[This question paper contains 10 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4541 **E**

Unique Paper Code : 32341201

Name of the Paper : Programming in Java

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

Year of Admission : 2019-2020 onwards

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. The question paper consists of **two** sections. **Section A** is compulsory. Attempt any **four** questions from **Section B**.
3. State the assumptions taken, if any, in your answers.
4. All parts of a question must be answered together.
5. The data types of variables/data members/arrays and return types of the methods should be clearly stated.

P.T.O.

SECTION A

(Compulsory)

1. (a) Identify valid and invalid literals from the following : (1×5=5)

   (i) int a = 0_x56;

   (ii) byte b = $xyz;

   (iii) char c = a4;

   (iv) float pi = 3.14_15F;

   (v) int d= 0x85_;

   (b) What is the purpose of Dynamic Method Dispatch? How can this method be implemented? Explain with the help of an example. (5)

   (c) Assuming that all necessary packages have been imported (where required) in the following Java code snippets, write the output(s) of the following : (2+3=5)

   (i)
```
class ABC {
    public static void main(String [] args) {
      int a = 5;
      int b = 6;
```

```
        String s1 = "7";
        System.out.println (s1 + a + b);
        System.out.println (a + b);
    }
}
```

(ii)
```
class Demo {
    static {
        System.out.println ("In static block");
    }
    public static void main(String [ ] args) {
        System.out.println ("In main method");
    }
}
```

(d) (i) How is a class prevented from being inherited? Illustrate with the help of an example. (3)

(ii) Given the following hierarchy of Java classes, write the order in which the constructors are called when an object of class z is instantiated. (2)

```
class A {...}
class B extends A {...}
class C extends B {...}
```

P.T.O.

(e) Name the event listener interface(s) notified when each of the following event occurs in a Java program. (1×5=5)

(i) When a mouse is pressed.

(ii) When a component gains focus.

(iii) When a key is typed.

(iv) When a mouse is dragged.

(v) When a window is activated

(f) Write statements in Java to create a two-dimensional array that has 3 rows. Row 1 has 3 columns; row 2 has 1 column and row 3 has 2 columns. Also write a for-each loop statement to print this array. (5)

(g) Given two integer variable x = –1 and y = 0, write the value of x and y after the following expressions are executed : (5)

(i) x++;

(ii) y = x++;

(iii) x > 24;

(iv) x >> 24;

(v) x >>> 24;

SECTION B

2. (a) What is the purpose of the super keyword in Java? (2)

(b) Assuming that all necessary packages have been imported (where required) in the following Java code snippets, write the output(s) of the following : (4+4=8)

(i)
```
class X {
    int 1 = 9;
class Y extends X {
    int i = 90;
    void showSuper () {
        System.out.println (i);
        System.out.println (super.i);
    }
}
```

```
class Demo {
    public static void main (String args[ ]) {
        Y a = new Y ( ) ;
        a.showSuper ( ) ;
    }
}
```

(ii)
```
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);
    }
}
```

3. (a) What is AWT in Java? How are events handled using AWT? Explain using an example. (5)

(b) Using Java AWT, write a program to create two buttons named "Alpha" and "Beta". When a user clicks on the Alpha button , the background color changes to Red color while clicking on the Beta button, the background color changes to Blue color. (5)

4. (a) How can a protected member of Java class be accessed by its subclass in a different package? Illustrate with an example. (4)

(b) Explain the use of try with resources statement in Java. (2)

(c) Write a program in Java using enhanced for loop to find out the sum of values in an array. (4)

5. (a) Explain the usage of the keywords throw, throws and finally used in managing exception handling in Java. Is it possible to use multiple catch blocks with a single try block? Explain with an example. (6)

(d) Rewrite the following code segment to handle the exception(s) that will occur on executing the following codes segments : (2+2=4)

(i) public static void main (String [ ] args) {

```
int x = 97, y = 0;
int z = x/y;
System.out.println (z);
}
```

(ii) int a[ ] = new int [20];

```
a[20] = 20;
```

6. (a) Explain with suitable example, the concept of method overloading and method overriding in java. (4)

(b) Differentiate between final and abstract modifier in Java. (2)

(c) Assuming that all necessary packages have been imported (where required) in the following Java code snippets, write the output(s) of the following : (4)

```
class Base {
    public final void show( ) {
        System.out.println("Base class function called");
    }
}
class Derived extends Base {
    public void show( )
        System.out.println("Derived class function called");
    }
}
class Main {
    public static void main (String[ ] args) {
        Base b = new Derived ();
        b.show();
    }
}
```

7. (a) What are Event Listeners in Java? Mention its two major requirements. How they are helpful in the delegation event model? (4)

(b) Write a program in Java using AWT to display a string "Hello" in frame window and set its background color as Red. (3)

(c) Write the prototypes of any three methods of the MouseListener interface. (3)

8. (a) Write a program in Java to print the following pattern. (5)

1

2 4

3 6 9

4 8 12 16

5 10 15 20 25

(b) Write a program in Java to input a 2-dimensional array of integers and print the greatest odd number and the smallest even number present in the array. (5)

 4661

Unique Paper Code	:	**32341202**
Name of the Paper	:	**Discrete Structures**
Name of the Course	:	**B. Sc. (Hons.) Computer Science (LOCF)**
Semester	:	**II**
Duration	:	**3 Hours**
Maximum Marks	:	**75**

(For admissions of 2019, 2020, & 2021)

Instructions for Candidates:

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

Section A

Q1. (a) Among 100 students, 32 study mathematics, 20 study physics, 45 study biology, 15 study mathematics and biology, 7 study mathematics and physics, 10 study physics and biology and 30 do not study any of three subjects.

i. Find the number of students studying all three subjects.
ii. Find the number of students studying exactly one of the 3 subjects. 5

(b) Let R be the relation on positive integer set **Z+** defined as:

$$R = \{(x, y) \mid x+3y=12\}$$

Answer the following questions:

i. Define R as a set of ordered pairs.
ii. Is R an equivalence relation? Justify. 5

(c) Let f and g be functions from **R** to **R** such that: $f(x) = x^2$ and $g(x) = x - x^2$. Compute $O(f.g)$ 5

(d) Let $\boldsymbol{a}$ be a numeric function such that:

$$a_r = \begin{cases} 3, & 0 \le r \le 3 \\ r+2, & r \ge 4 \end{cases}$$

Find Δa and ∇a 5

(e) Using truth table, prove that $(p \wedge q) \rightarrow (p \vee q)$ is a tautology. 5

(f) Show that among any group of five (not necessarily consecutive) integers, there are at least two integers with the same remainder when divided by 4. 5

(g) State the Handshaking Theorem in graphs. How many edges are there in an undirected graph with 2 vertices of degree seven, 4 vertices of degree five and 4 vertices of degree six? 5

Section B

Q2. (a) Show by mathematical induction that for n >= 1:

$$1^2 + 2^2 + \ldots\ldots\ldots + n^2 = \frac{n(n+1)(2n+1)}{6}$$

5

(b) Let A = {2, 4, 6, 18, 24, 32} 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. 5

Q3. (a) Suppose that an urn contains 15 balls, of which eight are red and seven are black. 5

i. In how many ways can five balls be chosen, so that two are red and three are black?

ii. In how many ways can five balls be chosen so that at least two are red?

(b) i. Determine whether the function $f(x) = 5x + 4$ is a bijection from R to R.

ii. Given that $g(x) = 2x$, find $f \circ g$ and $g \circ f$ for the functions f and g. Is $f \circ g = g \circ f$?

5

Q4. (a) Determine the numeric function for the following generating function:

$$A(z) = \frac{2 + 3z - 6z^2}{1 - 2z}$$

5

(b) Solve the following recurrence relation:

$$a_r + 4a_{r-1} = 7 \text{ given that } a_0 = 3$$

5

Q5. (a) Use the Bubble Sort Algorithm to sort the following numbers:

13	76	2	14	84	45	10	63

Show the list obtained at each step.

5

(b) Use the Master method to give tight asymptotic bounds for the following recurrence relation:

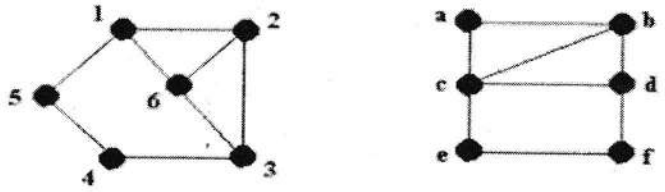
$$T(n) = 9T\left(\frac{n}{3}\right) + n$$

5

Q6. (a) Show that a full **m-ary** balanced tree of height **h** has more than $\mathbf{m}^{\mathbf{h-1}}$ leaves. How many leaves does a full **3-ary** tree with 100 vertices have?

5

(b) Define Isomorphism. Are the following pair of graphs isomorphic? Justify?



5

Q7. (a) State and prove the necessary and sufficient condition for a graph to have a Euler Circuit and Path.

5

(b) i. State the contra-positive and inverse of the following statement:
"If you will send me the link, then I will open the website."

ii. Let P(x, y) denote the statement "x helps y". Express in English the following formula:

a. $\forall x \, \forall y \, P(x, y)$

b. $\forall y \, \exists x \, P(x, y)$

5

[This question paper contains 8 printed pages.]

05 JUN 2023

Your Roll No.....

Sr. No. of Question Paper : 4523 **E**

Unique Paper Code : 32341401

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 : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. **1** is compulsory.
3. Attempt any **four** of Questions Nos. **2** to **7**.

1. (a) Use the Master's Theorem to give tight asymptotic bounds for the recurrence $T(n) = 8T(n/2) + \theta(n^2)$. (3)

(b) Discuss the running time of the following snippet of code :

```
count = 0
for (i=1, i<=n, i++)
    for (j=1, j<=n, j = 2 * j)
        count++
```

(3)

(c) A team of explorers is visiting the Sahara desert. As the weather is very hot, they are having n bottles of different sizes to carry water and keep them hydrated. In covering few kilometres, they used all of their water but fortunately found a water source nearby. This water source is having only L litres of water which is way lesser then the capacity of all bottles. They want to fill L litres of water in minimum number of bottles. Describe a greedy algorithm to help them fill U litres of water in minimum number of bottles. (3)

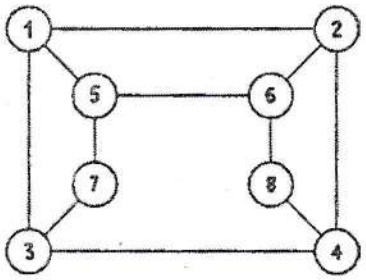
(d) Will the greedy strategy with the greedy parameter being value per unit weight of the items yield an optimal solution for the 0-1 knapsack problem? Justify. (3)

(e) Can dynamic programming be applied to all optimization problems? Why or why not? (3)

(f) Let G be a tree-graph. Further, let T_B and T_D be the trees produced by performing BPS and DFS respectively on G. Can T_B and T_D be different trees? Why or why not? (4)

(g) Why is the worst-case running time for bucket sort $\theta(n^2)$? What changes would you make to the algorithm so that its worst-case running time becomes O(nlgn)? (4)

(h) Consider the following graph: (4)



Specify whether the above graph is bipartite or not. If yes, give the partition, else justify.

P.T.O.

(i) We are given a weighted graph G in which edge weights are not necessarily distinct. Can graph G have more than one minimum spanning tree (MST)? If yes, give an example, else justify. (4)

(j) Show that in any subtree of a max-heap, root of the subtree contains the largest value occurring anywhere in that subtree. (4)

2. (a) Consider the scheduling problem wherein you are given a single resource and a set of requests having deadlines. A request is said to be late be late if it misses the deadline. Your goal is to minimize the maximum lateness. With respect to a schedule S, idle time is defined as the time during which the resource is idle, in between two requests. S is said to have an inversion when request i has been scheduled before j and $d(i) > d(j)$, where d(i) and d(j) are the deadlines of the requests i and j respectively. Argue that all schedules with no idle time and no inversions have the same maximum lateness. (6)

(b) For each of the following sorting algorithms, merge sort and insertion sort, discuss whether or not it is

(i) stable

(ii) in-place (4)

3. (a) Let G = (V,E) be a directed unweighted graph. Given two vertices s and t in V, what is the time required to determine if there exists at least one s-t path in G? Can we use the DFS algorithm to find the shortest-path distance from the s to t? If yes, justify, otherwise give a counter example. (6)

   (b) Suppose we perform a sequence of stack operations on a stack whose size never exceeds k. After every k operations, we make a copy of the entire stack for backup purposes. Show that the cost of n stack operations, including copying the stack, is O(n) by assigning suitable amortized costs to the various stack operations. (4)

4. (a) Show that for an n-element max heap (having distinct elements) represented through an array, the leaves are the nodes indexed by floor (n/2 + 1), floor (n/2 + 2),....., n. What would be the location of the minimum clement in the above heap? (6)

   (b) Given an array A of n integers, you need to find the maximum sum of any contiguous subarray. For instance, the maximum sum of any contiguous

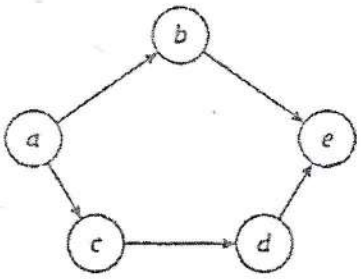
subarray in the array –1, 2, 3, –2, 5, –6, 7, –8 is 9 (which is the sum of the subarray 2, 3, –2, 5, –6, 7). Complete the following Dynamic Programming solution for the above problem :

DP[0] = A[0]

For i = 1 to n

DP[i] = max(A[i], _____) (4)

5. (a) How many topological orderings does the following graph have? Specify all of them. (6)



(b) A student was asked to sort a list of n numbers in decreasing order. The student writes an algorithm which works iteratively as follows. In every iteration, the following two steps are done :

(i) Linear search is used to find the maximum element in the portion of the array which is not yet sorted.

(ii) The maximum element found in step 1 is placed at the beginning of the not-yet-sorted portion of the array.

This algorithm is given as input a list already sorted in decreasing order. What would be the time complexity of the algorithm on this input? Explain. (4)

6. (a) (i) What is the smallest possible depth of a leaf in a decision tree for a comparison sort? Name a sorting technique to which this smallest depth would correspond. (6)

(ii) What is the minimum number of leaves in the decision tree for a comparison sort? Use this observation to derive a lower bound on the number of comparisons performed by a comparison sort in the worst case.

(b) Show that at most 3* floor (n/2) comparisons are sufficient to find both the minimum and maximum in a given array of size n. (4)

7. (a) The BFS algorithm has been used to produce the shortest paths from a node s to all other nodes in a graph G. Can the Dijkstra's algorithm be used in place of BFS? In a different scenario, the Dijkstra's algorithm has been used to produce the shortest paths from a node s to all other nodes in a graph G'. Can BFS be used in place of the Dijkstra's algorithm? Explain your answers for both the scenarios. (6)

(b) Write a pseudocode for the memorized recursive algorithm to compute the nth Fibonacci number. What would be its time complexity? (4)

[This question paper contains 6 printed pages.]

Your Roll No.....

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

Unique Paper Code : 32341402

Name of the Paper : Software Engineering (DSC)

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

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. The paper has **Two** Sections.
3. All questions in **'Section A'** are compulsory.
4. Attempt Any **Four** questions from **'Section B'**.
5. Parts of a question must be answered together.

SECTION A

1. (i) What are umbrella activities? Are they applied evenly across the software development life cycle? Justify your answer. (4)

P.T.O.

(ii) What do you understand by Time-Line Chart? How is it used in project scheduling? (4)

(iii) What are Incremental Process Models? Explain the use of incremental process model with the help of an example. (4)

(iv) Explain any three agility principles. (3)

(v) What is the significance of functional and non-functional requirements? Explain with the help of suitable examples. (4)

(vi) "A software engineer must design the modules with the goal of high cohesion and low coupling". Justify this statement. (4)

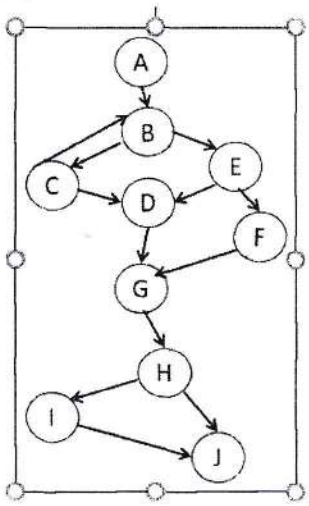
(vii) Illustrate the importance of testing. Explain why software fails after it has passed the acceptance testing? (4)

(viii) How do you assess Impact of the Risk? Give the formula for determining the overall Risk Exposure (RE). (4)

(ix) Define the five capability levels of CMMI. (4)

SECTION B

2. What is the purpose of computing cyclomatic complexity? Compute cyclomatic complexity using 3 different methods. List all the independent paths in the given graph. (3+3+4)



3. (a) Explain the spiral model for software development with the help of diagram. How does "project risk" factor affect this model. (7)

   (b) Give three basic assumptionsthat an agile process is expected to handle. (3)

P.T.O.

4. Assume that you are asked to build a software system that : (3+4+3)

   (i) allows candidates to submit their online admission form to seek admission in a listed course and college

   (ii) automatically verify the eligibility of a candidate

   (iii) provides an environment to teachers and administrators to verify the records

   (iv) allows an eligible candidate to submit fee online

   (v) generates acknowledgement slip for candidates and

   (vi) generates course-wise students' report for college authority.

   Draw the following :

   1. Context level diagram (0 Level DFD (Data Flow Diagram))

   2. Level 1 DFD

   3. Data Dictionary for the above system

5. (a) Compute the Function Point value for a project with the following information domain characteristics : (5)

Assume the measurement parameters equally divided among low, average and high complexity. Further, assume that the complexity adjustment value is 1.5.

Measurement Parameters	count	Weighing factors		
		low	average	high
Number of user inputs	12	3	4	6
Number of user outputs	30	4	5	7
Number of user inquiries	6	3	4	6
Number of files	9	7	10	15
Number of external interfaces	3	5	7	10

(b) At the end of a project, it has been determined that 20 errors were found during the analysis phase and 10 errors were found during the design phase that were traceable to errors that were not discovered in the analysis phase. What is the DRE for the analysis phase? (5)

6. (a) Describe any five activities of software quality assurance that focuses on the management of the software quality. (5)

P.T.O.

(b) What are the characteristics of Risk? Explain different type of risks considered during the software project. (5)

7. Differentiate between the following : (10)

(i) Coupling and Cohesion

(ii) Verification and Validation

(iii) Reactive Risk Strategy and Proactive Risk Strategy

(iv) Milestone and Deliverable

(v) Alpha Testing and Beta Testing

8. (a) What is software requirement specification (SRS)? How is it used to bridge the communication gap between the developer and the customer? (5)

(b) Consider a program for computing the function f(a,b) where the input variables a and b are in the range

2<=a<=5

1<=b<=10

Design the boundary value test cases for the program. (5)

[This question paper contains 12 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4803 **E**

Unique Paper Code : 32341403

Name of the Paper : Database Management Systems

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

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. **Section A** is compulsory.
3. Attempt any **four** questions from **Section B**.
4. Parts of a question must be answered together.
5. Marks are indicated against each question.

Section A

1. (a) When is it necessary to have a surrogate key while mapping EER to a relational database? Justify with an example. (2)

P.T.O.

(b) In the relation R (A, B, C, D, E) given below:

A	B	C	D	E
a1	b1	60	d1	2
a2	b2	80	d2	3
a3	b1	50	d3	4

Which amongst the following dependencies are violated? Justify your answer.

(i) B –> C

(ii) D –> E (2)

(c) Why is it necessary to give role names in a recursive relationship? Justify with an example. (2)

(d) Explain the usage of the following clauses in the SQL Query "ON UPDATE CASCADE" and "ON DELETE NULL". (2)

(e) Find out the closure of CD in the following relation R (A, B, C, D, E, F, G) for the given set of functional dependencies

F = {A –> BC, E –> C, CD –> AEG, ABG –> BD, DG –> BC}

Show the steps to compute the closure for CD. Using the closure, can we say that CD is a candidate key, if yes, Justify. (3)

(f) Consider the following Medical Database relations to keep track of Patients and Physicians :

Patient (PP#, PName)

Physician (Dname, Specialization)

Test (PP#, Test_name, Date, Time, Dname)

Identify the primary and foreign keys for the relations given above (State any assumptions made). (3)

(g) Give an example of the following with its proper notation used in ER Model

(i) Identifying Relationship

(ii) Complex attribute (3)

(h) Differentiate between the following : (6)

(i) Database Definition language and Database Manipulation language

(ii) Logical data independence and Physical data independence

(iii) Database Intension and Database Extension

P.T.O.

(i) Find the output of the following expressions in relational algebra on the tables A, B1, B2, B3 as given below : (1+2)

A1

S.No.	P.No.
S1	P1
S1	P2
S1	P3
S1	P4
S2	P1
S2	P2
S3	P2
S4	P2
S4	P4

B2

P.No.
P2

B1

P.No.
P2
P4

B3

P.No.
P1
P2
P4

(i) B1-B2

(ii) A/B3, where '/' is a division operator.

(j) Consider the Relation given below :

STUDENT_COURSE

Name	Course	Grade	Ph_no	Major	Department

Does this given relation STUDENT_COURSE suffer from any of the following anomalies? Justify your answers using appropriate example.

(i) Insertion

(ii) Deletion

(iii) Modification (3)

(k) Two transactions T1 and T2 are executing concurrently (assuming concurrency control is not in place) with initial value of X=15 and Y=5.

T1	T2
1. Read_item(X)	
2. X = X+10	
3. write_item (X)	
	4. Read_item(X)
	5. X = X+Y
	6. write_ item (X)
7. Read_item(X)	

Transaction T1 fails during the execution of statement number 7. After the completion of the transaction T2 what will be the value of X. Is this the correct value, if not, identify the name of the concurrency control problem. (3)

P.T.O.

Section B

2. (a) Consider a database PROJECT_EXAMINATION that maintains data about the project reports submitted for consideration by the examiners. Comments by the examiners are recorded for use in the project selection process. The database system caters primarily to examiners who record answers to pre-decided questions for each report they evaluate. The examiners make recommendations regarding whether to accept or reject the project. The data requirements are summarized as follows : (6)

- Students write the project reports.
- Students are uniquely identified by e-mail id. first and last names are also recorded.
- Each project is assigned a unique identifier by the system and is described by a title, abstract, and the name of the electronic file containing the project report.
- Multiple students may be involved in the same project, but one of the students is designated as the coordinator.

- Examiners of project reports are uniquely identified by e-mail address. Each examiner's first name, last name, phone number, areas of interest are also recorded.

- Each project report is assigned to two and four reviewers. An examiner rates each report assigned to him or her on a scale of 1 to 10 in four categories: technical merit, readability, originality, and presentation. Finally, each examiner provides an overall recommendation regarding each report.

Design an Entity–Relationship Diagram (ER) for the above database and identify existing composite attributes (if any).

(b) For the given binary relationship, suggest the cardinality ratio of the relationship based on the general context of entity types and state the context clearly : (4)

	Entity Set1	**Entity Set2**
I.	Country	President
II.	Teacher	Course
III.	Players	Team
IV.	Book	Author

P.T.O.

3. Consider the relation R, which has attributes to store timetable of courses and

(a) sections at a university; (6)

R = {Course_no, Sec_no, Offering_dept, Credit_hours, Course_level, Instructor_ssn, Semester, Year, Days_hours, Room_no, No_of_students}.

Suppose that the following functional dependencies hold on R :

{Course_no} → {Offering_dept, Credit_hours, Course__level}

{Course_no, Sec_no, Semester, Year} → {Days_hours, Room_no, No_of_students, Instructor_ssn}

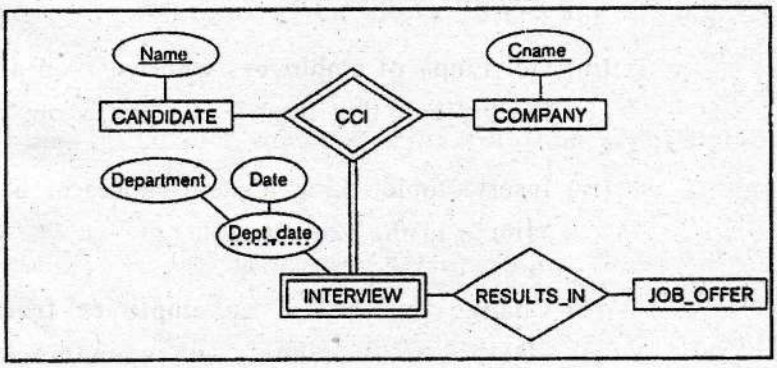
{Room_no, Days_hours, Semester, Year} → {Instructor_ssn, Course_no, Sec_no}

(i) Identify the Primary key in relation R?

(ii) Apply normalization to convert it into 3NF stating the reasons behind each decomposition (assume R is already in 1NF).

(b) Find the minimal cover of Functional dependency set F : $\{B \rightarrow A,\ D \rightarrow A,\ AB \rightarrow D\}$. (4)

4. (a) Map the following ER-diagram into a Relational database (Assume appropriate cardinality ratios for each of the given relationships), Here CCI denotes a ternary relationship between candidate, company and interview. (6)



(b) Differentiate between a Specialization Hierarchy and a Specialization Lattice using appropriate examples. (4)

5. Given the following relations for an EMP_PROJ database :

(a) Employee (Emp#, Name, Age, Salary, City, Mobile)

Allotted (Project#, Emp#)

P.T.O.

Project (Project#, Project_Name, Project_Manager)

Solve the following Queries on the above-mentioned database using SQL :

(i) Get Emp# of employees working on both Project# 353 and Project# 354.

(ii) Get details of employees working on all "database" project.

(iii) Get Emp# of employees who work on all the projects that Emp # 107 works on.

(iv) Insert a tuple <555 , "Operation Research", "Jim"> in the Project table.

(v) Change the city of an employee from "Delhi" to "Chennai" whose name is "James". (1+1+2+1+1)

(b) List all the FDs satisfied by the following table

A	B	C	D
a1	b1	c1	d1
a1	b1	c2	d2
a2	b2	c2	d2
a2	b2	c4	d4

(4)

6. (a) Create a B-tree of order 4 inserting following values in the given order (in steps)

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 (6)

(b) Consider the following relations for the EMP-PROJ database with the following relations :

Employee (Emp#, Name, Age, Salary, City, Mobile)

Allotted (Project#, Emp#)

Project (Project#, Project_Name, Project_Manager)

Write the following queries in Relational Algebra for the relations given above :–

(i) Display the project details of projects managed by "James".

(ii) Count the number of employees working on the "Artificial Intelligence" Project. (4)

7. (a) Compute the number of blocks of access required to get records from an ordered file with r = 20,000 records stored on a disk with Block size B = 1024 bytes with or without primary index. Also, calculate

blocking factor. Assume that file records are of fixed size with record length R = 100 bytes, ordering key field is 9 bytes long and block pointer is 6 bytes long. (6)

(b) What are the four desirable properties of a Transaction that should be enforced by the concurrency control? (4)

B.Sc CHJ Comp Sci

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4506 **E**

Unique Paper Code : 32341601

Name of the Paper : Artificial Intelligence

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. Question **1** is compulsory.
3. Attempt any **four** questions from Question **2** to Question **8**.
4. Parts of a question must be answered together.

1. (a) What do you understand by the term "Rational Agent"? (2)

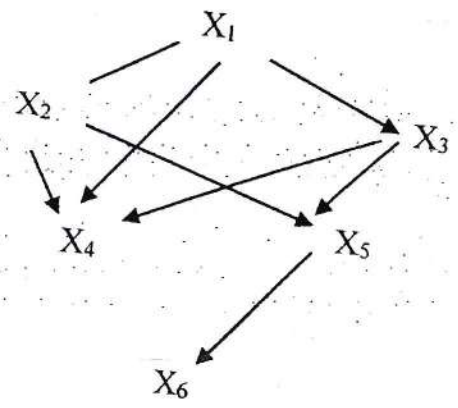
P.T.O.

(b) What would be the output of the following statement in Prolog, and Why? (2)

?- A is 6+3, B = 5+4, A=B.

(c) Construct the truth table for the expression (A & (A V B)). What single term is this expression equal to? (2+1)

(d) Write the joint distribution of xl, x2, x3, x4, x5 and x6 as a product of chain conditional probabilities for the following network : (3)



(e) Develop a parse tree for the sentence "Raja slept on the sofa". (2)

(f) Compare and contrast Depth first search and Breadth first search? (4)

(g) Transform the following into Conjunctive Normal Form (CNF) : (6)

(i) P V (~P & Q & R)

(ii) (~P & Q) V (P & ~Q) & S

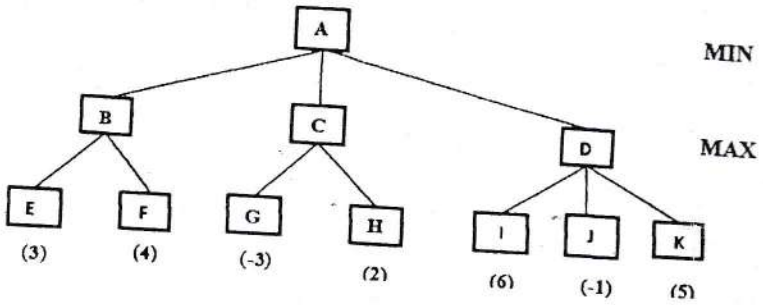
(h) Express the sentences given below into the conceptual dependency structure : (4)

(i) Ram drove the car fast.

(ii) Rita gave Sita a bunch of flowers.

(i) Give the properties of Type 1 and Type 2 grammars from the Chomsky Hierarchy of grammars. (4)

(j) In the following two-ply game tree, the terminal nodes show the utility values computed by the utility function. Use the Minimax algorithm to compute the utility values for other nodes in the given game tree. (2)



(k) Write about the limitations of Hill Climbing search? (3)

2 a) Describe the water-jug problem. Also give a suitable state space representation for this problem? (2+3)

(b) Transform the following into clausal form: (5)

$\exists x \forall y (\forall z P(f(x), y, z) \rightarrow (\exists u Q(x, u) \& \exists v R(y, v)))$

---

3. (a) Write a Prolog program maxlist (L, Max) to find the greatest number Max in the list L. (5)

(b) Find the probability of the event A when it is known that some event B occurred. From experiments, it has been determined that $P(B|A) = 0.84$, $P(A) = 0.2$, and $P(B) = 0.34$. (5)

4. (a) Determine whether the following sentence is satisfiable, contradictory or valid :

S : (P V Q) → (P & Q) (2)

(b) Find whether the following sets are unifiable or not? If they are unifiable, find most general unifier (m.g.u.) otherwise give justification why they are not unifiable.

(i) {S(x, Ram), S(y, Sita)}

(ii) {P(x, y), P (f(x),z), P(z, x)} (4)

(c) Give PEAS description for Taxi Driver Agent? (4)

5. (a) When do we say that the search is admissible? You can take the example of A*. (3)

(b) What is a horn clause? Given an example. (3)

(c) Solve the following crypt arithmetic problem using constraint satisfaction. (4)

P.T.O.

```
  TWO
+ TWO
-----
 FOUR
-----
```

6. (a) What is a Truth Maintenance System (TMS)? Give the architecture of a problem solver with a TMS in the form of a diagram. (2+2)

(b) Express the following concepts as an associative network structure with interconnected nodes and labeled arcs.

Company ABC is a software development company. Three departments within the company are Sales, Administration and Programing. Joe is the manager of programming. Bill and Sue are the programmers. Sue is married to Sam. Sam is an editor for the Prentice Hall. They have three children and they live on Elm Street. Sue wears glasses and five feet four inches tall. (6)

7. (a) What is default reasoning? (2)

(b) Given the following information for a database :

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.

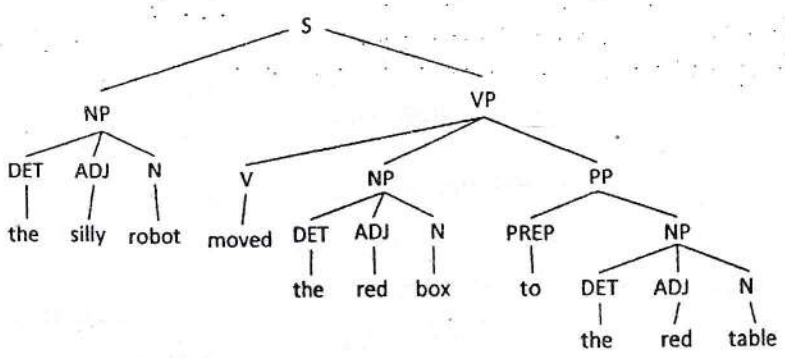
A3. A cup is above a book.

A4. A cup is touching a book.

(i) Translate the statements A1 through A4 into clausal form.

(ii) Show that the predicate supports(book, cup) is true using resolution. (4+4)

8. (a) Based on the context free grammar represented by the following parse tree, draw the corresponding Recursive Transition Network (RTN). (5)



(b) Draw the block diagram of learning agent and explain its working. (5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4711 **E**

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 **8 (Section B)**.
4. Parts of a question must be answered together.

Section A

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

(2)

(i) Bronze, Silver, Gold medals awarded at Olympics

(ii) Number of patients in hospital

(iii) Car color

(iv) Dates in a Calendar

(b) List two applications where graph data structure is used to model the data. (2)

(c) Consider an association rule between items from market basket domain which has high support and high confidence. What does it signify? (2)

(d) Explain the following terms with respect to a density-based clustering algorithm: Core point and Border point (2)

(e) Consider a categorical attribute with five values {awful, poor, OK, good, great}. Covert this attribute to asymmetric binary attributes. (3)

(f) List any two ways in which a noise object differs from an outlier? Explain with the help of the example. (4)

(g) Consider the given dataset with two attributes Age and Salary measured on different scales. What problems might arise if the dataset is directly used for k-means clustering? What steps will you suggest to handle the problem? (4)

	Age (in years)	Salary (in rupees)
1	44	72000
2	27	48000
3	30	54000
4	38	61000
5	50	83000
6	37	67000

(h) How is an eager learner classifier different from a lazy learner classifier? Support your answer with an example from both category of classifiers. (4)

(i) Specify whether each of the following activities should fall under the purview of a data mining task or a database query. Justify your answer.

(i) Dividing the customers of a company according to their gender.

(ii) Predicting the future stock price of a company using historical records. (4)

P.T.O.

(j) Explain the concept of following types of clustering schemes :

(i) Fuzzy clustering

(ii) Hierarchical based clustering (4)

(k) Consider the following values for two attributes corresponding to four data points: P1(0,2), P2(2,0), P3(3,1), and P4(5,1). Compute the proximity matrix using the metric as Euclidean Distance. (4)

Section B

2. (a) Consider the following dataset for binary classification problem : (6)

Instance	A	B	C	Target Class
1	T	T	1	+
2	T	T	6	+
3	T	F	5	-
4	F	F	4	+
5	F	T	7	-
6	F	T	3	-
7	F	F	8	-
8	T	F	7	+
9	F	T	5	-

Calculate the information gain when splitting on A and B. Which attribute would the decision tree induction algorithm choose?

(b) For evaluating the performance of a classifier, how does holdout method and 4 differ from k-fold cross validation? For k=5 and datapoints- D1, D2, D3, D4, D5, D6, D7, D8, D9, and D10 in the dataset, mention one possible dataset distribution between training and test partition for k-fold cross-validation. (4)

3. Consider the dataset shown below : (10)

Outlook	Temperature	Humidity	Windy	Play Golf
Rainy	Hot	High	False	No
Rainy	Hot	High	True	No
Overcast	Hot	High	False	Yes
Sunny	Mild	High	False	Yes
Sunny	Cool	Normal	False	Yes
Sunny	Cool	Normal	True	No
Overcast	Cool	Normal	True	Yes
Rainy	Mild	High	False	No
Rainy	Cool	Normal	False	Yes
Sunny	Mild	Normal	False	Yes
Rainy	Mild	Normal	True	Yes
Overcast	Mild	High	True	Yes
Overcast	Hot	Normal	False	Yes
Sunny	Mild	High	True	No

(i) Estimate the conditional probabilities for *P(Outlook|Yes), P(Temperature|Yes), P(Humidity|Yes), P(Windy|Yes), P(Outlook|No), P(Temperature|No), P(Humidity|No),* and *P(Windy|No).*

P.T.O.

(ii) Use these estimate of conditional probabilities to predict the class label (*Play Golf*) for a test sample (*Outlook = Rainy, Temperature = Cool, Humidity = High, Windy = True*) using the naive Bayes approach.

4. The DM Pizza Parlour sells pizzas with optional toppings: pepperoni, pineapple, and pickled-onion. Suppose, you have tried five pizzas (P1 to P5) and kept a record of which you liked :

	Pepperoni	**pineapple**	**pickled-Onion**	**liked**
P1	True	True	True	False
P2	True	False	False	True
P3	False	True	True	False
P4	False	True	False	True
P5	True	False	False	True

Show binarization of the above data and use it to calculate Euclidean distances, to demonstrate how the k-Nearest-Neighbor (k-NN) classifier with majority voting would classify a tuple <*False, True, True*>, for k = 1 and k = 3 respectively. (10)

5. Suppose we have height, weight and T-shirt size of some customers and we need to predict the T-shirt size of a new customer given only height and weight information we have. Use k-Nearest-Neighbor classifier to classify the tuple <161, 64>. Assume

k = 5. Note that the data set should be scaled to range [0-1] prior to classification, using min-max normalization. (10)

Height (in cms)	Weight (in kgs)	T-shirt Size
157	58	S
158	59	S
158	63	M
160	59	M
157	56	S
163	60	M
163	61	M
160	64	M
168	64	L
165	61	L
171	62	L
169	63	L

6. Considerthe 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	I1, I2, I5
T2	I2, I4
T3	I2, I3
T4	I1, I2, I4
T5	I1, I3
T6	I2, I3
T7	I1, I3
T8	I1, I2, I3, I5
T9	I1, I2, I3

P.T.O.

7. Consider the following data set: {4, 8, 12, 20, 32, 36, 48}. Assuming that k = 2, and initial cluster centers for k-means clustering are 32 and 48. Perform the k-means clustering to arrive at final set of cluster solutions. Also, at the end of every iteration, compute the SSE. (10)

8. Use the distance matrix given below to perform hierarchical clustering using single link and show the dendrogram. (10)

	P1	P2	P3	P4	P5	P6
P1	0					
P2	0.24	0				
P3	0.22	0.15	0			
P4	0.37	0.20	0.15	0		
P5	0.34	0.14	0.28	0.29	0	
P6	0.23	0.25	0.11	0.22	0.39	0

[This question paper contains 6 printed pages.]

Your Roll No. ....

Sr. No. of Question Paper : 4786 E

Unique Paper Code : 32341602

Name of the Paper : Computer Graphics

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

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 a question must be answered together.

SECTION A

1. (a) What is a polygon Mesh? List any one polygon mesh representation. (2)

P.T.O.

(b) Consider a polygon with vertices ABCD with co-ordinates A(1,2), B(6,6), C(8,3) and D(5,10). Trace the contents of Active Edge Table according to scan line fill algorithm. (3)

2. (a) Define horizontal and vertical retracing. (2)

(b) What are the properties of unweighted area sampling technique of anti-aliasing? (3)

3. (a) Why is depth-sort algorithm for visible surface determination called painter's algorithm? (2)

(b) Prove that parallel lines remain parallel under 2-D Transformations. (3)

4. (a) Differentiate between orthographic and oblique projections. (2)

(b) Rotate a triangle with coordinates A(0,0), B(1,1), C(5, 2) by 45° about coordinate C in clockwise direction. (3)

5. (a) How to convert RGB color model to CMY color model? (2)

(b) Draw a 3 X 3 pixel grid pattern to display 10 intensities on a bi-level system display. Show patterns for all the intensity values. (3)

6. (a) What is the condition to switch from region 1 to region 2 of the first quadrant of an ellipse in mid-point ellipse drawing algorithm? (2)

(b) What is diffuse reflection? How is it different from specular reflection? (3)

7. (a) Differentiate between cabinet and cavalier parallel projections. (2)

(b) Write the 4X4 3-D transformation matrices for each of the following transformations respectively :

(i) Uniform scaling to double the size of an object.

(ii) Translate an object 2 units in x direction and 3 units in y direction. (3)

SECTION B

8. (a) Explain briefly raster scan display architecture. (4)

(b) Give the steps to clip the lines PQ and RS (having co-ordinates P(5,12), Q(20,25), R(11,8) and S(25,16)) against the clip rectangle ABCD (having co-ordinates A(10,20), B(20,20), C(10,10), D(20,10)) using Cohen Sutherland line clipping Algorithm. (6)

9. (a) Consider a 3D object with coordinate points P(0,3,3), Q(3,3,6), R(3,0,1) and S(0,0,0). Perform a local scaling on the object with scaling factors of 2, 3 and 3 along X, Y and Z axes respectively, to obtain the new coordinates of the transformed object. (4)

(b) A cubic Bezier curve segment is described by control points $P_0(2,2)$, $P_1(4,8)$, $P_2(8,8)$ and $P_3(9,5)$. Another curve segment is described by $Q_0(a,b)$, $Q_1(c,2)$, $Q_2(15,2)$ and $Q_3(18,2)$. Find the values of a, b, c, such that the curve segments join smoothly and C^1 continuity exist between them. (6)

10. (a) Write steps to shade an object using Phong shading method of polygon rendering? How does it overcome the drawback of Gouraud shading method? (5)

(b) Consider a line from (0,0) to (5,5). Rasterize the line using Bresenham line drawing algorithm. (5)

11. (a) Reflect the polygon whose vertices are A(–1, 0), B(0, –2), C(1,0) and D(0,2) about the line $x = 2$ using homogeneous co-ordinates. (4)

(b) Clip the polygon ABCD with the vertices A(0,7), B(5,12), C(7,7) and D(6,2) against the window P (2,0), Q(10,0), R(10,10) and S(2,10) using the Sutherland-Hodgeman Polygon Clipping algorithm. Also show out vertex array at each step. (6)

12. (a) Explain Hue, Saturation and Value in HSV color model. (3)

(b) Consider a line segment AB parallel to the Z axis with end points A[3 2 2 1] and A[3 2 4 1], Overall scale to double the size of line AB followed by 2-point perspective projection with COP along x-axis and Y-axis as Xc=10 and Yc=20 respectively. Also, write the corresponding vanishing points. (7)

13. (a) Explain depth sort algorithm for visible surface determination. (5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4835 E

Unique Paper Code : 32347607

Name of the Paper : Machine Learning

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

Year of Admission : (Admission of 2019)

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. Use of scientific calculator is allowed.

Section A (Compulsory)

1. (a) Explain the cost function of logistic regression. (3)

P.T.O.

(b) Give a formula for the binary sigmoid activation function. Also obtain the first derivative of this function. (3)

(c) What is K-means clustering algorithm used for? (3)

(d) Explain two applications of machine learning. (3)

(e) Consider the following data. Find the information gain if A2 is selected as the root of the decision tree. (6)

A1	A2	A3	Class
True	Hot	High	No
True	Hot	High	No
False	Hot	High	Yes
False	Cool	Normal	Yes
False	Cool	Normal	Yes
True	Cool	High	No
True	Hot	High	No
True	Hot	Normal	Yes
False	Cool	Normal	Yes
False	Cool	High	Yes

(f) Can a single layer perceptron solve the XOR problems? Justify your answer. (3)

(g) Find the line of best fit using least square regression method, given the following data :

x	y
2	6
6	13
10	28
12	30

Predict the value of y for the test data $x = 11$.

(4)

(h) Given two situations : (4)

(i) A publishing house wants to predict the number of copies of a book would be sold. They want to use the popularity rating of the author, success index of her/his previous books and one other variable.

(ii) Based on the blood test reports, a researcher builds a model to identify the type of diabetes (type 1, type 2, gestational diabetes) that a patient has.

Identify each of these situations as a classification problem or a regression problem. Justify your answer.

P.T.O.

(i) Consider the Confusion matrix given below:

		Actual Values	
		True	False
Predicted Values	True	10	11
	False	4	20

Compute :

(i) Accuracy

(ii) Precision

(iii) Recall (6)

Section B

2. (a) Differentiate between supervised, unsupervised and reinforcement learning. (6)

(b) Using a diagram, depict the following scenarios for a machine learning model :

(i) High variance, low bias

(ii) Low variance, high bias (4)

3. (a) It is found that a classification model performs with a high accuracy on training data, but with new instances, it generalizes poorly. What could be the problem in this model? Explain using a suitable diagram. Give two possible solutions to this problem. (6)

(b) Define and elaborate the terms : (4)

(i) Hypothesis space

(ii) Inductive bias

4. (a) Apply the K-nearest neighbor algorithm on the following dataset : (4)

a	b	Class
7	7	False
7	4	False
3	4	True
1	4	True

Predict the class for X (a = 3, b = 7). Assume K = 3 (Use Euclidean distance to compute the distance)

(b) What is the disadvantage of the filter approach for feature selection?

List the steps for feature selection using Principal Component Analysis (PCA). (6)

5. (a) Design a neural network for the Boolean function AND (for two variables) with the help of a neat diagram. (4)

(b) Explain the back-propagation algorithm for a multilayer perceptron. (6)

6. (a) What do you understand by the following terms w.r.t. Support Vector Machine (SVM) learning algorithm?

(i) Support vectors

(ii) Marginal distance (4)

(b) For the following data, apply one iteration of K-means clustering to partition the data in 2 clusters. Assume points C1 = (1,2,3) and C2 = (3,4,5) as the initial cluster centers. Show the generated clusters and cluster centers after the first iteration. (Use Manhattan distance to compute the distance). (6)

A	B	C
1	2	2
2	4	1
2	3	1
6	3	8
5	2	9
1	4	3

7. (a) What is the basic assumption of a Naive Bayes classifier? (2)

(b) Consider the following training data set for car theft :

Sample No.	Color	Type	Origin	Stolen?
1	Red	Sports	Domestic	Yes
2	Red	Sports	Domestic	No
3	Red	Sports	Domestic	Yes
4	Yellow	Sports	Domestic	No
5	Yellow	Sports	Imported	Yes
6	Yellow	SUV	Imported	No
7	Yellow	SUV	Imported	Yes
8	Yellow	SUV	Domestic	No
9	Red	SUV	Imported	No
10	Red	Sports	Imported	Yes

Use the Naive Bayes classification rule to classify a Red Domestic SUV. (8)

P.T.O.

8. (a) Consider the following linear regression problem :

x	1	2	4	3	5
y	1	3	3	2	5

Given the initial values of θ_1, θ_2 as 0.5, 0.5 and learning rate as 0.1. Compute the next set of values for regression coefficients, using gradient descent method. (6)

(b) Answer the following for 5-fold cross validation on a training data set of 45 tuples :

(i) How many rounds of learning will be performed?

(ii) Statethe size of the training and testing set for each round of learning.

(iii) How would the accuracy of the classifier be calculated in 5-fold cross validation? (4)