph given below : (4)



- (i) Check whether this graph has an Euler Circuit. Give such a circuit, if it exists.
- (ii) Check whether this graph has a Hamiltonian Circuit. Give such a circuit, if it exists.
- (c) Identify all the cut vertices and cut edges in the graph given below : (8)





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**Your Roll No.....**

**Sr. No. of Question Paper : 4152**

**H**

Unique Paper Code : 2342011203

Name of the Paper : Probability for Computing

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

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**. Each question is of **15** marks.
4. Part of the questions to be attempted together.
5. Use of non-programmable Scientific Calculator allowed.

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## Section A

1. (a) Let E, F, G be three events. Find expression for the events that of E, F, G

(i) Both E and F but not G occur

(ii) At least one events occur

(iii) At most two occur

(iv) All three events occur (4)

(b) (i) When are two states said to communicate with each other?

(ii) For the given transition probability matrix of a four-state Markov chain with states 0, 1, 2, and 3, answer the following :

$$P = \begin{pmatrix} \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ \frac{1}{4} & \frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

- (a) Which state is an absorbing state?
- (b) Do states 0 and 2 communicate?
- (c) Do states 0 and 1 communicate? (2+3)
- (c) What is Random number? Write the name of one approach to define the Random number. (2)
- (d) There are  $n$  components. On a rainy day, component  $i$  will function with probability  $p_i$ ; on a non-rainy day, component  $i$  will function with probability  $q_i$ , for  $i = 1, 2, \dots, n$ . It will rain tomorrow with probability  $\alpha$ . Calculate conditional expected number of components that function tomorrow, given that it rains. (3)
- (e) Write down the probability mass function of the following distributions:

(i) Binomial Random variable

(ii) Geometric Random Variable (2+2)

(f) If  $X$  and  $Y$  are independent, then show that for any function  $h$  and  $g$ :  $E[g(X)h(Y)] = E[g(X)]E[h(Y)]$  (3)

(g) Prove the following :

$$\text{Var}(X) = E[\text{Var}(X|Y)] + \text{Var}(E[(X|Y)]) \quad (4)$$

(h) Coming home from work, Neha always encounters traffic signal. The probability that she makes it through a traffic signal is 0.2. How many traffic signals can she expect to hit before making it through one? What is the probability of the third traffic light being the first one that is green? (5)

### Section B

2. (a) What is Normal Random Variable? Drive the formula of the following :

(i) Normal density function of Normal Random Variable.

(ii) Cumulative distribution function of Normal Random Variable. (2+2+2)

(b) Let X and Y be two jointly continuous random variables with joint Probability Joint Function (PDF) :

$$(x, y) = \begin{cases} x + cy^2, & 0 \leq x \leq 1, 0 \leq y \leq 1 \\ 0, & \text{otherwise} \end{cases}$$

Find the constant c. (5)

(c) A fair die is rolled. Consider the following events :

$A = \{1, 3, 5\}$ ,  $B = \{2, 3\}$ , and  $C = \{2, 3, 4, 5\}$ . Find (4)

(i)  $P(A/B)$  and  $P(B/A)$

(ii)  $P(A \cup B / C)$

3. (a) Two urns contain 2 red, 3 white, and 3 red, 5 white balls, respectively. One ball is drawn at random from the first urn and transferred into the second one. A ball is then drawn from the second urn and it turns out that the ball is red. What will be the probability that the transferred ball was white? (5)

(b) Calculate  $E[X]$  when  $X$  is a Poisson random variable with parameter  $\lambda$ . (4)

(c) Suppose that whether or not it rains today depends on previous weather conditions through the last two days. Specifically, suppose that if it has rained for the past two days, then it will rain tomorrow with probability 0.7; if it rained today but not yesterday, then it will rain tomorrow with



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[This question paper contains 12 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 3109**

**H**

Unique Paper Code : 32341403

Name of the Paper : Database Management Systems

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

Semester : IV

Year of Admission : 2019, 2020 & 2021

Duration : 3 Hours

Maximum Marks : 75

**Instructions for Candidates**

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. **Section A** is compulsory.
3. Attempt any **FOUR** questions from **Section B**.

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## SECTION A

1. (a) Consider the following relations : (6)

*Book Author*(*AuthorID*, *Author\_Name*, *City*)

*Book*(*BookID*, *Book\_Name*, *AuthorID*, *Royalty\_Fees*)

- (i) Write the SQL command to insert a new attribute *Price* in the relation *Book*.
  - (ii) Write the SQL command to change the value of *City* to "New Delhi" for *AuthorID*="A1001".
  - (iii) Write the SQL query to list the names of books written by author whose name has 5 letters and starts with 'A'.
  - (iv) Write an SQL query to list the total of *Royalty Fees* for each author.
- (b) Differentiate between controlled and uncontrolled redundancy? Give suitable examples. (2)
- (c) What is Entity Integrity constraint in a relation? Explain the concept of weak entity. (3)

(d) Give an example for each of the following using EER diagram : (4)

(i) Predicate-defined disjoint subclasses

(ii) Partial-overlapping specialization

(e) Consider the given two sets of FDs, F and G, for a relation  $R(A,B,C,D,E)$  : (5)

$$F = \{A \rightarrow B, AB \rightarrow C, D \rightarrow AC, D \rightarrow E\}$$

$$G = \{A \rightarrow BC, D \rightarrow AE\}$$

Are F and G equivalent? Justify your answer.

(f) What is the role of data independence in three-schema architecture? Differentiate between logical data independence and physical data independence. (3)

(g) Consider the tables T1 and T2 as follows : (6)

Table T1

P	Q	R
10	a	5
20	b	1
30	c	7
40	a	9

Table T2

X	Y	Z
20	a	5
40	b	4
10	a	6
40	a	8

The attributes P, Q, R and X, Y, Z, respectively, are domain compatible. Show the results for the following :

$$(i) \Pi_{P,Q}(T1) \cap \Pi_{X,Y}(T2)$$

$$(ii) T1 \bowtie_{T1.P=T2.X} T2$$

$$(iii) \Pi_{T1.R, T2.Z} (\sigma_{T1.Q=T2.Y} (T1 \times T2))$$

- (h) Consider the following concurrent execution of two transactions, T1 and T2. Identify and explain the problem with its execution. (4)

Timestamp	T1	T2
T0	read_item(X);	
T1	X:=X+N;	
T2		read_item(X);
T3		X:=X-M;
T4	write_item(X);	
T5	read_item(Y);	
T6		write_item(X);
T7		
T8	Y:=Y-N;	
T9	write_item(Y);	

- (i) Consider the following two relations : (2)

*Faculty*

<i>FacultyID</i>	<i>Name</i>	<i>CourseID</i>
101	Rakesh	5
201	Shikha	12
301	Prakashtha	5
401	Daisy	10

*Course*

<i>CourseID</i>	<i>Name</i>
5	DBMS
12	Java
15	C++
10	AI

Show the result after the execution of the following on these two relations :

(i) Right Outer Join

(ii) Natural join

### Section B

2. Design the ER diagram for the following database that contains information concerning sales representatives, sales areas and products. (10)

- (i) Each representative has a unique identifier with name, age and salary.
- (ii) Each area is described by a unique identifier with name, city and budget allocated to that area.

- (iii) Each product has a unique identifier with name, product description and price.
- (iv) Each representative is responsible for sales in one or more areas; and has the number of hours and revenue in rupees from sales in each area recorded. Each area has one or more representatives.
- (v) Similarly, each representative is responsible for sales of one or more products; and has the number of hours and revenue in rupees from sales of each product recorded. Each product has one or more responsible representatives.
- (vi) Every product is sold in every area. The quantity sold of every product is also recorded.

Specify key attributes and all constraints on the relationships.

3. Consider the following database schema : (10)

*Item*(Name, Category, Price)

*Store*(Name, City, Area)

*Ordered*(ItemName, StoreName, Date)



Give SQL queries for the following :

- (i) Create the table *Ordered*, with all the constraints.
  - (ii) List maximum and minimum price for each category of items.
  - (iii) List all items ordered by stores located in either "Pune" or "Delhi".
  - (iv) List all items priced at more than Rs. 10000 and are never ordered by store located in area="North".
  - (v) For each store, count the number of items ordered on "12 April 2023".
4. (a) Consider the following FDs for R(ABCDEFGH) :
- $A \rightarrow E, AD \rightarrow BE, AC \rightarrow E, E \rightarrow B, BG \rightarrow F, BE \rightarrow D, BDH \rightarrow E, F \rightarrow A, D \rightarrow H, CD \rightarrow A$
- Find a minimal cover for the given FDs. (5)
- (b) Consider the following relations : (5)

*Author*

<u>AuthID</u>	<u>Name</u>	<u>BookID</u>
101	Rakesh	5
201	Shilpa	12
301	Prakash	5

*Book*

<u>BookID</u>	<u>Name</u>	<u>Price</u>
5	DBMS	344
12	Dbase	489
15	C++	676

The table *Author* stores information about authors and *Book* stores information about the books. *BookID* in *Author* references *BookID* in the table *Book*.

For each of the following operations, indicate whether it results in constraint violation and if so, why?

- (i) Insert <401, "Ramesh", 20> in Author
- (ii) Insert <401, "Vivek", 5> in Author
- (iii) Delete <5, "DBMS", 344> from Book
- (iv) Insert <17, "Transactions", 239> in Book
- (v) Update Author

set BookID=25, Name="Priyanka"

where AuthID=201

5. (a) Consider an empty B+ tree with order  $p=3$  and perform the following : (6)

- (i) Insert keys 70, 15, 20, 35, 18, 55, 43 in the given order. Show the tree after each insertion.

(ii) Show the tree after deleting key 18 from the tree.

(b) Consider a file having 20,000 *STUDENT* records of fixed length. Each record has the following fields: *ID#* (7 bytes), *NAME* (35 bytes), *ADDRESS* (46 bytes), and *COURSE* (12 bytes). This file is stored on a disk of block size  $B = 512$  bytes.

- (i) Calculate the record size and the blocking factor *bfr*.
- (ii) Calculate the number of block accesses needed to search for a record if a binary search is performed on this file (assuming the records are stored sorted on *ID#*).
- (iii) How many block accesses would be required to search for a record, if a primary index on the key *ID#* is created, given that the size of block pointer is 6 bytes?

(4)

6. (a) Consider the schema  $R(ABCDEFGH)$  with the following FDs : (7)

$BE \rightarrow GH, G \rightarrow FA, D \rightarrow C, F \rightarrow B$

Find the key of  $R$  and show the steps of derivation. Decompose the given schema  $R$  into the highest normal form possible. Is the resulting schema in BCNF? Justify.

- (b) Differentiate between database schema and database state. (3)

7. (a) Consider the following database schema : (7)

*Sailor*(sid, sname, rating, age)

*Boats*(bid, bname, color)

*Reservation*(sid, bid, date)

The table *Sailor* stores information about sailors and *Boats* stores information about boats. The table *Reservation* stores information about the reservation of boat by a sailor on a date.

Write the following queries in relational algebra :

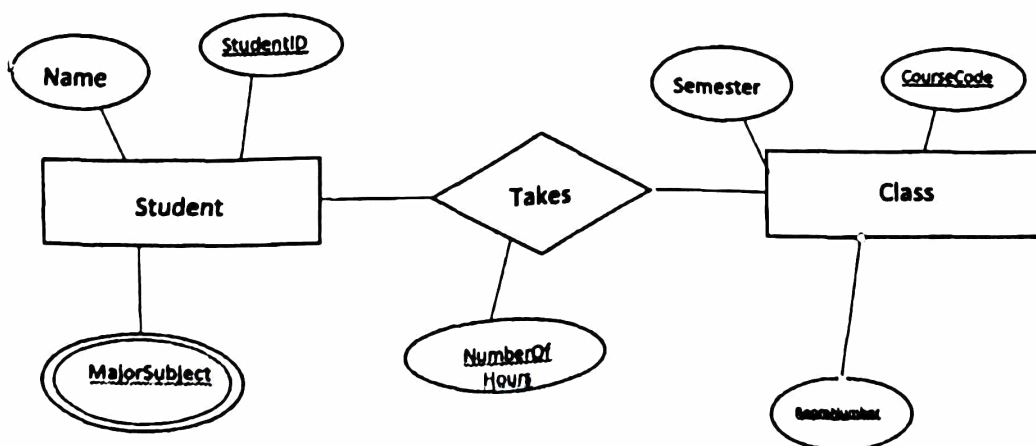
- (i) Find the color of boats reserved by "Aman".

(ii) Find the names of the sailors who have not reserved a red boat.

(iii) Find the names of sailors who have reserved every boat reserved by those with a lower rating.

(b) Given the following ER diagram : (3)

A *Student* entity is stored with *ID*, *Name* and *MajorSubject*, whereas, *Class* entity is stored with *Semester*, *CourseCode* and *RoomNumber*. The relationship between the entities student and class is given by *Takes*, which indicate that a student takes a class and spends *NumberOfHours* on it.



**3109**

**12**

Map the ER diagram to a relation schema.  
Mention all primary keys and foreign keys for each  
relation.

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6  
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**Your Roll No.....**

**Sr. No. of Question Paper : 4057**

**H**

Unique Paper Code : 2342012401

Name of the Paper : Design and Analysis of Algorithms

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

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. 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.

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## Section – A

1. (a) Arrange the following sorting techniques in the increasing order of the number of comparisons that they would do in order to sort the data : {7, 3, 9, 12, 11}. Justify your answer.

Insertion sort, Merge sort, Improved Bubble Sort (5)

- (b) What is (5)

(i) greedy-choice property?

(ii) optimal substructure property?

- (c) Write the recurrence equation for solving 0-1 knapsack problem using dynamic programming. How is memoization technique used in solving the problem? (5)

- (d) Consider a directed graph  $G$  with one component. Can a vertex  $u$  of  $G$  end up in a depth-first tree containing only  $u$ , even though  $u$  has both incoming and out-going edges in  $G$ ? Justify your answer with an example. (5)

- (e) Use Strassen's algorithm to compute the product of the following matrices : (5)

$$\begin{pmatrix} 1 & 3 \\ 5 & 7 \end{pmatrix} \begin{pmatrix} 8 & 4 \\ 6 & 2 \end{pmatrix}$$

- (f) A sequence of  $n$  operations is performed on a data structure. The  $i^{\text{th}}$  operation costs  $i$  if  $i$  is an exact power of 2, and 1 otherwise. Use aggregate analysis to determine the amortized cost per operation. (5)

### Section – B

2. (a) Can 0–1 knapsack problem be solved optimally using greedy strategy? Justify your answer. (7)

- (b) “Suppose  $Y \leq_p X$ . If  $X$  can be solved in polynomial time, then  $Y$  can be solved in polynomial time.”

Based on the above statement, which of the following statements are correct? If any statement is incorrect, write its correct version. (8)

- (i) If  $Y$  cannot be solved in polynomial time, then  $X$  cannot be solved in polynomial time.
  - (ii)  $Y$  is at least as hard as  $X$ .
  - (iii) If  $X$  belongs to NP, then  $X$  is NP-complete problem. (8)
3. (a) What is an in-place sorting algorithm? Is heap sort an in-place sorting algo-rithm? Sort the following data using heap sort.
- 4, 3, 7, 1, 8, 5, 9 (7)
- (b) Suppose there exists an  $O(n)$  time algorithm to find the 5<sup>th</sup> smallest element in an array of size  $n$ . Sort the following data using quick sort assuming 5<sup>th</sup> smallest element as the pivot.
- 7, 3, 5, 1, 2, 4, 6
- Also, determine the time complexity of the algorithm. (8)
4. (a) Consider the following algorithm for finding an element  $t$  in a sorted array  $A$  of size  $n$ : (7)

ternary\_search(Array A, Index first, Index last, Element t)

Array A is divided into 3 equal parts.

Let p and q be the index of the elements that divide A such that  $p < q$

if  $t = A[p]$  return p

else if  $t < A[p]$  then ternary\_search(A, first, p-1, t).

else if  $t = A[q]$  return q

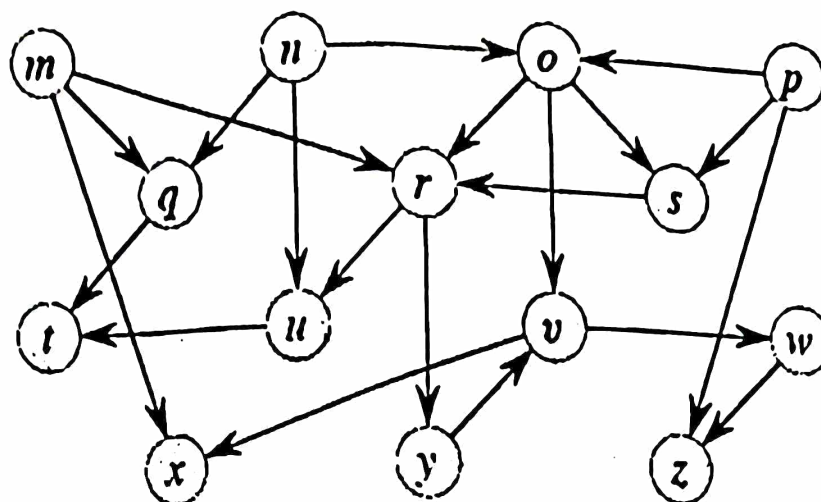
else if  $t < A[q]$  then ternary\_search(A, p+1, q-1, t).

else ternary\_search(A, q+1, last, t)

Write a recurrence equation for computing the time complexity of the above algorithm and Justify the equation obtained by you and also solve it.

- (b) An implementation of radix sort uses heap sort instead of count sort as the intermediate sorting technique. Is radix sort still stable? Justify your answer with an example. (8)

5. (a) For the given directed acyclic graph, determine the topological ordering. (7)



- (b) Write an efficient algorithm to check if a given undirected graph has a cycle. Discuss the time complexity of your algorithm. (8)

6. (a) Solve the subset sum problem using dynamic programming for the set  $\{4, 2, 9, 6\}$  and intended sum 17. (7)

- (b) Let  $T$  be the Minimum Spanning Tree (MST) with cost  $C$  corresponding to a graph  $G(V, E)$ . Suppose  $c(e)$  denotes the non-negative edge cost for an edge  $e$  in  $E$ . In each of the following cases, indicate whether  $T$  and  $C$  will change if the edge costs are replaced with : (8)



(i)  $c(e)^2$

(ii)  $1 - c(e)$

Justify your answer.

7. (a) Given a set of  $n$  numbers, write an algorithm to find the maximum and minimum element using divide and conquer strategy. Also, determine the time complexity. (7)

- (b) Consider a department of the university with 60 teachers and 20 courses. The administration department maintains the records such that each record contains the name of a teacher and the course he/she is teaching. A teacher name can be maximum 32 characters long and courses are coded as BCS101, MCS101, MCA101, etc. Each teacher may be teaching more than one course and one course may be taught by more than one teacher. Give a linear time algorithm to sort the teachers course wise, in alphabetical order. Courses should also be reported in chronological order. For example, the sorted records must look like the following : (8)

BCS101	SNEHA
BCS101	SWAPNIL
...	
BCS102	ANIL
BCS102	BEENA
BCS102	SNEHA
...	
MCA101	AJAY
MCA101	AMARJEET
...	

and, so on

(7)  
[This question paper contains 16 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4095**

**H**

**Unique Paper Code : 2342012402**

**Name of the Paper : Database Management Systems**

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

**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.

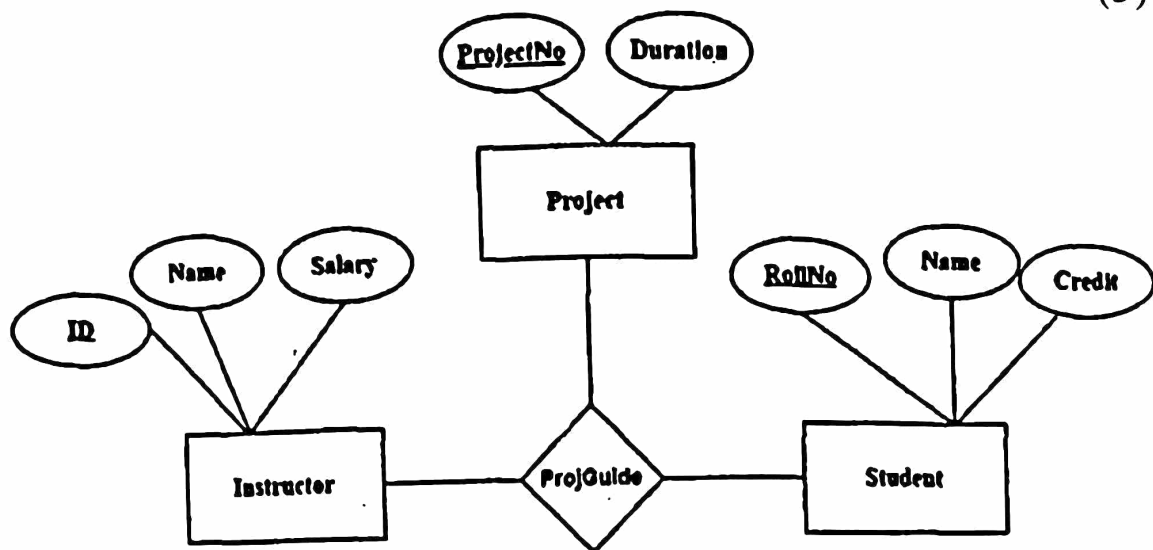
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## Section A

1. (a) Consider the following Entity Relationship diagram (ERD) for a ternary relationship ProjGuide. Map the given ER diagram to a relation schema.

(3)



- (b) Consider the following SQL statements : (3)

(i) CREATE TABLE

(ii) SELECT

(iii) INSERT

(iv) CREATE VIEW

(v) DELETE

(vi) ALTER TABLE

For each of the above commands, indicate whether it is a Data Manipulation Language (DML) command, Data Definition Language (DDL) command, or View Definition Language (VDL) command.

(c) Consider the following relations : (3)

Employee(empID: integer, deptID: integer, empSalary: integer, empHobby: char (20))

Department(deptID: integer, deptName: char (20), deptFloor: integer)

Which attributes will appear in the output on executing the following SQL queries?

(i) SELECT \* FROM Employee E NATURAL JOIN Department D;

(ii) SELECT \* FROM Employee E, Department D WHERE E.deptID = D.deptID;

(d) Consider the following relations for a database that keeps track of business trips of salespersons working in a sales office : (3)

SALESPERSON (SSN, name, joiningDate, supervisorSSN)

4095

TRIP (tripID, SSN, fromCity, toCity, departureDate, returnDate)

EXPENSE (tripID, accountNo, amount)

The sales office maintains multiple bank accounts. A trip can be charged to one or more accounts. Specify the foreign keys for the above relations.

(e) Consider the following relations R and S : (3)

R				S		
A	B	C	D	B	D	E
15	1	15	a	1	a	15
20	2	25	a	3	a	20
25	4	20	b	1	a	25
15	1	25	a	2	b	30
30	2	20	b	3	b	null

Show the output for the following relational statements :

(i)  $R \bowtie_{R.B = S.B} S$

(ii)  $R \bowtie_{R.C = S.E} S$



- (f) Consider the following relational schema : (3)

Suppliers(sID: integer, sName: string, address: string)

Parts(pID: integer, pName: string, color: string)

Catalog(sID: integer, pID: integer, cost: real)

Write relational algebra expressions to perform the following :

- (i) Find the names of suppliers who supply a red part.
  - (ii) List the IDs and names of parts with an entry in the table Catalog.
- (g) Identify multivalued and composite attributes from the following complex attribute : (3)
- {Hobby\_stats (Name (First\_name, Last\_name), {Phone (Area\_code, Phone\_number)}, {Hobbies})}
- (h) In the given schedule, what is the problem encountered due to concurrent execution of transactions T1 and T2? Assuming the initial value  $X=5$ , what will be the value of  $X$  after the schedule is executed? (3)

Timestamp	T1	T2
1	read(X)	
2	X=X+10	
3		Read(X)
4		X=X+20
5	Write(X)	
6		Write(X)
7		Commit
8	Commit	

(i) Consider the following relation StudentCourse.

(3)

StudentCourse

studentID	studentName	CGPA	courseID	courseName	credits
123	Shyam	9	C118	C++	4
132	Shyam	8.5	C121	Java	4
131	Mohan	7.5	C118	C++	4
135	Vijay	8	C118	C++	4

Which of the following commands result in an update anomaly? Justify your answer.

(i) DELETE FROM StudentCourse WHERE  
studentID = 132

(ii) UPDATE StudentCourse SET credits = 3  
WHERE courseID = 118

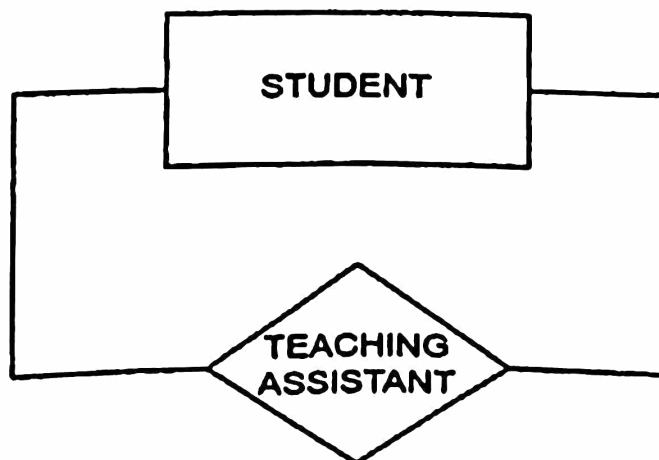
- (j) Consider the relation  $R = \{A, B, C, D, E, F, G, H, I, J\}$  and the set of functional dependencies  $F = \{\{A, B\} \rightarrow \{C\}, \{A\} \rightarrow \{D, E\}, \{B\} \rightarrow \{F\}, \{F\} \rightarrow \{G, H\}, \{D\} \rightarrow \{I, J\}\}$ . (3)

(i) Find the closure of  $\{A, B\}$ .

- (ii) Assuming  $\{A, B\}$  as the primary key, does the relation  $R$  exhibit partial dependency? Justify your answer.

### Section B

2. (a) Consider a relation  $R(\underline{A}, B)$ . Is the given relation in BCNF? Why or why not? (3)
- (b) Consider the following ER diagram and answer the questions that follow : (5)



- (i) Specify the role names for the given relationship.
  - (ii) Determine the cardinality ratio. Justify your answer.
  - (iii) Determine the participation constraint. Justify your answer.
- (c) Consider the following relation for which {Car#, Salesperson#} is the primary key. Assume that all attributes are simple and atomic. Also, assume that a car may be sold by multiple salespersons.
- CarSale(Car#, dateSold, Salesperson#, Commission%, DiscountAmt)

Additional functional dependencies are :

{dateSold  $\rightarrow$  DiscountAmt}, {Salesperson#  $\rightarrow$  Commission%} (3+4)

- (i) Based on the given primary key, check whether the above schema is in 2NF. Justify your answer.
- (ii) If required, normalize the given relation up to 3NF. Show all the intermediate steps.

3. (a) Consider the following relation schema : (4)

Student(SSN, Name, Major, Birthdate)

Course(CourseId, CourseName)

Enroll(SSN, CourseId, Duration)

Which of the relational model constraints may be violated by the following operations? Justify your answer in each case,

(i) Insert a record in the Enroll table.

(ii) Delete a record from the Student table.

- (b) Describe the three-schema architecture with the help of a suitable diagram. In this context, give a suitable example of data independence. (3+2)

- (c) State and prove the Pseudotransitive inference rule. (1+3+2)

Apply the above rule to infer ONE additional functional dependency for the given set  $F = \{M \rightarrow P, MY \rightarrow P, YP \rightarrow C\}$

4. (a) Consider a relation  $R(A, B, C, D, E)$  with the following dependencies : (2)

$\{AB \rightarrow C, CD \rightarrow E, DE \rightarrow B\}$

Is AB a candidate key of this relation? Justify your answer.

(b) Consider the following SQL statement : (4)

Create table Student

(Rollno INT,

Name VARCHAR(15),

Marks DECIMAL(3,2),

Age INT CHECK(Age >= 17 and Age <= 25),

DOB DATE);

Which of the following values entered for the columns holds valid? Justify your answer for each case.

(i) '14-12-2002' for DOB

(ii) 34.75 for Marks

(iii) 16 for Age

(iv) '21' for RollNo



- (i) Specify the role names for the given relationship.
  - (ii) Determine the cardinality ratio. Justify your answer.
  - (iii) Determine the participation constraint. Justify your answer.
- (c) Consider the following relation for which {Car#, Salesperson#} is the primary key. Assume that all attributes are simple and atomic. Also, assume that a car may be sold by multiple salespersons.
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- (b) Describe the three-schema architecture with the help of a suitable diagram. In this context, give a suitable example of data independence. (3+2)
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Which of the following values entered for the columns holds valid? Justify your answer for each case.

(i) '14-12-2002' for DOB

(ii) 34.75 for Marks

(iii) 16 for Age

(iv) '21' for RollNo

(c) Consider the following relation schema : (9)

Student (sNum: integer, sName: string, major: string, level: string, age: integer)

Class (cName: string, room: string, fID: integer)

Enrolled (sNum: integer, cName: string)

Write SQL statements to perform the following :

- (i) Find the names of all classes that either meet in room 'R12' or have five or more students enrolled.
- (ii) For all levels except 'JR', display the level and the average age of students for that level.
- (iii) Find the names of students not enrolled in any class.

5. (a) Consider the following relational schema : (3)

retiredEmployee

empID	empName	basicSalary	deptName	payGrade
101	Rahul	25000	Finance	ABC
102	Rohit	35000	Admin	DEF
103	Naman	15000	Research	ABC
104	Sreejee	40000	Finance	DEF
105	Pranay	22000	Admin	PQR
106	Dheeraj	45000	Research	PQR
107	Aarav	14000	Finance	ABC

P.T.O.

pensionGrade

payGrade	Amount
ABC	2500
DEF	3000
PQR	3500

Show the result for each of the following on the tables :

(i) SELECT deptName, COUNT (\*), SUM  
(basicSalary)

FROM retiredEmployee

GROUP BY deptName;

(ii) SELECT empID, empName, deptName

FROM retiredEmployee

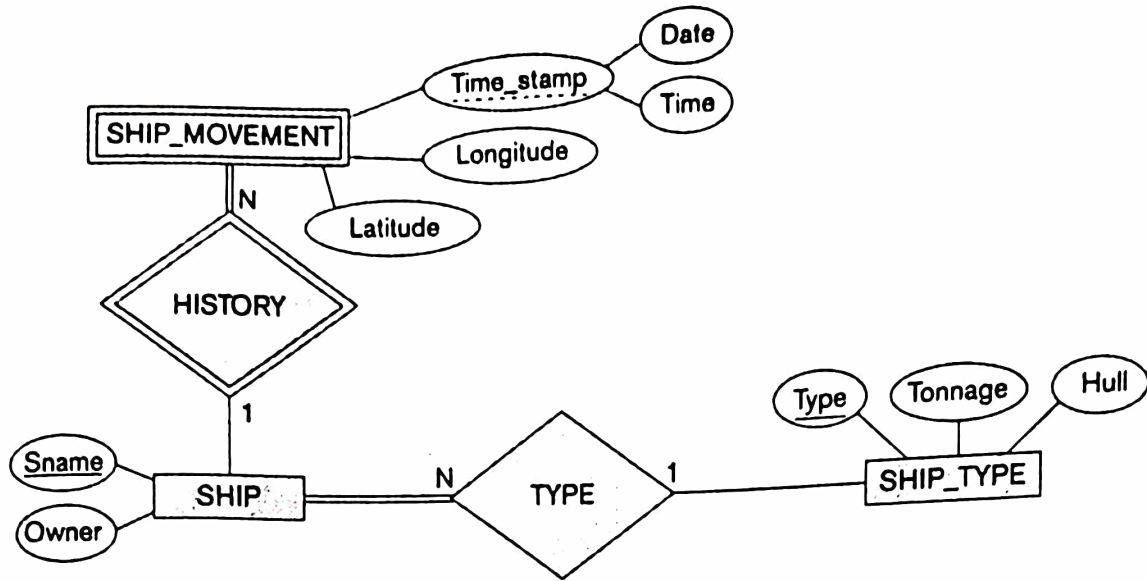
WHERE empName LIKE '\_a%';

(b) Consider the following ER diagram to conceptualize a database that can be used to keep track of transport ships and their locations. (6)

(i) Map the given ER diagram into a relational schema.

(ii) Specify the primary key and foreign keys for each relation.





(c) Consider the following two tables, T1 and T2 :  
(6)

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	C
10	b	6
15	c	3
10	b	5

Show the results of the following operations :

- (i)  $\rho_T (T1 \times T2)$
- (ii)  $T1 - T2$
- (iii)  $T1 \cap T2$



6. (a) Compare and contrast the traditional file processing approach with the database approach in the context of the self-describing nature of the database system. (2)
- (b) Why can a database allow at most one primary index on a file but several secondary indexes? (3)
- (c) Consider a relation R with three attributes {A, B, C}. It is decomposed into relations R1 with attributes {A, B} and R2 with attributes {B, C}. State the condition (using relational algebra notation) that should be met for this decomposition to satisfy lossless-join property. (4)
- (d) Considering the below given state of R(A, B, C, D): (6)

A	B	C	D
1	2	3	4
1	2	3	5
6	7	8	2
2	1	3	4

Which of these FDs may hold on R? Justify your answer.

- (i)  $D \rightarrow A$
- (ii)  $BC \rightarrow D$
- (iii)  $BC \rightarrow A$

7. (a) How does multilevel indexing improve the efficiency of searching an index file? (3)

(b) Suppose that we have an ordered file with  $r = 10,000$  records stored on a disk. The records are of fixed size and are unspanned. The search key field in each record is  $V = 9$  bytes long. The remaining attributes of the record are 91 bytes in total. The block size for the disk is  $B = 1024$  bytes.

Compute the following :

(i) record length (R)

(ii) blocking factor (bfr)

(iii) number of file blocks (b)

(iv) number of block accesses required during binary search on the data (4)

(c) ABC shipping company prides itself on having up-to-date information on the processing and current location of each shipped item. To do this, the company relies on its database management system.

Shipped items can be characterized by item number (unique), weight, dimensions, insurance

amount, destination, and final delivery date. Shipped items are received into the system at a single retail center. Retail centers are characterized by their type, unique ID, and address. Shipped items arrive at their destination via one or more standard transportation events (i.e., flights, truck deliveries). These transportation events are characterized by a unique schedule number, a type (e.g., flight, truck), and a deliveryRoute.

Create an Entity Relationship diagram that captures this information about the company. Also, indicate the primary key, cardinality, and participation constraints. (8)

[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4133 H**  
**Unique Paper Code : 2342012403**  
**Name of the Paper : Computer Networks**  
**Name of the Course : B.Sc. (Hons.) Computer Science (UGCF NEP)**  
**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. The paper has **two** sections. All 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**

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

(i) Five devices arranged in a mesh topology

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- (ii) Five devices arranged in a bus topology
  - (iii) Five devices arranged in a ring topology
- (b) For each of the following network applications, indicate whether TCP or UDP would best fit the service requirements of the application, and justify. (3)
- (i) Multiplayer online first-person shooting game
  - (ii) Text-based instant messaging app
  - (iii) Video Streaming
- (c) Calculate the maximum data rate of a channel with a bandwidth of 200KHz when sixteen levels of digital signaling are used. (3)
- (d) Suppose a communication system has a bandwidth of 10 MHz. Using FDM, this bandwidth is divided into 5 equal frequency bands. Each band carries a separate signal with a bandwidth of 2 MHz. Calculate the total bandwidth required for multiplexing these signals using FDM. (3)
- (e) Name the layer of the OSI model which performs the following functions : (3)
- (i) Route determination



- (ii) Process-to-process delivery
  - (iii) Error Correction and error Detection
- (f) State the significance of the following special IP addresses : (3)
- (i) 127.0.0.1
  - (ii) 255.255.255.255
  - (iii) 0.0.0.0
- (g) What is the purpose of following flag bits with respect to TCP header? (3)
- (i) SYN
  - (ii) FIN
  - (iii) DF
- (h) In a mesh network configuration comprising eight devices, how many ports does each device require to establish direct connections with every other device in the network? Furthermore, what is the total count of physical links necessary to facilitate data communication between all interconnected devices? (3)
- (i) Give three differences between circuit switching and packet switching? (3)



(j) Name the protocols to be used in the following scenarios : (3)

- (i) To map an IP address to a MAC address
- (ii) To map a MAC address to an IP address
- (iii) To assign the IP addresses to the host automatically

### Section B

2. (a) Compare and contrast TCP and UDP (User Datagram Protocol) in terms of their features, advantages, and disadvantages. Discuss scenarios where each protocol would be suitable for data transmission. (7)

(b) Consider a network comprising five routers labeled as A, B, C, D, and E. The interconnections and their associated costs are given as follows :

- Link between A and B: Cost 2
- Link between A and C: Cost 4
- Link between B and C: Cost 1
- Link between B and D: Cost 5
- Link between C and D: Cost 3
- Link between C and E: Cost 7
- Link between D and E: Cost 2

Using Dijkstra's algorithm, illustrate the step-by-step process of determining the shortest path from router A to router E. (8)

3. (a) Consider a Go-Back-N ARQ protocol operating over a network. The window size ( $W$ ) is 4, and the sequence numbers range from 0 to 7. Assume that frames with sequence numbers 0, 1, 2, and 3 have been successfully received by the receiver, and the receiver has sent acknowledgment (ACK) for frames up to sequence number 3. Now, due to network congestion, the frame with sequence number 4 is lost. (7)

- (i) What is the size of the window for sender and receiver?
- (ii) Calculate the range of valid sequence numbers at the sender's side after the loss of frame with sequence number 4.
- (iii) Determine the range of sequence numbers expected by the receiver after it has sent ACK for frames up to sequence number 3.
- (iv) Explain how the sender and receiver handle the loss of frame 4 and maintain synchronization using sequence numbers in the Go-Back-N ARQ protocol.

(b) Differentiate between the following : (8)

(i) Unipolar and Bipolar Line Coding Schemes

(ii) Data Element and Signal Element

4. (a) Which algorithm is used in CSMA/CD networks, particularly in scenarios where multiple stations contend for the channel while transmitting long files? Give the functionality of the algorithm.

(5)

(b) Given the IP address 192.168.0.0/24, an organization needs to create two subnets with the following requirements: (10)

- Subnet 1: 50 hosts
- Subnet 2: 30 hosts

For each of these subnets, give the

- (i) first IP address assigned
- (ii) last IP address assigned
- (iii) subnet mask in the w.x.y.z/s notation
- (iv) identify the range of IP addresses available
- (v) number of host and network bits

5. (a) Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth. (5)
- (b) (i) A code includes the four four-bit codewords: 1001, 0110, 1010, and 0101.
- What is the minimum distance of this code?
  - What is the maximum number of errors that this code is guaranteed to detect?
  - What is the maximum number of errors that this code is guaranteed to correct?
- (ii) A 12-bit odd-parity Hamming code whose binary value is 111001001111 arrives at a receiver. What was the original value of the message ? Assume that not more than 1 bit is in error. (4+6)
6. (a) The following character encoding is used in a data link protocol: A: 7 11010101; B: 10101001; FLAG: 01111110; ESC: 10100011 Show the bit sequence transmitted (in binary) for the five-character frame: A ESC B ESC FLAG when each of the following framing methods are used : (7)
- (i) Flag bytes with byte stuffing.

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(ii) Starting and ending flag bytes, with bit stuffing.

(iii) Character Count

Also, what will be the original data, if the output after byte-stuffing is given as :

FLAG A B ESC ESC C ESC ESC ESC FLAG  
ESC FLAG D X FLAG.

(b) Write short notes on : (8)

(i) File Transfer Protocol

(ii) Simple Mail Transfer Protocol

7. (a) State Shannon's theorem. Determine the maximum achievable data rate for this channel based on Shannon's theorem when the communication channel has a bandwidth of 5 MHz and an SNR of 40 dB. (7)

(b) Draw the layered architecture of TCP/IP model explaining the services provided by each layer. Given an example network, if we change the LAN technology to a new one, which layers in the TCP/IP protocol suite need to be changed and why? List the layers at which routers and switches are used. (8)



[This question paper contains 4 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4194**

**H**

**Unique Paper Code : 2343012007**

**Name of the Paper : Network Security**

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

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

**Section A**

**(Compulsory)**

1. (a) What are Network Security goals? (3)

(b) Differentiate among threat, attack and Vulnerability

(3)

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- (c) Explain the term plain text, cipher text and key?(3)
- (d) What are the characteristics of a good security policy? (3)
- (e) Describe Encryption and Decryption with suitable examples? (3)
- (f) Differentiate between Private key cryptography and Public key cryptography (3)
- (g) Explain Forensics analysis with suitable examples. (3)
- (h) What is Rogue Access Point. (3)
- (i) Define the following terms: (3)
  - (i) Hub
  - (ii) IPS
  - (iii) Router
- (j) Explain Mobile Device Management (MDM). (3)

### Section B

- 2. (a) What is access control? Describe all access control approaches. (5)

- (b) What is a firewall and what are the various categories of firewall. (5)
- (c) What is the difference between WLAN and Bluetooth technologies? Explain in detail. (5)
3. (a) What is an IDS? Explain how do signature-based IDS differ from heuristic IDS. (5)
- (b) Encrypt the message "Meet me tonight at square point" using the Ceasar cipher with key size 7. Also decrypt the ciphertext. (5)
- (c) Explain the DMZ in Networking. (5)
4. (a) What is Regulatory Compliance. Why HIPPA was created? (5)
- (b) What is various type of wireless attack? Explained (5)
- (c) What are risk control strategies (5)
5. (a) Perform the encryption of plain text  $(m) = 2$  and decryption of the generated cipher text using the RSA Algorithm. (Given:  $p=3$ ,  $q=11$ ). (5)
- (b) What is risk analysis? List the basic steps of risk analysis. (5)

- (c) Write Short notes on (5)
- (a) Patch management
  - (b) Antivirus
6. (a) What do you mean by password crackers? (4)
- (b) What is PKI? What are the three key components of the PKI? (6)
- (c) What is the difference between the management, technical and operational control? (5)
- 7.(a) Answer the following: (6)
- (i) Virtual Private Network (VPN).
  - (ii) Multifactor Authentication
  - (iii) OSI model
- (b) How do I implement single sign - on (SSO)? (4)
- (c) Why we use hash function ? Explain with suitable example (5)

[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 2926**

**H**

Unique Paper Code : 32341601

Name of the Paper : Artificial Intelligence

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

Year of Admission : 2019 & Onwards.

Semester : VI

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**.
4. Parts of the question must be answered together.

**SECTION A**

1. (a) Explain uses of Cut-Fail predicates in PROLOG.

(2)

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(b) Is it possible to compute  $P(A|\sim B)$  when you are only given  $P(A)$ ,  $P(B|A)$ , and  $P(B)$ ? Explain your answer. (2)

(c) What do you understand by Closed World Assumption. Explain using suitable example? (3)

(d) Transform the following sentence into conjunctive normal form : (3)

$$P \vee (\sim P \ \& \ Q \ \& \ R)$$

(e) What do you understand by Means Ends Analysis? Explain using suitable example? (3)

(f) Is the problem decomposable. Justify the statement. (3)

(g) Differentiate between Model based agent and Utility based agent. (3)

(h) Explain the architecture of the problem solver with a TMS. (3)

(i) Differentiate between deterministic and non-deterministic parser with the help of suitable diagram. (4)



- (j) Draw an associative network for the following sentences : (4)

(i) The car is red and has a powerful engine.

(ii) The cake is delicious and has a creamy frosting.

- (k) Write a script for going to a museum. (5)

### SECTION B

2. (a) Create a frame network for transportation methods and give one complete frame for any one type transportation method which includes the slots for the main component parts, their attributes and relations between parts. (5)

- (b) Transform the following into disjunctive normal form (3)

$$P \rightarrow ((Q \& R) \leftrightarrow S)$$

- (c) Express the following structure as a conceptual graph structure:

“Dog scratches its ear with its paw” (2)



3. (a) Develop a parse tree for the sentence "I saw the man with a telescope" using the following rules : (4)

$S \rightarrow NP VP$

$NP \rightarrow N \mid DET N \mid NP PP$

$VP \rightarrow V \mid VP PP$

$PP \rightarrow PREP NP$

$N \rightarrow I \mid \text{man} \mid \text{telescope}$

$V \rightarrow \text{saw}$

$DET \rightarrow \text{the}$

$PREP \rightarrow \text{with}$

- (b) Draw the RTN to implement the grammar given above. (3)

- (c) Write schemata for default reasoning using the sentence: If someone is adult and it is consistent to assume that adults can vote, infer that person can vote. (3)

4. (a) Give the similarities and differences between Best First Search and A\* algorithm. Under what conditions A\* algorithm provide an optimal solution? (5)

- (b) Using Constraint Satisfaction algorithm. Solve the following cryptarithmic problem. (3)

$$\begin{array}{r}
 \text{T W O} \\
 + \text{T W O} \\
 \hline
 \text{F O U R} \\
 \hline
 \end{array}$$

- (c) Differentiate between a static and dynamic environment of an agent. (2)
5. (a) Explain the following terms with respect to fuzzy sets : (4)

(i) Dilation

(ii) Concentration

- (b) Write a Prolog program to implement GCD of two number (3)

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(c) Given the formulae : (3)

E1:  $A \rightarrow B$

E2:  $\sim B$

G:  $\sim A$

Prove that G is the logical consequence of E1 and E2.

6. (a) Transform the following formula to Prenex Normal Form : (4)

$\forall xy(\exists z P(x, z) \ \& \ P(y, z)) \rightarrow \exists u Q(x, y, u)$

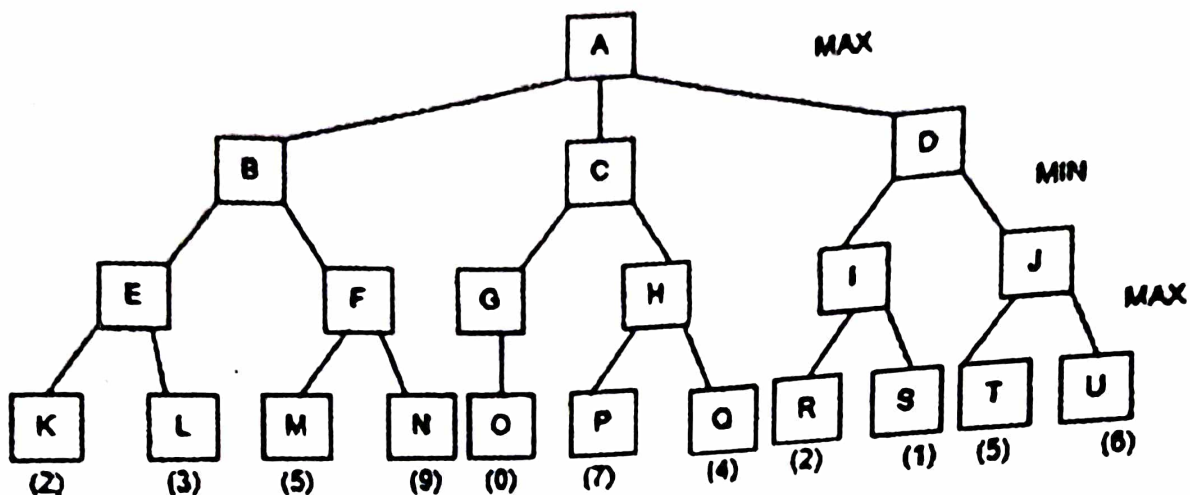
(b) Draw a pictorial definition for the linguistic variable TALL giving your own subjective values for TALL variables and their values. (4)

(c) Explain the following sentence as conceptual dependency structure. (2)

"Susan gave the keys to Peter".

7. (a) Consider the following game tree in which static scores are all from the first player's point of view : (5)

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What move should be chosen and why? Which nodes will be pruned according to the alpha-beta pruning procedure? Give justification of each.

(b) Question - Given the following information for a database : (5)

A1: If x is on top of y, y supports x

A2: If x is above y and they are touching each other, x is on top of y

A3: A cup is above a book

A4: A cup is touching a book

- (i) Translate the above statements A1 to A4 into clausal form.
- (ii) Show that the predicate supports(book,cup) is true using resolution.

[This question paper contains 4 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 2980**

**H**

Unique Paper Code : 32341602

Name of the Paper : Computer Graphics

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

Semester : VI

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. The question paper consists of two sections
3. **Section-A** is compulsory.
4. Attempt any **four** questions from **Section B**.

**Section A**

1. (i) Prove that two scaling transformations are commutative. (2)  
(ii) How long would it take to load a  $640 \times 480$  frame buffer with 12-bit per pixel if  $10^5$  bits can be transferred per second? (3)



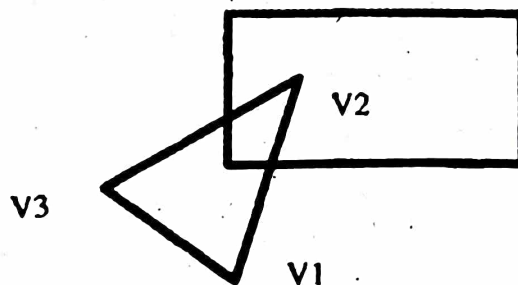
- (iii) Derive 2D transformation that rotates a point by  $\theta^\circ$  about the origin. Write matrix representation for rotation. (3)
- (iv) State any two differences between parallel and perspective projection. (2)
- (v) Describe briefly the steps involved in design of animation sequence.. (3)
- (vi) What is RGB color model? (2)
- (vii) Scan convert the first three coordinates of a line segment P(1,1) and Q(8,5) using Bresenham's mid-point line algorithm. (3)
- (viii) State any two properties of Bezier curve. (2)
- (ix) What is the condition for trivial rejection of a line segment LM with L(0,5) & M(1,5) in Cohen Sutherland Line Clipping algorithm using rectangular window defined by vertices A(0,0), B(1,0), C(1,1) and D(0,1). (3)
- (x) Name two techniques to generate color in a CRT. (2)
- (xi) Magnify the triangle with vertices A(0,0), B(1,1) and C(5,2) to twice its size keeping C(5,2) fixed. (3)
- (xii) Define resolution and persistence (2)

- (xiii) What are the three steps to fill a span in Scanline Polygon filling algorithm? (3)
- (xiv) What is morphing? (2)

### Section B

2. (i) Scan convert the first octant of a circle using midpoint circle algorithm whose radius = 8 and Centre is (0,0). (6)
- (ii) Obtain the reflection of triangle ABC with vertices A(0,1), B(1,2) and C(2,0) about the line  $y = -x$ . Use homogeneous coordinates. (4)
3. (i) Derive the Basis matrix for parametric cubic Bezier curve. Also, obtain its blending functions. (5)
- (ii) Find the equation of the Bezier curve which passes through points (0,0) and (4,2) and controlled through points (14,10) and (4,0). (5)
4. (i) What do you mean by hidden surface removal? Explain depth buffer algorithm for visible surface determination. (6)
- (ii) What is dithering? What are its advantages over halftoning? (4)
5. (i) Describe Phong interpolation shading method what are the merits and demerits of this method? (5)

- (ii) Consider any 3D object, Write the transformations matrices to rotate it about y-axis by  $\theta = -30^\circ$ , about x-axis by  $\alpha = 45^\circ$  and projected onto  $z = 0$  plane from center of projection at  $z_c = 2.5$ . What will be the value of vanishing point? (5)
6. (i) Specify the rules to equalize the set of edges in key frames "k" and "k+1" in an animation scene using these rules, transform a triangle into a pentagon. (5)
- (ii) Draw the four stages of the Sutherland-Hodgeman clipping algorithm as the polygon shown below is clipped by the right, top, left, and bottom clip rectangle edges. (5)



7. (i) List and explain the data structures used in Scan line Polygon filling algorithm. (3)
- (ii) Discuss the architecture of raster display system with integrated display processor. (4)
- (iii) Compute a  $4 \times 4$  3D transformation matrix to rotate the triangle ABC having coordinates  $A(0, 0, 0)$ ,  $B(1, 1, 2)$  and  $C(1, 1, 3)$  by  $90^\circ$  about X-axis keeping B fixed. (3)

[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 3032**

**H**

**Unique Paper Code : 32347611**

**Name of the Paper : Data Mining**

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

**Semester : VI**

**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 (Section A) is compulsory.
3. Attempt any 4 Questions from Nos. 2 to 7 (Section B).
4. Parts of a question must be answered together.
5. Use of Scientific Calculator is allowed.

**Section A**

1. (a) Determine the attribute type for the following :

(i) Price of a Book

(ii) Number of students in a class

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- (iii) Eye color
- (iv) Dates in a Calendar (2)
- (b) How many association rules can be generated from a transactional dataset that contains five items? (2)
- (c) Consider an association rule between items from market basket domain, which has high support and low confidence. What does it signify? (2)
- (d) Consider a categorical attribute with three values {Grade A, Grade B, Grade C}. Covert this attribute to asymmetric binary attributes. (2)
- (e) Give an example to show how the Apriori principle uses the anti-monotone property of support to prune the number of candidate itemsets. (2)
- (f) Explain the problem of class imbalance with the help of an example. (2)
- (g) Explain the following terms with respect to a density-based clustering algorithm: Core point, Border point, and Noise point. (3)
- (h) List two ways to handle missing values and outliers in a dataset. (4)

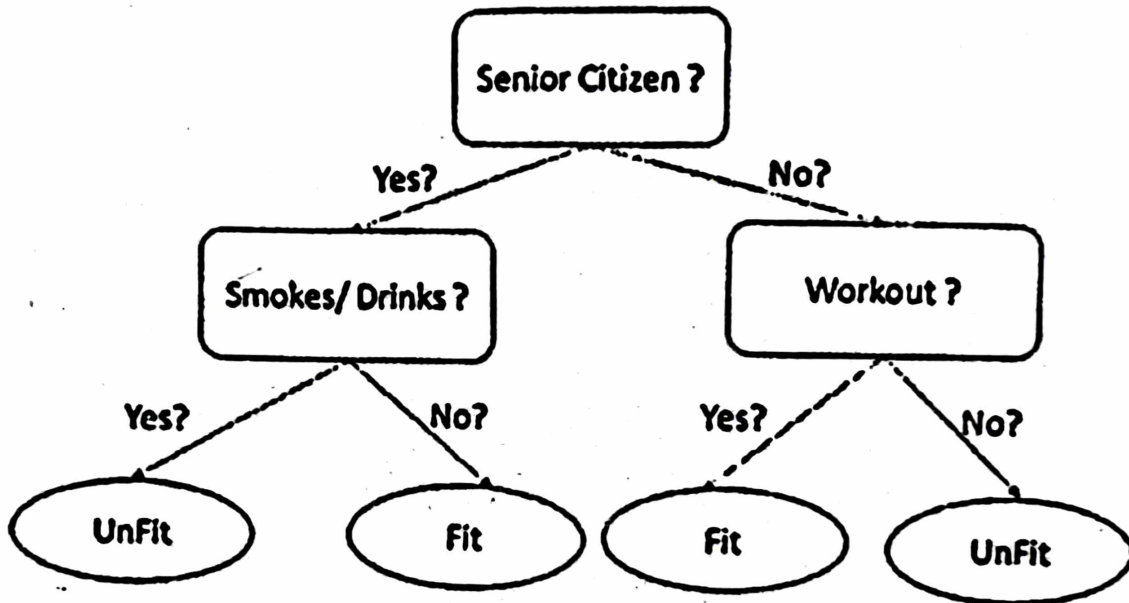
- (i) Enumerate four factors that affect the computational complexity of Apriori Algorithm. (4)
- (j) List two points of difference between the following clustering schemes : (4)
- (i) Complete vs. Partial clustering
- (ii) Partitional vs. Hierarchical clustering
- (k) Consider the following values for two attributes corresponding to four data points:  $P_1(1, 3)$ ,  $P_2(3, 1)$ ,  $P_3(4, 2)$ , and  $P_4(6, 3)$ . Compute the proximity matrix using Euclidean Distance. (4)
- (l) Consider the given dataset with two attributes: Age and Loan Amount measured on different scales. What problem might arise if the dataset is directly used for K-means clustering with Euclidean distance as proximity measure? Show how can this problem be resolved on the data given in following table. (4)

	Age (in years)	Loan Amount (in rupees)
1	42	690000
2	25	510000
3	32	560000
4	37	590000
5	49	850000
6	36	700000



## Section B

2. Consider the following decision tree to classify health of a senior citizen and perform the listed tasks.



- (a) Extract all the classification rules from the tree. Arrange the rules according to class-based ordering. (5)

- (b) Are the extracted set of rules exhaustive? Justify. (2)

- (c) Classify the following records : (3)

- Senior Citizen = Yes, Smokes/Drinks = No, Health = ?
- Senior Citizen = No, Workout = Yes, Health = ?

3. Suppose we have a dataset of 10 patients, where each patient is classified as either 'having a heart disease' or 'not having a heart disease'. The dataset contains three categorical features: the patient's age group ( $x_1$ ), blood pressure level ( $x_2$ ), and cholesterol level ( $x_3$ ). A Naive Bayes classifier is to be used to predict whether a new patient is likely to have a heart disease based on the age group, blood pressure level, and cholesterol level. The dataset and their class labels are given below :

Age Group ( $x_1$ )	Blood Pressure ( $x_2$ )	Cholesterol Level ( $x_3$ )	Heart Disease ( $y$ )
< 40	Normal	Normal	No
< 40	Normal	High	No
< 40	High	Normal	No
40-49	High	Normal	Yes
40-49	High	High	Yes
50-59	Normal	Normal	No
50-59	Normal	High	Yes
50-59	High	High	Yes
60+	High	Normal	Yes
60+	High	High	Yes

- (a) Estimate the conditional probabilities for  $P(\text{Age Group}=60+\backslash\text{Yes})$ ,  $P(\text{Blood Pressure}=\text{High}\backslash\text{Yes})$ ,  $P(\text{Cholesterol Level}=\text{Normal}\backslash\text{Yes})$ ,  $P(\text{Age Group}=40-49\backslash\text{No})$ ,  $P(\text{Blood Pressure}=\text{High}\backslash\text{No})$ , and  $P(\text{Cholesterol Level}=\text{High}\backslash\text{No})$ . (6)
- (b) Use the estimate of conditional probabilities to predict the class label (*Heart Disease*) for a test sample (*Age Group = 50-59, Blood Pressure = High, Cholesterol Level=Normal*) using the Naive Bayes approach. (4)
4. (a) Given a  $2 \times 2$  confusion matrix for a binary classifier, where  $n_{ij}$  denotes number of instances of class  $j$  predicted as class  $i$ . Further,  $\sum_i \sum_j n_{ij} = N$  is the total number of instances. Write expressions for accuracy, precision, recall, and F1-score and compute these metrics for the following confusion matrix : (5)

<u>Original Class</u>	<u>Predicted Class</u>	
	Positive	Negative
Positive	513	2
Negative	4	101

- (b) What is  $k$ -fold cross-validation? Suggest one advantage over the holdout method. (2)

(c) What is 'curse of dimensionality'? What is the difference between feature subset selection and dimensionality reduction techniques. (3)

5. Consider the following dataset, which consists of 10 tuples with two features, X1 and X2, and a binary class label Y.

Tuple No.	X1	X2	Y
T1	0.5	500	A
T2	1	750	A
T3	1.5	250	A
T4	2	1000	A
T5	2.5	600	B
T6	3	200	B
T7	3.5	800	B
T8	4	900	B
T9	4.5	400	A
T10	5	700	A
T11	3	600	?

(a) Scale the features X1 and X2 to range [0 – 1] using min-max normalization. (4)

(b) Use the k-Nearest Neighbor (k-NN) classifier with  $k = 5$  and proximity measure as Euclidean distance to classify the tuple T11 (3, 600). Which class would the k-NN classifier assign to the tuple T11? Justify. (6)

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6. Consider the following data set with nine transactions. Use Apriori algorithm to compute all frequent itemsets of size one and two, considering  $1/3$  as the minimum support. Also, generate strong association rules using frequent 2-itemsets, considering 0.65 as the minimum confidence. (10)

TID	Items
T1	Pen, Pencil, Paper
T2	Pencil, Sharpener
T3	Pencil, Eraser
T4	Pen, Pencil, Sharpener
T5	Pen, Eraser
T6	Pencil, Eraser
T7	Pen, Eraser
T8	Pen, Pencil, Eraser, Paper
T9	Pen, Pencil, Eraser

7. Use complete link agglomerative clustering to group the data described by the following distance matrix. Show the dendrogram. Use Euclidean distance as proximity measure. (10)

	A	B	C	D
A	0	1	4	5
B		0	2	6
C			0	3
D				0

[This question paper contains 12 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 3143**

**H**

**Unique Paper Code : 32347607**

**Name of the Paper : Machine Learning**

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

**ADMISSIONS OF 2019,  
2020 & 2021**

**Semester : VI**

**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. Use of scientific calculator is allowed.

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**Section A**  
**(Compulsory)**

1. (a) Consider a scenario where 6000 patients are tested for Covid positive. Out of which 5000 are actually Covid negative and 1000 are actually Covid positive. For covid positive patients the test however gave positive indication for 700 only and for covid negative patients, the test gave positive indication for 200 patients. Construct a confusion matrix for above scenario and find the values of True Positive Rate (TPR), False Positive Rate (FPR), Specificity, Sensitivity metrics. (5)

- (b) Answer the following : (5)

(i) What is the impact of small dataset with respect to large number of features?

(ii) For the given values  $\theta_0=0.2$ ,  $\theta_1=0.1$ , and  $\theta_2=0.1$ ; predict values of dependent variable  $y$  for all

instances of independent variables  $x_1$  and  $x_2$  as given in following data table using linear regression. Also predict mean squared error.

$x_1$	$x_2$	$y$
1	2	3
2	4	5
3	8	9
2	1	1.5

- (c) Cluster the following set of data objects in two clusters by applying one iteration of k-means algorithm. Treat objects 2 and 5 as initial cluster centres. Use Euclidean distance as the distance metric. Determine updated cluster centre coordinates. (5)

Object Number	X-coordinate	Y-coordinate
1	2	4
2	4	6
3	6	8
4	10	4
5	12	4

- (d) Differentiate between linear regression and polynomial regression. Derive the gradient descent algorithm to find the unknown parameters in multivariate linear regression. (5)
- (e) How PCA (Principal Component Analysis) algorithm helps in dimension reduction in machine learning? Write the steps of PCA algorithm. (5)
- (f) What is regularization? Write equations of cost function for regularized linear and regularized logistic regression. What will be the effect on model when the regularization parameter is set to zero? (5)
- (g) Consider the following dataset with 8 training instances. Use k-NN algorithm (for  $k=3$ ) to determine the 'Result' status for a new test instance with values CGPA = 7.6, Assessment = 60 and Project Points = 7. (5)

S.No.	CGPA	Assessment	Project Points	Result
1	9.2	85	8	Pass
2	8	80	7	Pass
3	8.5	81	8	Pass
4	6	45	5	Fail
5	6.5	50	4	Fail
6	8.2	72	7	Pass
7	5.8	38	5	Fail
8	8.9	91	9	Pass

### Section – B

2. (a) Consider two features in a dataset and their possible values as shown below : (4)

- Income: values (medium, low, high, very high)
- Status: values (SO, AO, Clerk)

Answer the following questions :

- (i) Using Cartesian product on above feature set, construct a new feature and generate its possible values list.

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(ii) State one advantage and one disadvantage of above approach for feature construction.

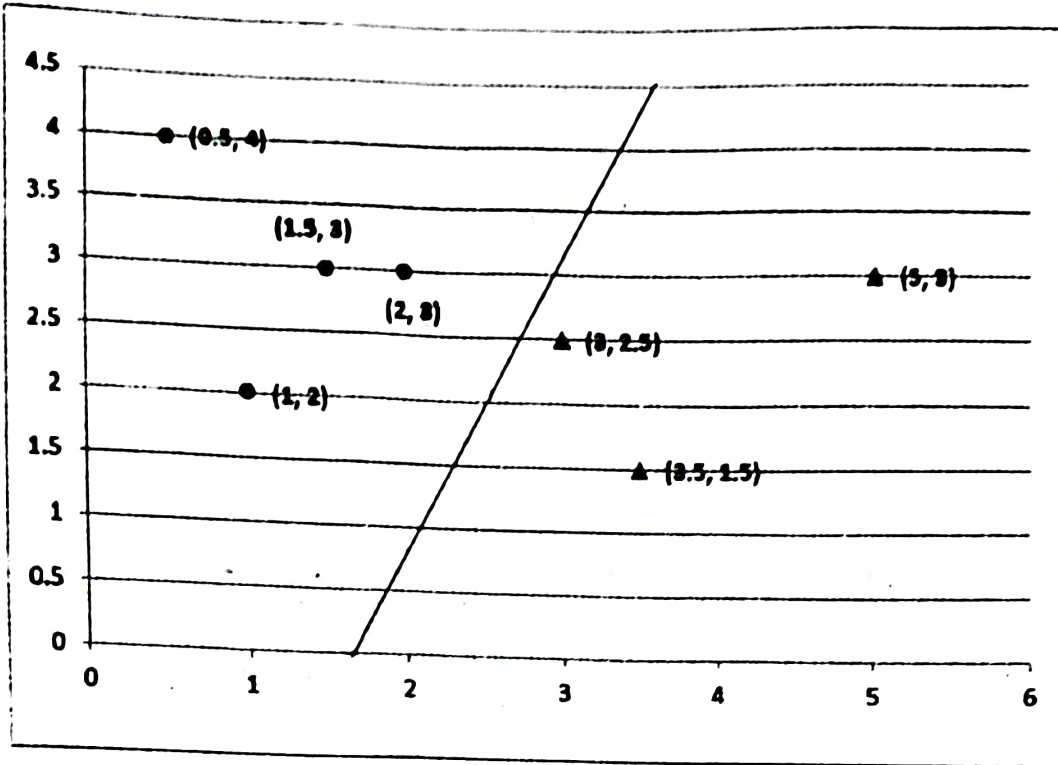
(b) For the given set of points, identify clusters using complete linkage in agglomerative clustering. Use Euclidean distance to calculate the distance between two points. (6)

Points	X coordinate	Y coordinate
P1	1	1
P2	1.5	1.5
P3	5	5
P4	3	4

3. (a) Consider the following two dimensional space with some data points such that circle points represent positive class points and triangular points represent negative class points separated by a decision boundary as shown. (5)

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Answer the following questions :

- (i) Identify support vectors, (with respect to SVM classifier applied on above data)
  - (ii) Draw marginal planes, (with respect to SVM classifier applied on above data)
  - (iii) Define Marginal Distance in SVM algorithm.
- (b) Construct neural network for a two input NOR gate using truth table. Show diagram for your generated neural network model with weights.

(5)



4. (a) Apply Naive Bayesian Classifier to Predict whether a car is stolen or not with features {Color:RED, Origin:Domestic, Typer:SUV} based on given dataset. (5)

Color	Type	Origin	Stolen
RED	SPORTS	DOMESTIC	YES
RED	SPORTS	DOMESTIC	NO
RED	SPORTS	DOMESTIC	YES
YELLOW	SPORTS	DOMESTIC	NO
YELLOW	SPORTS	IMPORTED	YES
YELLOW	SUV	IMPORTED	NO
YELLOW	SUV	IMPORTED	YES
YELLOW	SUV	DOMESTIC	NO
RED	SUV	IMPORTED	NO
RED	SPORTS	IMPORTED	YES

- (b) Differentiate between hold out method, leave one out method and k-fold method for cross-validation. Which of the above methods has low bias and high variance. Justify. (5)

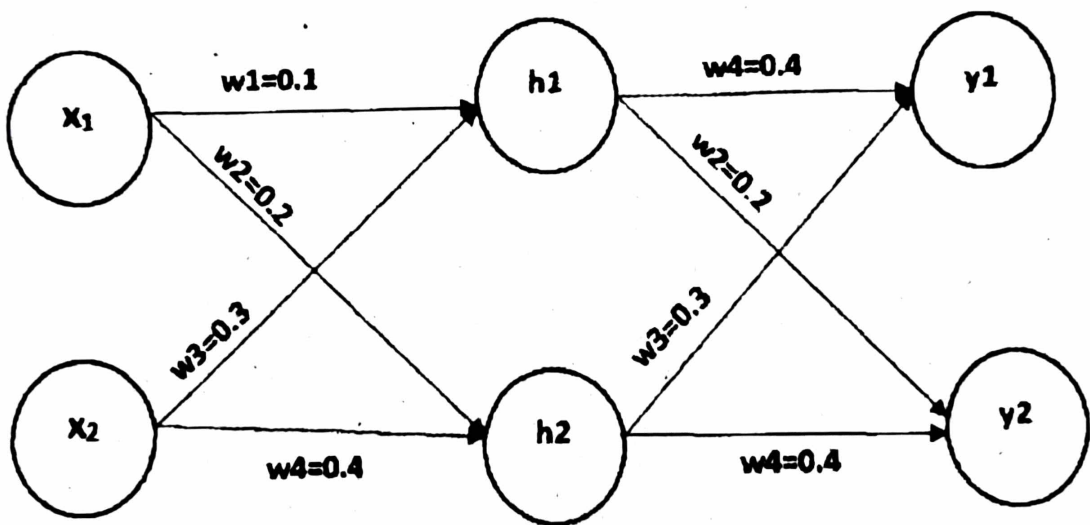
5. (a) Using the data given below, build a logistic regression model to predict whether a student is pass or fail based on exam score using gradient descent algorithm. Assume initial values for model parameters (thetas) as 0 and learning rate as 0.3. Use one iterations of gradient descent algorithm to update the model parameters. (6)

Exam Score (x)	Pass/Fail (y)
50	0
55	0
60	0
65	1
70	1
75	1
80	1
85	1
90	1
95	1

- (b) Using least squares method, learn the regression coefficients for the data given below. Also predict the value of  $y$  for  $x=12$  using your learned coefficients. (4)

X	Y
2	21
4	27
6	29
8	64
10	86

6. (a)



For given input values of  $x_1$  and  $x_2$  as 0.3 and 0.5 respectively, determine the values of output nodes  $y_1$  and  $y_2$ . Use bias  $b_1=0.5$  and  $b_2=0.5$ . Use sigmoid as the activation function for hidden as well as output layer. (7)

(b) Explain the effect of following factors in achieving model convergence with respect to gradient descent algorithm.

- Learning rate is too small.

- Learning rate is too large. (3)

7. (a) Consider following training data for 5 persons. For binary classification of a person as sick or not sick create a decision tree model. Show all the steps. (8)

Person No	A1	A2	A3	Class
1	Yes	Yes	Yes	Not Sick
2	Yes	No	Yes	Sick
3	No	No	Yes	Sick
4	No	Yes	Yes	Not Sick
5	No	Yes	No	Sick

(b) Consider the expected and predicted outcomes of a machine learning classifier on a data set containing 7 observations. Calculate the

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performance of the classifier using Jaccard Index  
metric. (2)

Y expected	0	0	0	0	1	1	1
Y predicted	1	0	0	1	0	1	0



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[This question paper contains 12 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 3352**

**H**

Unique Paper Code : 42341202

Name of the Paper : Database Management Systems

Name of the Course : **B.Sc. (Prog.) Physical  
Science with Computer  
Science/B.Sc. (Prog.)  
Mathematical Science**

Semester : II

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 **5** questions from **Section B**.

**Section A**

1 Answer the following :

- (a) Differentiate between DELETE and DROP command in SQL? Explain with example. (2)

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- (b) Find the cardinality ratio between the following Entity (2)

Entity1

Entity2

School

Principal

Bank

Bank\_Branch

- (c) A *STUDENT* table has following two attributes *Stud\_Id* and *Stud\_Name*. Write an SQL statement to insert a new attribute *Stud\_Address* to the *STUDENT* table. (2)

- (d) Write any two advantages of using database approach over traditional file processing system. (2)

- (e) Who are parametric end users? What kind of transactions do they use? (2)

- (f) State True/False for the following statements :

- (i) If we use GROUPBY command, we cannot see the non-aggregated data in the same query.

- (ii) Multiple constraints can be included in single query. (2)
- (g) What is meant by degree of a relationship type. (2)
- (h) Given the following table and its associated functional dependencies : (2)

**STUD\_PROJECT**

Stud_ID	Project_No	Hours	Student_Name	Proj_Name
---------	------------	-------	--------------	-----------

$Stud\_ID \rightarrow Student\_Name$

$Project\_No \rightarrow Proj\_Name$

$StudID, ProjectNo \rightarrow Hours$

In which normal form is the above relation STUD\_PROJECT? Justify your answer.

- (i) Suggest appropriate datatypes in Structured Query Language (SQL) for the following attributes :

- (i) Date of Birth of an Employee

- (ii) Salary of an Employee
  - (iii) Name of an Employee (3)
- (j) Explain and specify the notation for the following as used in the Entity Relationship Diagram
- (i) Derived attribute
  - (ii) Weak entity (3)
- (k) What is NULL value? Write a query to retrieve all the records from table RESULT where Marks are NULL. (3)

### Section B

2. Consider the database **SALES** consisting of the following relations : (10)

SALES\_PERSON(SNo, SName, Commission)

PRODUCT(PID, Description)

SALE (Date, CNo, SNo, PID, Qty)

CUSTOMER(CNo, CName, CAddress)

Write **SQL Queries** for the following :

- (i) Create the relation SALE. Include primary key and foreign key constraints in the command.
  - (ii) Display the names of all the Sales Person in the company.
  - (iii) Retrieve the name of Sales Person who sold product having PID 17.
  - (iv) Display the total number of products purchased by each customer.
  - (v) Increase the commission by 15% of all Sales Person whose name starts with A.
3. (a) Describe the three level schema architecture of database approach for a DBMS with the help of block diagram. (4)
- (b) Considering the following database **SALES** (6)



SALES\_PERSON(SNo, SName, Commission)

PRODUCT(PID, Description)

SALE(Date, CNo, SNo, PID, Qty)

CUSTOMER(CNo, CName, CAddress)

Write the **relational algebra** queries for each of the following :

(i) Rename the PRODUCT table to PRODUCT\_DETAILS.

(ii) Display the details of customers who live in Delhi.

(iii) Display details of product with product id 1001.

4. (a) Explain Specialization and Generalization used in EER diagram. Give an example for each.

(4)

(b) What is the cardinality (1:1 / 1:N / M:N) for each of the following binary relationships based on the meaning of the entity types? Justify your answer. (6)

(i) Artist and Artwork

(ii) Account\_No and Customer

(iii) PrimeMinister and Country

5. (a) Give one example each of the following : (4)

(i) Identifying relationship

(ii) Recursive relationship

(b) Given the relational schema  $R(A,B,C,D,E)$  and the following set of functional dependencies. (6)

$\{\{A,B\} \rightarrow \{C\}, \{B\} \rightarrow \{E\}, \{A\} \rightarrow \{D\}, \{D\} \rightarrow \{E\}\}$

(i) Derive the primary key for R.

(ii) What normal form is the relation R in?

(iii) Apply normalization to bring it to 3NF if required. State the reason behind each decomposition.

6. (a) Consider the following relations R1 and R2 (4)

**R1**

Id	Name
1008	Amrish
1012	Suman
2000	Tarun
2002	Rani

**R2**

ID	Name
1015	Anita
2005	Varun
2002	Rani
1008	Amrish

Find the result of the following operations :

(i)  $R1 \cap R2$

(ii)  $R1 \cup R2$

(iii)  $R1 - R2$

(iv)  $R2 - R1$

(b) Consider the following relation : (6)

STUDENT (RollNo, SName, Marks, Attendance, Course)

Rollno	SName	Marks	Attendance	Course
1	Smith	95	30	B. A
2	Paul	70	33	B. Sc.
3	James	90	40	B. A
4	John	85	32	B. A
5	Lizza	75	29	B. Sc.

Give the output of the following queries :

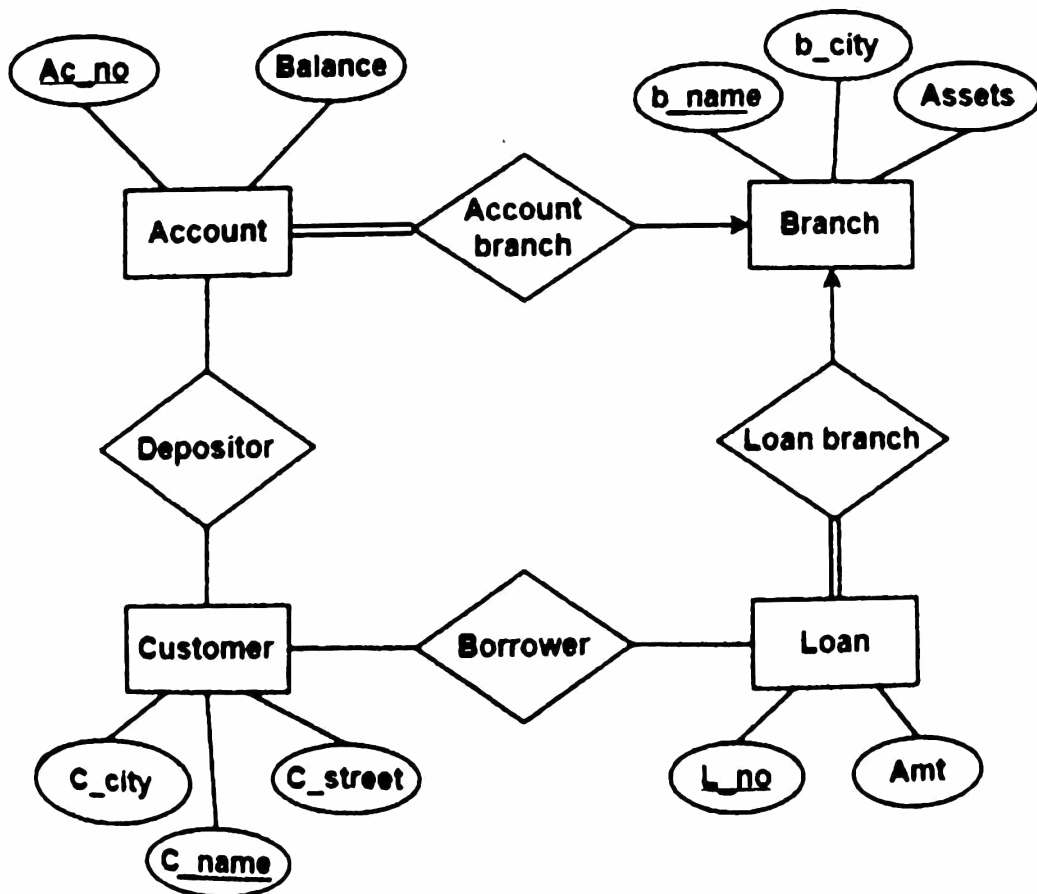
(i) Select max(Marks) from STUDENT group by Course.

(ii) Select SName, Marks, Attendance from STUDENT where Course = 'B.A.'

(iii) Select SName from STUDENT where attendance between 30 and 40.

7. (a) Explain the concept of Specialization Lattice and Specialization Hierarchy with the help of an example. (4)

(b) Map the given ER model into the Relational Model. (6)





8. (a) Design an **entity-relationship diagram (ERD)** (Specify the entities, attributes, relationships, cardinality ratio and participation constraints in the ERD) for the following business rules :

- (i) A university comprises of several colleges.
- (ii) Each college has a Principal.
- (iii) A college has many professors but a professor can serve in one college only.
- (iv) Each college has many students but each student is admitted to only one college.

(4)

- (b) Consider the following schema COMPANY to answer the given questions :

(6)

PROJ(Pnmuber, Pname, Manager – number)

EMP(Empno, Empname, hiredate)

ASSIGNED(Pnumber, Empnumber, Hours)

- (i) Find foreign keys of each table (if any) in the given schema.

- (ii) Give one example of violation of entity integrity constraint while insertion in PROJ table.
- (iii) Give one example of an insertion in ASSIGNED table that violates Referential Integrity Constraint.

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[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4008**

**H**

Unique Paper Code : 2342571201

Name of the Paper : Data Structure

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

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. **Section A** is compulsory.
3. Answer any **four** questions from **Section B**.
4. All parts of Question must be attempted together.

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## SECTION A

1. (a) Explain any two Abstract Data Types in C++.  
(3)
- (b) What will be the output of the following operations on an empty Stack.  
(3)  
  
Push(3),Push(4),Pop(),Push(5),Push(6),Pop()
- (c) Write C++ code to add an element into a Queue.  
(3)
- (d) Define Deque and explain any two operations that can be performed on it.  
(3)
- (e) Write C++ code to read and write an array of n-dimension.  
(3)
- (f) Differentiate between the following with a suitable example :

(i) BFS and DFS tree traversal

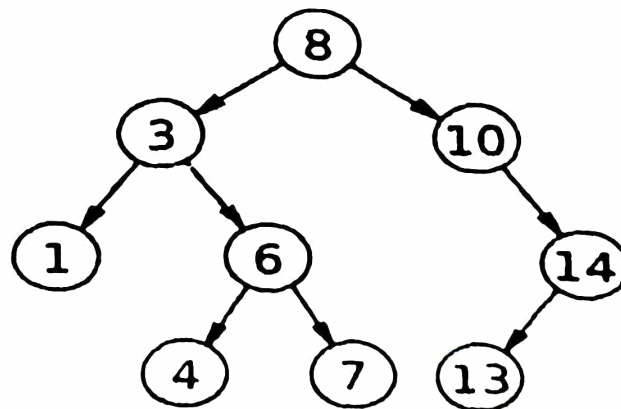
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- (ii) Complete and Perfect Binary tree (6)
- (g) Define Height Balanced trees with a suitable example. (3)
- (h) How to convert a singly link list into a circular link list? Explain. (3)
- (i) What do you mean by asymptotic Big-O analysis of an algorithm? (3)

### SECTION B

2. Consider the following BST (15)



Show the status of BST after each of the following operations :-

- (i) Draw the updated tree after 2 will be inserted in the BST.
  - (ii) Draw the updated tree after deleting 3 from the BST.
  - (iii) Write post-order traversal of the resultant BST.
  - (iv) Check if the resultant tree is height balanced or not? Justify your answer.
  - (v) Write pre-order traversal of the Final resultant tree.
3. (a) Explain Master's theorem with the help of suitable example. (6)



- (b) Write a program in C++ to find  $n^{\text{th}}$  Fibonacci Series using recursive function. (5)
- (c) Write a program in C++ to find factorial of a number 'n'. (4)
4. (a) Write a program in C++ to implement stack using Linked List. (6)
- (b) Draw a tree whose in-order and post-order traversals are given below : (5)
- In-order: BFEADGC
- Post-order: FEBGDCA
- (c) Evaluate the Cost of the given function:— (4)
- $$T(n) = 7T(n/6) + n^2$$

5. (a) Differentiate between Singly and Doubly Linked list. Also, write a program in C++ to insert an element in the beginning of a singly linked list. (6)
- (b) Write C++ code to delete a node from the end of a singly linked list. (5)
- (c) Mention any two advantages and disadvantages of Linked list. (4)
6. (a) Create a BST with the following values {7,5,1,8,3,6,0,9,4,2} if the numbers are inserted in the order as given into an initially empty BST. Also, write its in- order traversal. (6)
- (b) Draw a Recursion tree for the recurrence
- $$T(n) = 3T\left(\frac{n}{4}\right) + cn^2. \quad (5)$$

- (c) Write any two real-life applications each of stack and queue. (4)

7. (a) Consider the following sequence of operations performed on an initially empty doubly linked list : (6)

- InsertBeginning(12),
- InsertBeginning(4),
- InsertEnd(3),
- InsertEnd(1),
- DeleteBeginning(),
- Deletenode(l)

Show the contents of the list, links between the nodes, and head and tail after each operation.

- (b) Perform and explain count sort on the array {5,5,7,6,7,4,3} (5)

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(c) Mention any two properties of a Binary Heap.

(4)

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[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4935 H**

**Unique Paper Code : 2342571201**

**Name of the Paper : Data Structures**

**Name of the Course : B.A. (Prog) / B.Sc.  
(Programme) NEP**

**Year of Admission : 2022**

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

**Section A**

1. (a) Sort an array of elements  $A = \{13, 12, 14, 6, 7\}$  using insertion sort. Write the elements of the array after each step. How many comparisons will be needed to sort the array. (4)

(b) Solve the recurrence given  $T(n) = 3T(n/2) + n^2$  using the masters method. (4)

(c) List two differences between each of the following :-

(i) Array and Linked List

(ii) Stack and Queue (4)

(d) Identify and write the name of the Data Structures suitable for the following applications (4)

Application 1: Storing high score entries for a game

Application 2: Undo/Redo Functionality in text editors

Application 3: To manage traffic flow in the transportation systems

Application 4: To find a specific element in a sorted collection of elements

(e) In the array implementation of a circular queue how are front and rear indices modified upon insertion and deletion of an element. Write the conditions for the following :

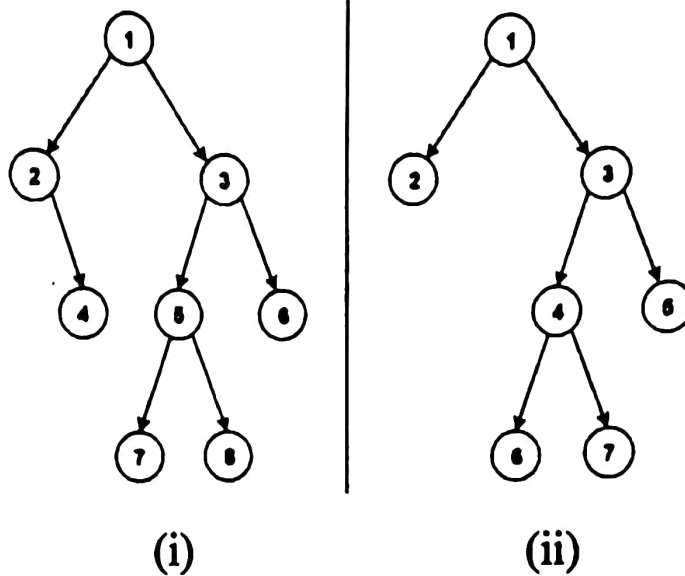
(i) Full Queue

(ii) Empty Queue (4)

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- (f) What is an abstract data type (ADT)? Give two advantages of using ADT in data structure? (4)
- (g) What is a height balanced tree? Are the following binary trees height balanced trees? Justify your answer. (4)



- (h) Give two advantages of a doubly linked list over a singly linked list. (2)

### Section B

2. (a) Write a C++ program to create a singly linked list of integers. Write functions to insert and delete an element from the front of the list. (6)
- (b) Consider an initially empty doubly linked list. Show the updated doubly linked list after each operation. (5)

Insert AtStart(30)

InsertAtStart(18)

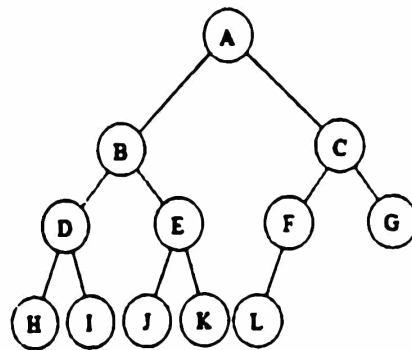
Delete(33)

InsertAtEnd(8)

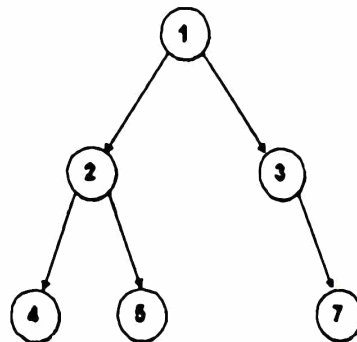
DeleteAtStart()

- (c) What is a complete binary tree? Consider the following binary trees. Are the following binary trees complete binary trees? Justify your answer.

(4)



(i)



(ii)

3. (a) Sort the given array  $A = \{7, 1, 2, 0, 2, 3, 4, 5, 1, 6, 3\}$  using counting sort. Show the array contents after each step.

(6)

- (b) Write a recursive program in C++ to calculate  $x^n$ , taking  $x$  and  $n$  input from the user.

(5)

- (c) Give two differences between static arrays and dynamic arrays. Write the syntax of declaring a dynamic array in C++. (4)
4. (a) Consider a queue with a maximum size of 6 elements. Currently the queue has three elements A, D and F with Front=2 Rear=4 as shown in figure.



figure: Queue

Write the output and status of queue after each of the following operation :

- (i) enqueue(L)
  - (ii) enqueue(K)
  - (iii) dequeue()
  - (iv) front()
  - (v) enqueue(X)
  - (vi) size()
- (6)
- (b) Write a C++ program to implement a stack using linked list. Give necessary declarations for the stack. Write functions for push and pop operations. (5)

- (c) List two real life applications of a priority queue.  
What are the two types of priority queues?

(4)

5. (a) Construct a binary search tree with the following numbers.

51, 14, 61, 5, 20, 57, 90, 3, 7, 35, 60, 25

Write the steps required to delete the root node from the binary search tree. Show the resultant tree.

(6)

- (b) Write two properties of a heap data structure.  
Differentiate between min heap and max heap.  
Give two applications of the heap data structure.

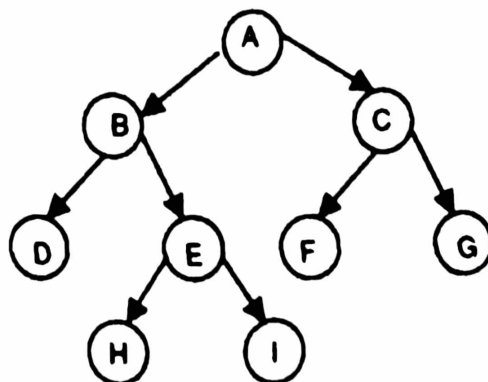
(5)

- (c) Prove that running time  $T(n) = n^3 + 20n + 1$  is  $O(n^3)$ . What would be the value of  $c$  and  $n_0$ ?

(4)

6. (a) Write the preorder, inorder and post order tree traversal of the following binary tree.

(6)



Binary Tree

- (b) Let us consider the following series of operations on an initially empty double

ended Queue(Deque).

insertFront(13)

insertFront(15)

front()

eraseFront()

eraseFront()

size()

Write the output and contents of the deque after each operation. (5)

- (c) What will be the time complexity of delete operation (dequeue()) of a linear queue, when the queue is implemented using

(i) stack

(ii) array

Give justifications for your answer. (4)

7. (a) Consider the given series of operations to be performed on an initially empty stack of size 5 :

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push(9)

Pop()

Pop()

push(7)

push(12)

empty()

Show the output and stack contents after each stack operation. (6)

(b) What is the advantage of using a circular linked list over a singly linked list? Enumerate four different operations that can be performed on a circular linked list. (5)

(c) Write and explain the time complexity of performing the following operations on one dimensional array.

(i) Deleting an element at a given index

(ii) Searching an element in an array of n elements (4)



[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4955**

**H**

Unique Paper Code : 2342571201

Name of the Paper : Data Structures

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

Year of Admission : 2022 & onwards

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

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## SECTION A

1. (a) Can you perform a binary search on the following list : (3)

2, 4, 1, 9, 3, 7

If not give reasons and modify this list so that binary search can be performed.

- (b) State true or false for the following statements and justify your answer: (3)

(i) Nodes of a binary tree may have 0 or 1 or 2 children.

(ii) Stacks use the FIFO access method.

(iii) A doubly linked list uses more memory than a singly linked list.

- (c) Considering root of the Binary tree at level 1, what is the maximum number of nodes : (3)

(i) In a Binary tree of height 4

(ii) At level 3

(iii) At lowest level

(d) What is a recursive function? Under which situations is it desirable to use a recursive function?

(3)

(e) Why overflow error does not occur in a linked list?

(3)

(f) What is the difference between one-dimensional and two-dimensional array? Give one example with code declaration of each.

(3)

(g) Write the steps when binary search is applied on the following list to find 16:

(3)

2 4 6 8 10 12 14

(h) List any three primitive operations considered in complexity analysis of algorithms.

(3)

(i) Apply insertion sort for sorting the following data in ascending order. Show the outcome after each pass :

(3)

9 7 11 85

## SECTION B

2. (a) Write a program in C++ to implement multiplication of two matrices of order  $n \times n$  taking input from the user. Show the output row-wise. (5)

(b) Consider the following sequence of operations performed on an initially empty doubly-linked list, where `addtohead()`, `addtotail()` and `deletefromhead()` are user defined functions to add a node to the front, add a node to the tail and delete a node from the front respectively :

(i) `addtohead` (25)

(ii) `addtohead` (28)

(iii) `addtotail` (23)

(iv) `addtotail` (20)

(v) `deletefromhead` ( )

Show the pointers head, tail, content of the list, and links between the nodes after each operation. (5)

- (c) 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

3. (a) Write a function in C++ to count the number of elements in a linked list. (5)

- (b) Create a Binary Search Tree using the following values : (5)

12, 45, 13, 67, 10, 34.

Using the above tree perform the following operations :

(i) Delete 12

(ii) Insert 8

Show the tree after each operation.

- (c) What will be the output after performing the following operations on an initially 5 empty stack of size 5. Show the contents of the stack after each operation:

push(10)

push(20)

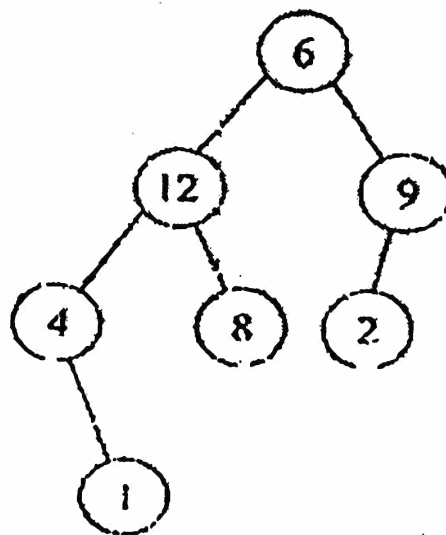
pop()

pop()

isempty()

(5)

4. (a) Traverse the following binary tree in preorder and inorder : (5)



- (b) Is the above tree in Q4(a) (5)

- (i) A complete binary tree
- (ii) Find the siblings of node 8
- (iii) What is the height of the above binary tree
- (iv) What is the degree of node 4
- (v) What is the value of the root node



- (c) Give the Depth First Traversal of the tree in Q4a. (5)
5. (a) Write a recursive function in C++ to reverse an array of integers. Array size and elements must be taken as input from the user. (5)
- (b) What are the properties of stack data structure? Show how stacks are used to add two numbers a and b. (5)
- (c) Differentiate between a queue and a priority queue. Give one application of a priority queue. (5)
6. (a) What is a deque? How is it different from a queue? List all the operations that can be performed on a deque. (5)
- (b) What are the limitations of a queue when implemented as a linear array? Give an example to illustrate. How can this error be avoided? (5)
- (c) State true or false giving reasons to justify your answer :
- (i) Elements of an array can be of different data types.

- (ii) The time complexity of Insertion sort is  $O(n \log n)$ .
  - (iii) An algorithm of complexity  $O(n \log n)$  is faster than one with complexity  $O(n^2)$ .
  - (iv) Master method can solve all recurrence relation.
  - (v) A recursive method is always more efficient than an iterative method. (5)
7. (a) Write a program in C++ to implement insertion sort on an array of  $n$  elements. Take  $n$  and array elements as input from the user. (5)
- (b) What is a recurrence relation? What is its significance in complexity analysis? Use recurrence tree method to solve the following recurrence relation :
- $$T(n) = T(n - 1) + n \quad (5)$$
- (c) Use master's method to solve following recurrence relation :
- $$T(n) = 3T(n/4) + n \log n \quad (5)$$

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5025

H

Unique Paper Code : 2342201202

Name of the Paper : Data Interpretation and  
Visualization using Python

Name of the Course : B.Sc. (Prog.)

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

**Section A**  
**(Compulsory)**

1. (a) Briefly explain different measures of central tendency. (3)

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(b) With help of an example differentiate between loc and iloc operators. (3)

(c) Write and justify the output of the given script.

```
import pandas as pd
s1 = pd.Series(np.arange(5),
               index=['a', 'c', 'b', 'e', 'd'])
print(s1)
print(s1['b' : 'd'])
```

 (3)

(d) Write and justify the output of the given Python statements. (3)

```
import pandas as pd
df = pd.DataFrame(np.arange(20).reshape(4,5))
print(df)
```

(e) Write the formula for calculating range. Calculate the range for the given data [32, 12, 56, 33, 44]. (3)

(f) Write and justify the output of the given Python statements. (3)

```
import pandas as pd
df = pd.DataFrame(np.arange(20).reshape(4,5))
print(df)
```

- (g) What is a pivot table? Give one example. (3)
- (h) Write the use of randint() function using appropriate example. (3)
- (i) What is the purpose of legend in plotting? Explain with appropriate example. (3)
- (j) Briefly explain regression using example. (3)

### SECTION-B

2. (a) Consider the two given dataframes studf and resdf and write the Python statements to do the following : (10)

studf		resdf	
rollno	name	rollno	marks
101	abc	101	66
102	pqr	102	76
103	xyz	101	55
		104	82

- (i) Display the rollno, name and marks for the students who appear in both dataframes.
- (ii) Display the rollno, name and marks of students who appear in either dataframe.

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- (iii) Count the number of students whose result is not available yet.
  - (iv) Display the rollno of the students who do not appear in dataframe studf.
  - (v) Display all the unique rollnos present in either dataframe.
- (b) With the help of suitable example, differentiate between is null() and notnull() methods. (5)
3. (a) Consider the given dataframe my df and write the Python statements to perform the following operations : (10)

	age	weight
102	23	52
103	34	67
101	25	60

- (i) Set the title of the row index as rollno.
- (ii) Add a column 'height' with values 152, 165, 171.



(iii) Sort the dataframe in descending order of the age column.

(iv) Reindex the dataframe in the order 101, 102 and 103.

(v) Drop the row corresponding to row index 102.

(b) What are the different ways to handle missing data? (5)

4. (a) Consider the file sales.csv as given below and answer the following questions. (10)

year;qtr1;qtr2;qtr3;qtr4

2019;3000;3200;;3500

2020;2900;-9999;;

2021;1800;2100;1900;1950

2021;1800;2100;1900;1950

2022;1850;-9999;2900;2550

2023;3400;3200;;

(i) Load the file sales.csv into a dataframe.

- (ii) Fill all the NaN values with 0.
  - (iii) Remove the duplicate rows from the original dataframe.
  - (iv) Replace all the -9999 values with a 0.
  - (v) Print the average sales made during qtr1 across all the years.
- (b) Differentiate between stack() and unstack() methods. Give examples. (5)
5. (a) Write the Python statements to do the following using numpy package : (10)
- (i) Create an array `a = [2,4,5,6,11,12,34,67,75,60]`.
  - (ii) Write numpy functions to find its minimum and maximum value.
  - (iii) Give output: `print (a[2:9])` and `print (a[2:])`
  - (iv) Give output: `print (a[:7])` and `print (a[:])`
  - (v) Differentiate between `rand()` and `rand()`

function using appropriate example.

- (b) Write the Python statements to create a dataframe tempdf for the given dataset and then plot a scatter chart with X1 on x-axis and X2 on y-axis. The points should be plotted in red colour. (5)

X1	X2
-2	3
1	1
1	2
3	4

6. (a) Write the Python statements to do the following using numpy package: (10)

- (i) Create a  $3 \times 3$  matrix with values ranging from 12 to 20
- (ii) Create a  $5 \times 5$  identity matrix.
- (iii) Create a  $2 \times 4$  matrix filled with 1s
- (iv) Create a  $3 \times 2$  matrix filled with random values
- (v) Change a  $4 \times 5$  matrix into  $5 \times 4$  matrix

- (b) Write python statements to create the given  $3 \times 3$  matrix using arange() in numpy and print its transpose.

$$A = \begin{bmatrix} 1 & 3 & 5 \\ 7 & 9 & 11 \\ 13 & 15 & 17 \end{bmatrix} \quad (5)$$

7. (a) Write python statements to perform the following operations using matplotlib package for the given dataset. (10)

Days	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Temperature in Degree Celsius	30	31	40	42	35	36	41

- (i) Plot histogram of the given dataset.
  - (ii) Set title as "7 Days Temperature".
  - (iii) Set X-axis label as "Weekdays".
  - (iv) Set Y-axis label as "Temperature".
  - (v) Save the plotted image as "temp-pick.jpg".
- (b) Differentiate between stacked bars and heat map. Also write python commands to plot them. (5)

[This question paper contains 4 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 6017**

**H**

Unique Paper Code : 6914000001

Name of the Paper : Python and Data Fundamentals

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. Candidates are advised to read these instructions carefully.
3. Candidates are required to attempt **ONLY FIVE** questions in all.
4. **All** questions carry equal marks.
5. If a question is divided into multiple parts, then all parts carry equal marks.

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1. (a) Write a Python function that uses loops to check whether a given number is prime.  
  
(b) How would you represent matrices in Python? Create a Python class named Matrix with methods to add and multiply two matrices. Also, write Python code that uses numpy to create matrices and perform the same matrix operations (addition and multiplication) on them. (18)
2. (a) Explain the concept of “Big Data” and its implications on traditional data analytics methods.  
  
(b) Describe the role of training and testing datasets in supervised machine learning. (18)
3. (a) Illustrate how to use Python’s pandas library to merge two dataframes and handle any duplicate records.



- (b) Illustrate how to handle missing values and outliers in a dataset using pandas. (18)
4. (a) Explain the process and importance of feature scaling and normalization in data preprocessing.
- (b) Explain the technique of coding nominal variables using example(s) in Python. (18)
5. (a) Describe how to perform a univariate analysis using a boxplot to detect outliers in a dataset.
- (b) Using an example, discuss how cross tabulation helps in understanding the interaction between two variables. (18)
6. (a) Using the matplotlib library, write Python code to create a histogram to visualize the distribution of a list of 20 positive integers. Customize the histogram by setting the number of bins and adding labels for the x and y axes.

(b) Describe the relevance of a pie chart. Write Python code that uses seaborn library to visualize the distribution of a dataset using a pie chart.

(18)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2288

**H**

Unique Paper Code : 62344414

Name of the Paper : Multimedia Systems &  
Applications (LOCF)

Name of the Course : B.A. (Programme) Discipline  
Course

Semester : IV

Year of Admission : 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 number 1 is compulsory from Section A.
3. Attempt any five questions from Section B.

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SECTION A

1. (a) What are jaggies? How do you remove them? (2)
- (b) What are the input devices used in multimedia? (3)
- (c) What do you understand by MPEG standard?  
Where do we use it? (3)
- (d) Define anchors, links and nodes. (3)
- (e) Briefly explain the concept of 3D Modelling and rendering (3)
- (f) What are Font editing and design tools? Give example. (3)
- (g) Differentiate between Linear and Non-Linear Multimedia projects. (4)
- (h) Expand the following terms : (4)
  - (i) HDMI
  - (ii) MIDI
  - (iii) SVG
  - (iv) TIFF

SECTION B

2. (a) What are the various components of Multimedia?  
Also explain application areas of Multimedia. (6)
- (b) Explain Hypermedia and Hypertext. (4)
3. (a) Give five audio file formats used in Multimedia  
Project and how they are used? (5)
- (b) Explain any five editing techniques used in digital  
audio. (5)
4. (a) What are the software and hardware requirement  
for multimedia? (5)
- (b) Explain the methods of making color (additive and  
subtractive). (5)
5. Write short note on : (2×5)
- (i) Web Browsers and search engine
- (ii) Dithering
- (iii) Codec

- (iv) OCR Software
  - (v) Authoring software
6. (a) Explain RGB, HSB and HSL computer color models. (6)
- (b) In what circumstances we should prefer MIDI over digital audio? (4)
7. (a) Explain the different analog video standards (NTSC, PAL, SECAM) used around the world? (6)
- (b) Write any four features that should be considered while selecting an image editing tool? (4)
8. (a) Explain the various types of multimedia authoring tools. (6)
- (b) What is content management system (CMS)? Name any two tools that are used for CMS. (4)



(21)

[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 3356**

**H**

**Unique Paper Code : 42344403**

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

**Name of the Course : B.Sc. (Prog.) Physical  
Science/Mathematical  
Sciences**

**Semester : IV**

**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 **five** questions from questions from Q. No. 2 to Q. No. 8.
4. Parts of a question must be answered together.

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Section A

1. (a) Give the truth table of the expression  $(A + AB')$ . (2)
- (b) Differentiate between RAM and ROM. (2)
- (c) Convert the following numbers with given radix or base : (2)
- (i)  $(6173)_8 = ()_2$
- (ii)  $(110110.100)_2 = ()_{10}$
- (d) Give the characteristic table of JK flip-flop. (2)
- (e) What is a binary counter? How many flip-flops will be required for an n-bit binary counter? (2)
- (f) Represent the following conditional control statement by two register transfer statements with control functions (3)

If  $(P = 1)$  then  $(R1 \leftarrow R2)$  else if  $(Q = 1)$  then  
 $(R1 \leftarrow R3)$

(g) Draw the logic diagram of 2-to-4 line decoder with only NOR gates. Include an enable input.  
(3)

(h) Differentiate between Programmed I/O and Interrupted initiated I/O.  
(3)

(i) What are the two instructions needed in the basic computer in order to set the E Flip-Flop to 1?  
(3)

(j) A computer has 32-bit instructions and 12-bit addresses. If there are 250 two-address instructions, how many one address instructions can be formulated?  
(3)

## Section B

2. (a) Simplify the Boolean function F together with the don't - care condition d in Sum-of-products form in four variables map : (6)

$$F(A,B,C,D) = \Sigma(0,1,2,3,7,8,10)$$

$$d(A,B,C,D) = \Sigma(5,6,11,15)$$

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

3. (a) Define the full adder. Illustrate same with the help of truth table and logic diagram. Also write Boolean expression for carry and sum operations. (6)

- (b) Design a 4-bit combinational circuit decrementer using four full adder. (4)

4. (a) Explain selective set, selective complement, selective clear and mask operation with the help of example. (6)

(b) Write a microoperations for following memory reference instructions : (4)

(i) AND to AC

(ii) LDA: Load to AC

5. (a) A computer uses a memory unit with 256K words of 32 bits each. A binary instruction code is stored in one word of memory. The instruction has four parts: an indirect bit, an operation code, a register code part to specify one of 64 registers, and an address part. (6)

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

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

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

(b) What is Flip-Flop? Explain RS Flip-Flop with the help of characteristic table and graphics symbol. (4)

6. (a) The content of AC in the basic computer is hexadecimal A937 and the initial value of E is 1. Determine the contents of AC, E, PC, AR, and IR in hexadecimal after the execution of the CLA instruction. Repeat 11 more times, starting from each one of the register-reference instructions. The initial value of PC is hexadecimal 021. (6)



- (b) Explain DMA with the help of example. (4)
7. (a) What is Multiplexer? Explain the working of a 4-to-1 MUX with a suitable diagram. (6)
- (b) Write short notes on each of the following : (4)
- (i) Registers
  - (ii) Combinational Circuit
  - (iii) Sequential Circuit
  - (iv) Counter
8. (a) Write a program to evaluate the arithmetic statement : (6)

$$X = (A-B)*(C+D)$$

- (i) Using a general register computer with three address instructions.

(ii) Using an accumulator type computer with one address instructions.

(b) Write four features of RISC.

(4)

[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 4003**

**H**

**Unique Paper Code : 2342572401**

**Name of the Paper : Operating Systems**

**Name of the Course : B.Sc. (Multidisciplinary  
Courses of Study with  
Three Core Disciplines  
under UGCF 2022)**

**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. Answer any **four** Questions from **Section B**.
4. Parts of a question must be answered together.

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**Section A**

1. (a) Mention names of any two mass storage devices.  
(1)
- (b) Differentiate between mv and cp commands in Unix/Linux.  
(2)
- (c) List two main functions of the Operating System.  
(2)
- (d) What is a thread? What are the benefits of using threads in a programming environment? (1+1)
- (e) What is a two-level directory structure? (2)
- (f) What is the difference between logical and physical address? (2)
- (g) What is dual mode of operation in the context of an Operating system? (3)
- (h) Give an example for absolute path and relative path in a directory? (3)
- (i) Briefly describe the working of Shortest Remaining Time First scheduling algorithm. (3)

- (j) What is meant by the term 'virtual address space' of a process? (2)
- (k) List two system calls for each of the following : (2+2)
- (i) Process control
  - (ii) Device management.
- (l) What is a Process Control Block (PCB)? Elaborate the information stored in it. (1+3)

### Section B

2. (a) In a multiprogramming uniprocessor system, how many processes can be in running state and how many processes can be in ready state at a particular time? (2)
- (b) What is the challenge faced by the designers of Operating System while implementing Shortest Job First scheduling algorithm? (2)
- (c) A process goes through various states from its creation to termination. Illustrate the states of a process using a diagram and explain briefly the different states. (3+2)

- (d) The following processes arrive in order P1, P2, P3, P4, P5 at time 0. Draw Gantt chart showing the execution of these processes using SJF (Shortest Job First). Calculate the average turnaround time and average wait time. (3+3)

Process	Burst Time
P1	3
P2	2
P3	7
P4	4
P5	5

3. (a) What is the Unix Kernel? (2)
- (b) What is the purpose of pipes in shell script? Give an example. (1+1)
- (c) Write a shell script to input a number N and print all the prime numbers between 1 and N. The program should be well documented. (5)



(d) A file named abc.txt contains following data

(3×2)

Amit

Bharat

Sanjeev

Sanjay

Dhanraj

Inderjit

Sankalp

What is the output of the following commands:

(i) `grep [s] abc.txt`

(ii) `grep san [^j] cut -c 3,5 abc.txt`

4. (a) Give Unix/Linux commands to remove a file and remove a directory. (2)

(b) Give the advantage of layered design of the Operating System (2)

- (c) What is an Application Programming Interface (API), what are the advantages of a programming environment which uses API. (1+1)
- (d) Explain the difference between system call and system program. (2)
- (e) Each system call will require passing some parameter(s) to the Operating System. What are the three parameter passing techniques? (3)
- (f) List any 4 categories of system programs. (4)
5. (a) What is the purpose of a page table in memory management? (1)
- (b) A memory has a page size of 1 KB. determine the page number and offset for the following addresses (3×2)
- (i) 3085
- (ii) 4205
- (iii) 65000

- (c) Given memory partition sizes of 200KB, 600KB, 100KB, 300KB and 450 KB. How would the processes of sizes 330KB, 250KB, 500KB and 350 KB be placed in the memory for first fit, best fit and worst fit algorithms. Calculate internal and external fragmentation in all three algorithms.  
(3×2+2)
6. (a) For a paging environment in the main memory, the logical address has two parts - page number and offset. The size of the page frame is 2K. What should be the size of the offset (in bits)? (3)
- (b) What is preemptive and non-preemptive process scheduling? Name two algorithms for each and justify your categorization into preemptive and non-preemptive. (2+4)
- (c) What are the three methods to access data in a file? Give comparison in terms of efficiency and ease of implementation. (6)
7. (a) Draw a labelled diagram showing structure of a magnetic disk. (4)

- (b) What is demand paging? What is Page fault? What are the steps to handle page fault? (1+1+3)
- (c) What is transfer rate, seek time and rotational latency in a disk? A disk has average seek time of 12ms and spins at 7200 RPM (revolutions per minute). Data transfer rate for the disk is 4MB/sec. Calculate the time required to transfer 8KB data to the disk. Assume there are no other time overheads/delays. (3+3)

SI No of QP 4871  
Unique Paper Code  
Name of Course  
Name of the Paper  
Semester  
Duration: 3 Hours

: 2342202401  
: B.A.(Prog)/ B.Sc. Non-Major (NEP-UGCF-2024)  
: Operating Systems  
: IV

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 a question must be answered together.

**Section- A**

- Q1 a) Differentiate between User mode and Kernel mode execution of a process. 3  
b) Explain the purpose of system programs. 3  
c) What is the context switching? 3  
d) What is the Compaction? 3  
e) What is the drawback of priority scheduling algorithm? How it can be resolved? 3  
f) What are the three different types of process scheduler in operating system? 3  
g) What is convoy effect in CPU scheduling? 3  
h) Consider a logical address space of 64 pages of 1024 words each, mapped onto a physical memory of 32 frames. 3  
a. How many bits are there in the logical address?  
b. How many bits are required to address each word in a frame?  
i) Distinguish between absolute and relative path name. 3  
J) Explain the use of UNIX commands: 3  
i. mkdir  
ii. pwd  
iii. cd

**Section- B**

- Q2 a) i) What are the goals of operating System? Explain Batch Operating System, multiprocessor system and real time Operating with suitable example? 4+4  
ii) List any two different types of mass storage devices. Explain seek time, rotational latency time, and data transfer rate in the disk?  
b) i) Briefly explain the layered approach and discuss its advantages and disadvantages for system design. 4+3  
ii) What are system calls? Explain different types of system calls.  
Q3 a) Consider the following set of processes, with the length of the CPU burst time given in milliseconds: 8

Process	Arrival time	Burst Time
P1	0	7



P2	1	5
P3	2	3
P4	3	1
P5	4	2
P6	5	4

- Draw Gantt chart that illustrate the execution schedule of these processes using preemptive SJF scheduling algorithm.
- Calculate the turnaround time and waiting time of each process. Also compute average turnaround time and average waiting time.

- What is PCB? What information is contained in the PCB? 3+4
  - Explain the different states of a Process with a suitable diagram?

- Q4 a) Given four memory partitions of 100KB, 500KB, 200KB and 600KB(in order), how would each of the first fit, best fit and worst fit algorithms place processes of 212KB, 417KB, 112KB and 426KB(in order)? 6

- What is Demand Paging in Operating System? Explain its advantages and disadvantages. 5+4
  - Consider a system which has main memory access time of 100ns and TLB access time of 20ns, and TLB hit ratio of 95%. What will be the effective memory access time with TLB and without TLB?

- Q5 a)
  - Explain the purpose of the *open()* and *close()* system calls in file operations. 4+3
  - Consider a system which has main memory access time of 35ns and page fault service time of 175ns and page hit ratio is 75%. What will be the effective memory access time?

- What is file system? Explain various file operations in file system? 5+3
  - Briefly, explain single-level, multi-level, and acyclic graph directories?

- Q6 a) Explain the terms: 6
- Swapping
  - Virtual memory
  - Page fault

- Explain the Single threaded and multithreaded process. What are the advantages of Threads in Operating Systems? 6+3
  - What are the major entries to evaluate the performance of CPU scheduling algorithms?

- Q7 Differentiate between following: 15
- Paging and segmentation
  - Dispatcher and scheduler
  - Preemptive and Non-preemptive scheduling
  - Multiprogramming and multitasking.
  - Internal fragmentation and External fragmentation



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[This question paper contains 4 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 2124** **H**

**Unique Paper Code : 62347627**

**Name of the Paper : Information Security and Cyber  
Laws**

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

**Semester : VI**

**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. Parts of a question must be answered together.
4. Attempt **any five** questions from Section B.
5. **All** questions in **Section B** carry equal marks.

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**Section A (Compulsory)**

1. (a) Differentiate between authorization and authentication. (2)
- (b) Differentiate between Public Key and Private Key. (2)
- (c) Describe cyber forensics with suitable example. (4)
- (d) Explain digital signature with the help of an example. (3)
- (e) What are the important aspects that an effective security policy must contain? (4)
- (f) Differentiate between iris scanning and signature dynamics techniques. (4)
- (g) Explain the term malicious software. (2)
- (h) What are the limitations of firewall? (2)
- (i) Write a short note on Digilocker. (2)

**Section B**

2. Explain the following sections under IT Act 2008 with their penalties and punishments. (10)

(a) 67A

(b) 67B

(c) 66B

(d) 66C

(e) 66E

3. Encrypt the plain text: "Computer Application" using the following ciphers:

(a) Caesar cipher with key-3 (5)

(b) Transposition cipher method-

Key(8→7, 7→6, 6→5, 5→4, 4→3, 3→2, 2→1, 1→8) (5)

4. Write short notes on the following: (2X5)

(a) Denial-of-service attacks

(b) Eavesdropping attack

- (c) Trojan Horse
  - (d) Brute force attack
  - (e) Birthday attack
5. (a) Explain the concept of firewalls in computer system. Describe any three types of firewalls and their uses. (5)
- (b) Explain Intrusion Detection System. Describe its types with their working. (5)
6. (a) What is risk management? Explain three strategies for dealing with risk. (6)
- (b) Differentiate between White Hat and Black Hat hackers. (4)
7. (a) Differentiate between Mandatory Access Control and Role Based Access Control. (5)
- (b) What is Hijacking? Explain TCP Session Hijacking. (5)
8. (a) Differentiate between Symmetric and Asymmetric encryption with help of example. (5)
- (b) What is the need of a security policy? Explain different types of security policies. (5)

2  
[This question paper contains 8 printed pages.]

**Your Roll No.....**

**Sr. No. of Question Paper : 3377**

**H**

Unique Paper Code : 42347610

Name of the Paper : Computer Networks (DSE)

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

Semester : VI

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. The paper has **two** sections.
3. **All** questions in '**Section A**' are compulsory.
4. Attempt any **five** questions from '**Section B**'.
5. Parts of a question must be answered together.

**Section A**  
**(Compulsory)**

1. (a) Consider the following data fragment in the middle of a data stream in a frame : (2)

A B ESC C ESC FLAG FLAG D

Give the output when byte-stuffing technique is used for framing.

- (b) Name the layers on which the following networking devices operate : (2)

(i) Bridge

(ii) Router

(iii) Gateway

(iv) Hub



(c) Indicate whether the following employ connection-less or connection-oriented mechanism : (2)

(i) WhatsApp call

(ii) Facebook chat

(iii) Postal System

(iv) WhatsApp Message

(d) Describe the function of Address Resolution Protocol (ARP). In which layer does it operate? (2)

(e) List at least two differences between the internet and the extranet. (2)

2. (a) Differentiate between the star and bus topologies. List one benefit and one drawback for each. (3)

- (b) What is the difference between a single-bit error, a two-bit error, and a burst error? (3)
- (c) Differentiate between circuit switching and packet switching. (3)
- (d) What is purpose of cladding in an optical fiber cable? Explain with the help of a diagram. (3)
- (e) What do understand by simplex, half duplex and full duplex mode of data communication? Give one example of each. (3)

### Section B

*(Attempt any Five)*

3. (a) We want to transmit the bit-string "10110011" using Cyclic Redundancy Check (CRC). The generator bit-string is "1001". Obtain the transmitted bit-string. (4)

- (b) What is the purpose of File Transfer Protocol (FTP)? Briefly explain the different transmission modes of FTP. (6)
4. (a) What do you understand by Domain Name System (DNS)? Which protocol does it use to resolve the name mapping? Discuss how domain name structure is organized. (6)
- (b) What are the components of a URL? And what punctuation is used to separate the components? (4)
5. (a) List the differences between ISO-OSI and TCP/IP protocol stacks. (4)
- (b) Find the class and subnet mask for each of the following IP addresses. (6)

(i) 208.34.54.12

(ii) 238.34.2.1

(iii) 114.34.2.8

6. (a) List the protocols that are used by modern E-mail Application system. Briefly discuss the role played by these protocols in the E-mail system. (6)

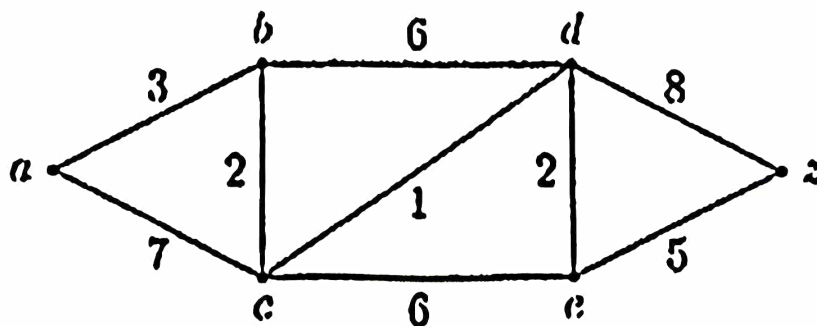
(b) A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers? (4)

7. (a) Briefly discuss the functionality of each layer of the ISO-OSI model. (7)

(b) Classify computer networks according to the coverage area. (3)

8. (a) What is the difference between multicast and broadcast in terms of network traffic? Explain with suitable examples. (4)

(b) Find the length and shortest path between "a" and "z" in the following weighted graph. (6)



9. Write short notes on the following (any two):

(a) Stop-and-Wait Protocol

3377

8

(b) TELNET

(c) Radio Waves

(10)

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