[This question paper contains 8 printed pages.]

Your Roll No.....

B

Sr. No. of Question Paper : 749

Unique Paper Code : 32341202

Name of the Paper : Discrete Structures

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

(For Admissions of 2019 & 2020)

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. Question No. **1** is compulsory in **Section A.**
3. Attempt any **four** questions from **Section B.**
4. Parts of a question should be attempted together.

P.T.O.

SECTION A

1. (a) A class of 30 students comprises of boys who can play Cricket (C), Hockey (H) and Football (F). The following table shows how many students play each single game and in their various combinations:

Game	C	H	F	CH	CF	HF	CHF
Play	3	3	2	2	11	10	4

Find how many students play at east one game? (5)

(b) Consider a set A = {U, V, W, X}. Let R be the relation defined on A as

R = {(U, U), (V, V), (Y, W), (W, Y) (X, Y), (X, X)}

Answer the following :

(i) Draw a Digraph for the given relation R.

(ii) Is R an Equivalence Relation or a Partial order relation? Justify your answer. (5)

(c) A graph has e edges and v vertices. Show that the given expression holds true in any connected planar graph with at least 2 edges and no loops

$$e \leq 3v - 6$$

Prove that K_5 is non-planar using the above expression. (5)

(d) Ashish, Aryan and their friend Abhay were playing inside the house. One of them broke a vase. When Mrs. Sharma, their mother, asked them about the vase, she gets these replies

Aryan : "I didn't break it"

Ashish : "Neither did I"

Abhay : "Aryan broke the window"

With the help of truth table find who broke the window, if two of the children lied? (5)

(e) Find the particular solution for the given Recurrence Relation

$$a_r - 5\ a_{r-1} = 3,\ r \geq 1$$

with the boundary conditions $a_0 = 1$. (5)

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(f) Use Master method to find asymptotic bounds for the following recurrence relation :

$$T(n) = 27\ T(n/3) + \theta(n^3)$$ (5)

(g) Convert the following statement in symbolic form:

"If you send me the URL, then I will finish configuring the software. If you do not send me the URL, then I will go for a walk and If I go for a walk, then I will keep my blood pressure in control leads to the conclusion If I do not configure the software, then I will keep my blood pressure in control." (5)

SECTION B

2. (a) Use mathematical induction to prove that :

$2n < n!\ \forall\ n$ with $n \geq 4$. (5)

(b) Let f: $R \rightarrow R$ and g: $R \rightarrow R$, where R is the set of real numbers.

Given $f(x) = x^2$ and $g(x) = x + 5$.

Find $f \circ g$ and $g \circ f$.

State whether f(x) is bijective. (5)

3. (a) Consider the word "MATHEMATICS". Calculate the number of ways these letters can be arranged. Calculate the number of ways the letters can be arranged such that the vowels should occur together. (5)

(b) Let R be a relation defined by xRy if and only if $|x - y|$ is even. Show that R is an equivalence relation. (2)

(c) Let f1 and f2 be functions from R to R such that :

$f1(x) = x^2$ and $f2(x) = x - x^2$. Compute $0(f1.f2)$ (3)

4. (a) How many vertices and edges are there in each of the following graphs?

(i) K_3

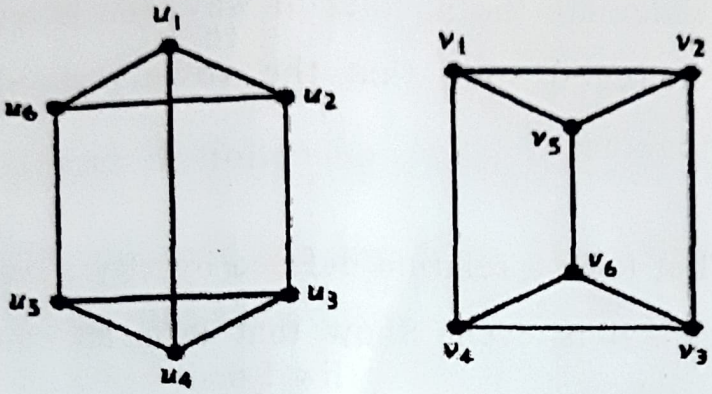
(ii) C_5

(iii) W_4

(iv) $K_{3,4}$

(v) Q_3 (5)

(b) Define Isomorphism. Are the following pair of graphs isomorphic? Justify. (5)



5. (a) Given that:

$$T(n) = 2\ T\ (n/2) + Cn$$

Using substitution method, prove that T(n) is $\theta(n \lg n)$. (5)

(b) Show all the steps of Insertion Sort to put the following list of items in an ascending order :

5	2	7	4	9	3	6	1	8

6. (a) "If you send me an e-mail message, then I will finish writing the program," "If you do not send me an e-mail message, then I will go to sleep early," and "If I go to sleep early, then 1 will wake up feeling refreshed".

Show that the above premises leads to the conclusion "If I do not finish writing the program, then I will wake up feeling refreshed." (5)

(b) Solve the given recurrence relation for the sequence defined by :

$$C_n = 5C_{n-1} - 6C_{n-2}$$

with initial conditions $C_1 = 2$, $C_3 = 1$. (5)

7. (a) Given a relation R on set A = {1,2,3,5,6,10,15,30} such that

R = {(a, b) : a is divisor of b and a ∈ A, b ∈ A}

Show that R is a POSET. Draw its Hasse Diagram. (5)

(b) Prove that $(\neg p \wedge ((\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R) \equiv R$. (3)

(c) Find the inverse and contra-positive for the statement :

"If you send me the URL, then I will finish configuring the software." (2)

8. (a) Given that the value of $p \rightarrow q$ is false, determine the value of $(p' \vee q') \rightarrow q$.

(5)

(b) Suppose that a connected planar simple graph has 20 vertices, each of degree 3. Into how many regions does a representation of this planar graph split the plane?

(3)

(c) How many edges does a full binary tree with 1000 internal vertices have?

(2)

[This question paper contains 10 printed pages.]

Your Roll No.....

A

Sr. No. of Question Paper : 1143

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 **8**.

1. (a) Consider the recursive version of Insertion sort algorithm as follows :

In order to sort A[1 : n], we recursively sort A[1 : n-1] and then insert A[n] into the sorted array A[1 : n-1]. Write a recurrence for the running time of this algorithm. (3)

P.T.O.

(b) What are the minimum and maximum number of elements in a binary heap of height h?. (2)

(c) Which of the following algorithms are stable: Insertion sort, Quicksort? Justify with the help of an example. (3)

(d) What are the two key factors that decide whether Dynamic Programming is applicable for an optimization problem or not? (2)

(e) "The minimum spanning tree in a graph is not always unique." Justify. Give a graph with 5 nodes that has two different minimum spanning trees. (2)

(f) Would you use BFS to find the shortest path between two nodes in a weighted graph with arbitrary edge weights? Justify your answer with the help of a graph having at least 5 Vertices and at least 7 edges. (3)

(g) "Counting sort is a comparison sort algorithm." Yes or No. Justify your answer using the input A = < 4, 3, 2, 4, 1, 5, 2, 4, 3 > (3)

(h) A priority queue can be implemented in two different ways using min-heap and using singly linked list in which elements are stored in sorted

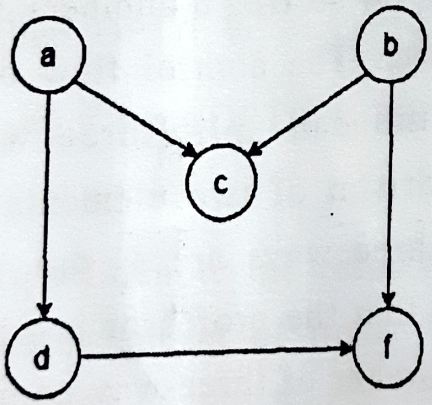
order (Smaller values indicates higher priority). Compare the time complexity of following operations when performed on two different implementations of priority queue.

(1) Finding the highest priority element

(2) Deleting the highest priority element

(3) Increase the priority of a certain element (6)

(i) Find possible Topological sorts of the given directed acyclic graph. Give any four : (2)



(j) Give the worst case for the merge algorithm to merge two sorted arrays A[1... k], B[1...m] (where $n = k + m$) and give the total number of comparisons in the worst case (in terms of n). Merge the two sorted arrays A = [3, 7, 9, 12, 14] and B = [2, 5, 6, 10] using merge algorithm. How many number of comparisons are done by the algorithm in the above example? (6)

(k) Consider the Interval Scheduling problem wherein we are given a resource and a set of requests each having a start time and a finish time. The goal is to maximize the number of requests scheduled. Show that the following greedy strategy does not give an optimal solution for the above problem.

Greedy strategy: Select the request with fewest number of incompatible requests. (3)

2. (a) Professor William claims that the $\Omega(n \lg n)$ lower bound for sorting n numbers does not apply to his machine. The control flow of a program on his machine can split three ways after a single comparison of two elements of the array $a_i : a_j$. The three ways are $a_i < a_j$, $a_i = a_j$, or $a_i > a_j$. Show that the professor is wrong by proving that the number of three-way comparisons required to sort n elements is $\Omega(n \lg n)$. (5)

(b) Suppose you have an algorithm to find median of n elements of an unsorted array in $O(n)$ time in the worst case. Now consider an implementation of Quicksort where you first find median using the above algorithm, then use median as pivot. What will be the time complexity of this modified

Quicksort? Write down the recurrence relation to justify your time complexity (Median of n elements is the element whose rank is $n/2$ if n is even and it is $(n+1)/2$ if n is odd). (5)

3. (a) Illustrate the operation of BUILD -MAX -H EAP on the array A <4, 3, 17, 10, 28, 19, 6, 12, 7>. Write down the total number of comparisons done by BUILD -MAX -H EAP. (5)

(b) Consider the following recursive relation for 0-1 knapsack problem.

If $w < w_i$, then OPT(i, w) = OPT(i-1, w)

else OPT(i, w) = max(OPT(i-1, w), v_i + OPT(i-1, _____))

where OPT(i, w) denote the value of the optimal solution using a subset of items {1,2,...i} with maximum allowed weight w.

v_i is the cost of ith item

Fill the missing value.

What is the running time of the recursive implementation of the above recurrence? Justify. Give memoized recursive algorithm for the above problem. Explain how does it improve the running time? (5)

4. (a) Give an algorithm to sort n integers in the range 0 to $n^3 - 1$ in O(n) time. Justify it's time complexity. (4)

(b) Suppose we use randomized select to select the minimum element of the array A = < 4, 2, 1, 7, 8, 12, 3, 0, 9, 5, 10 >. Describe a sequence of partitions that result in a worst case performance of randomized select. (4)

(c) Suppose an input to the bucket sort algorithm is not uniformly distributed. What will be the effect of this condition on the running time of the algorithm? Justify. (2)

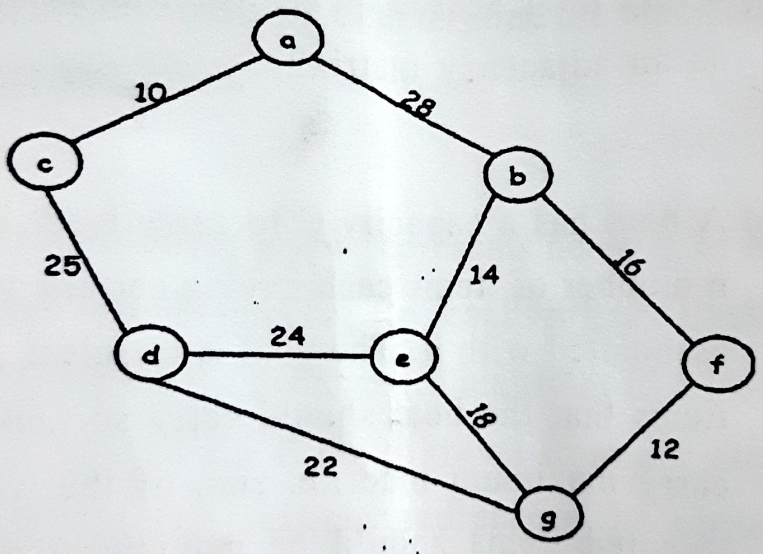
5. (a) A Shopkeeper has n empty boxes and M number of balls. Let $\{K_1, K_2 \ldots\ldots Kn\}$ denote the number of balls that each box can store.

Given M and $\{K_1, K_2 \ldots\ldots Kn\}$, describe a greedy algorithm which determines the minimum number of boxes needed to store the balls. Give time complexity of the algorithm. (4)

(b) Design a O(|V|+|E|) time algorithm to find whether a given undirected graph is bipartite (where V is the set of vertices, E is the set of edges of the graph). (4)

(c) Give space requirements of adjacency matrix and adjacency list representation having m edges and n vertices. (2)

6. (a) "Prim's algorithm only include an edge in the Minimum Spanning tree when it is justified by the Cut property." State the Cut Property. Justify the above statement on the given graph showing cuts in all the intermediate steps.



(5)

(b) Suppose divide and conquer approach is used by an algorithm to solve a problem on the input of size n. The algorithm divides the problem into k number of smaller instances, each of which is 1/b the size of the original problem. It solves the problem recursively on these smaller instances and combine their solutions to construct the final

solution of the original problem. Let G(n) denotes the cost of dividing the problem into smaller instances and F(n) denotes the cost of combining the solutions.

Write the recurrence relation to find the running time of the algorithm. Give G(n) and F(n) for Both Quicksort and Mergesort algorithm. (3)

(c) Let G be a graph with n vertices and m edges. What is the upper bound on the running time of Depth First Search on G, where G is represented as an adjacency matrix? (2)

7. (a) A boat has a capacity C to carry load. There are n number of items each having certain weight Wi associated with it. The goal is to select the set of items that the boat should carry so that it could carry maximum load(i.e. sum of the weights of selected items should be maximum) within its capacity C.

Design a Polynomial time Dynamic Programming algorithm for the problem. Derive the time complexity of the above algorithm.

Run this algorithm on the sample instance given below to find the optimal solution. (6)

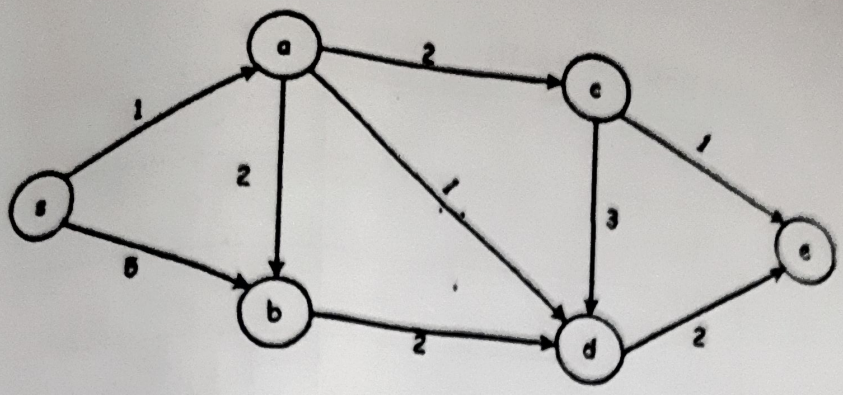
Capacity of the boat = 4kg

Items	Weights
Item1	3 kg
Item2	2 kg
Item3	1 kg

(b) Suppose we perform a sequence of n operations on a data structure in which the ith operation costs i if i is an exact power of 2, and 1 otherwise. Use aggregate analysis to determine the amortized cost per operation. (4)

8. (a) The following graph represents network of airports that are connected to each other. Each edge represents the distance (in multiples of 1000 miles) covered by the flight to travel from one airport to another and vertices represents the airports. A flight starts from airport s and has to reach destinations c, d and e. Run an efficient algorithm to find the route taken by the flight to each to its destinations in minimum possible time. Show all the intermediate steps taken by the algorithm.

Also derive its time complexity. (5)



(b) There are *n* Jobs where each job starts at time s_i and finishes at time fi. There is a profit associated with each job. The goal is to find a subset of non-overlapping jobs such that the sum of their profits is maximum.

Given below is the instance of the problem :

Job Number	Start Time (s_i)	Finish time (f_i)	Profit (p_i)
Job1	0	6	60
Job2	1	4	30
Job3	3	5	10
Job4	5	7	30
Job5	5	9	50
Job6	7	8	10

Give a Dynamic programming iterative solution for the above problem. Explain the recurrence relation used in the solution.

Show that the "Optimal solution to the above problem contains within it optimal solution to its subproblems." With reference to the above example. (5)

(1500)

3

[This question paper contains 12 printed pages.]

Your Roll No.....

A

Sr. No. of Question Paper : 1388

Unique Paper Code : 32341403

Name of the Paper : Database Management Systems

Name of the Course : B.Sc. (H) Computer Science (2019 onwards)

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 questions must be answered together.
5. Marks are indicated against each question.

SECTION A

1. (a) Explain the three-schema architecture with the help of a diagram. How does the three-schema architecture relate to data independence?

(3+1)

P.T.O.

(b) Consider the following database : (4)

Employee *(ID, Name, Address)*

Supervises *(EmployeeID, SupervisorID)*

Illustrate the concept of Recursive Closure using the relational algebraic query to retrieve the supervisors of an employee with *Name* = 'Sonia Verma'. Show the query for the first 2 levels of the recursive closure using the following data :

Employee		
ID	**Name**	**Address**
101	Rajesh Singh	Delhi
102	Viren Garg	Indore
103	Farah Khan	Mumbai
201	Vini Bala	Delhi
202	Ritika Madan	Delhi
205	Satish Meena	Delhi
302	Sonia Verma	Mambai
304	Nilesh Kumar	Mumbai

Manages	
EmployeeID	**SupervisorID**
101	102
302	102
102	103
201	103
205	202
103	304
304	205

(c) Draw the query tree to show a possible order of execution for the following relational expression:

$$R \times S - \pi_P(R \bowtie_{R.P=S.P \text{ AND } R.Q=S.T} S) \qquad (3)$$

(d) Consider the following two interleaved transactions **(T1, T2)** executed concurrently in a railway reservation system. W denotes the number of vacant seats on a train. Assume that the initial value of W is 10.

T1	T2
	1. read(W); 2. W := W - 2
3. read(W); 4. W := W - 3;	
	5. write(W);
6. write(W);	

Compute the value of **W** after the given schedule is executed. Is this value of **W** correct? If we remove the interleaving between the transactions **(T1, T2)**, what will be the value of **W**. (4)

(e) Consider a relation **R (X, Y, Z, W)**. Prove the correctness of the following **inference rule** :

$\{X \rightarrow Y, YW \rightarrow Z\} \mid = WX \rightarrow Z$ (3)

(f) Discuss the problem of spurious tuples and how we may prevent it. Illustrate using an example. (3)

(g) Consider a disk with **block size B = 500 bytes**. A block pointer is **P = 14 bytes** long. The records of the relation **BOOK** are stored in a file. The

file has **r = 50,000** records of fixed length. Each record has the following fields: **ISBN (16 bytes), Title (35 bytes), Publisher (20 bytes), Author (20 bytes), Publication_Date (8 bytes)**. An additional byte is used as a deletion marker. Calculate the record size R in bytes, the blocking factor bfr and the number of file blocks b, assuming an unspanned organization. (3)

(h) Compare and contrast Naive Users and Casual Users based on their interaction with the database. (2)

(i) Why is it said that good database design in a relational database model is characterized by minimal redundancy? (3)

(j) Draw an EER diagram that shows the entity type(s), attribute(s), relationship(s), and specialization(s) for the following SPORTS-COMPLEX database :

(i) A complex has a location, chief organizing individual, total occupied area, the number of facilities needed, budget, and information on the planned events.

(ii) For each event there is a planned date, duration, number of participants, number of officials.

(iii) A sports complex can be a one-sport or a multi-sport complex.

(iv) Multi-sport complexes have areas of the complex designated for each sport with a location indicator, namely. Fast, West. South, North, Center. (3)

(k) Consider the following relation for a STUDENT database :

STUDENT *(SSN, Name, Major, BirthDate)*

Which of the three update anomalies may be violated by the command:

"Insert a record in the STUDENT table"

Justify your answer. (3)

SECTION B

2. (a) Draw an ER diagram for the following case study :

Consider a company where the employees take orders for parts from customers. The employees are identified by a unique employee number, first and last name, and location code. Each customer of the company is identified by a unique customer number, first and last name, and location code. Each part sold by the company is identified by a unique part number, a part name, price, and quantity in stock. Each order placed by a customer is taken by an employee and is given a unique order number. Each order contains specified quantities of one or more parts, has a date of receipt as well as an expected shipment, date. The actual shipment date is also recorded.

Specify primary key, cardinality ratio and participation constraints in the diagram clearly.

(7)

(b) Consider the following relation that represents the courses taught in a University: (3)

(b) Consider the following two relations R and S :

R		
P	Q	D
1	a	5
25	b	8
5	a	6

S		
P	B	C
10	b	5
25	c	1
10	b	5

Show the result of the following relational queries :

(i) $\sigma_{C=D}(S \times R)$

(ii) S MINUS (R UNION S)

(iii) $\rho_R(\rho_{(C,D)}(\pi_{(P,Q)}(R)) \div \pi_C(S))$ (7)

6. Consider a relation R (A, B, C, D, E). The corresponding functional dependency set is given as follows :

$F = \{AB \rightarrow E, AE \rightarrow D, C \rightarrow AD\}$

(a) Find the primary key showing the method to arrive at the result.

(b) Assuming that the given relation is in 1NF, find the highest Normal Form that the relation satisfies. Show the steps for reaching the conclusion.

(c) Normalize the relation up to 3NF indicating the decomposition of the relations at each step. (10)

7. Consider the following relations (key of each relation is underlined) :

SALESPERSON (*SNo, SName, Commission*)

PRODUCT (*PId, Pname*)

CUSTOMER (*CNo, CName, CAddress*)

SALE (*Date, CNo, SNo, PId, Quantity*)

Write SQL statements for the following queries :

(i) Write the CREATE TABLE command for the SALE table in SQL ensuring that the following concepts are used at least once: Integer. String, and Date data type, NOT NULL constraint. CHECK constraint. PRIMARY KEY constraint. FOREIGN KEY constraints (with ON DELETE SET NULL and ON UPDATE CASCADE constraints, if applicable).

(ii) Get the names of the SALESPERSON who sold the product with PId = 56.

(iii) Get the names of CUSTOMERS who bought a product "Mixie".

(iv) Get the total number of PRODUCTS sold on "25-02-2022".

(v) Get the total number of PRODUCTS purchased by each CUSTOMER. (10)

[This question paper contains 7 printed pages.]

Your Roll No.....

A

Sr. No. of Question Paper : 1108

Unique Paper Code : 32341601

Name of the Paper : BHCS13: 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) Describe the following terms : (4)

   (i) Heuristic Function

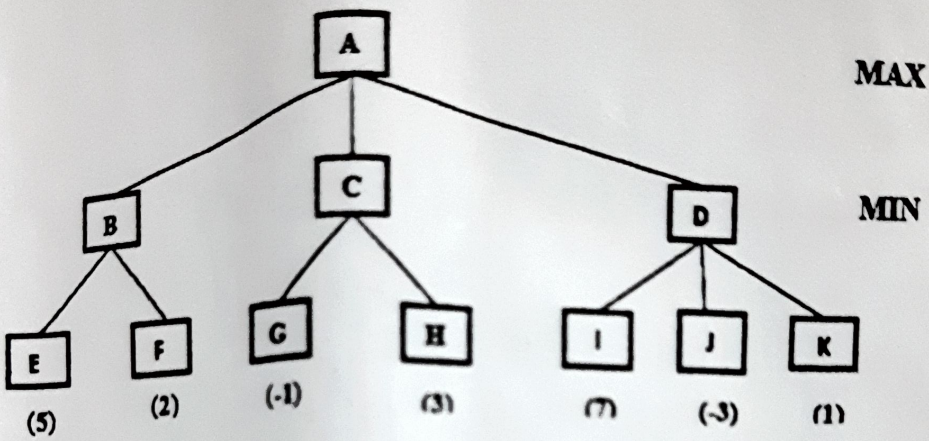
   (ii) Software Agent

   (b) Write a context free grammar that can accept the sentence: "Ram hit the ball". (3)

P.T.O.

1108

(c) 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)



(d) Find whether the following set is unifiable or not. If unifiable, find the most general unifier(m.g.u.).

w = {PARENTS(x, FATHER(x), MOTHER(bill)), PARENTS(bill, FATHER(bill), y)} (2)

(e) Express the following sentence as conceptual dependency structure:

"Sohan gave Tina a box of chocolate" (2)

(f) Write the conceptual graph and FOPL representation for the following sentence:

"Every motorbike has a handle" (4)

(g) Consider that append(L1,L2,L3) is a function in Prolog, in which list LI is contacted with L2 and the result is stored in L3. What would be the output of the following statement in Prolog?

?- append([2,3,4],L,[2,3,4,a,b]). (2)

(h) Find the meaning of the statement

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

for the interpretation: P is true, Q is false, R is true, S is true. (2)

(j) Transform the following sentence into disjunctive normal form :

$$\sim(P \vee \sim Q) \ \& \ (R \rightarrow S)$$ (3)

(k) Determine whether the following sentence is satisfiable, contradictory or valid:

$$S : P \rightarrow Q \rightarrow \sim P$$ (2)

(l) Why should the heuristic function of A* algorithm always underestimate? Give reason, example.

(3)

(m) What is non-monotonic reasoning? Give an example.

(3)

(n) Prove that if A and B are independent events, $P(A|B) = P(A)$. (Note that A and B are independent if and only if $P(A \& B) = P(A)P(B)$).

(3)

2. (a) Differentiate between partially observable and fully observable task environment of an agent. Give an example of each.

(5)

(b) Create a frame network for terrestrial motor vehicles (cars, trucks, motorcycles) and given one complete frame in detail for cars which includes the slots for the main component parts, their attributes, and relations between parts. (5)

3. (a) What is closed world assumption? Give an example.

(3)

(b) Define Modus ponens rule. Elaborate using an example.

(3)

(c) Given formula S_1 and S_2 below, show that Q(a) is a logical consequence of the two.

S_1: $(\forall x)(P(x) \rightarrow Q(x))$ and S_2: $P(a)$ (4)

4. (a) Create a script for shopping in a supermarket. (5)

(b) Joint probability $P(x_1, x_2, \ldots, x_7)$ by inspection as a product of chain conditional probabilities is :

$$P(x_1, x_2, \ldots, x_7) = P(x_7 \mid x_3) \cdot P(x_6 \mid x_5) \cdot P(x_5 \mid x_2 x_3) \cdot P(x_4 \mid x_1 x_2) \cdot P(x_3) \cdot P(x_2 \mid x_1) \cdot P(x_1)$$

Draw the Bayesian belief network for the same. (5)

5. (a) Write a program in Prolog to compute the sum of elements of a list. (5)

(b) What are alpha and beta cutoffs? How alpha-beta pruning is used to improve the efficiency of Minimax procedure? (5)

6. (a) Compare and contrast Best-first search and Hill Climbing search. You can use example. (4)

(b) What is a Recursive Transition Network (RTN)? Give an example. (4)

(c) Give two limitations of propositional logic. (2)

7. (a) Consider the following axioms :

January

Clouds

Cold & Preciptation → Snow

January → Cold

Clouds → Precipitation

Convert them into clausal form and prove the truth of "Snow" using resolution. (5)

(b) Develop a parse tree for the sentence "The cruel man locked the dog in the house" using the following rules.

S → NP VP

NP → N

NP → DET N

VP → V NP

VP → V PP

VP → V NP PP

PP → PREP NP

DET → ART ADJ

DET → ART

N → man | dog | house

V → locked

ART → the | a

ADJ → cruel

PREP → in (5)

8. (a) Solve the following crypt arithmetic problem using constraint satisfaction.

```
   ODD
 + ODD
----------
  EVEN
----------
```

(4)

(b) Describe the limitations of Hill Climbing Methods.

(3)

(c) Define the PEAS for vacuum cleaner agent.

(3)

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1262 **A**

Unique Paper Code : 32347607

Name of the Paper : Machine Learning

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

(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 **4 (four)** questions from **Section B**.
4. Use of scientific calculator is allowed.

SECTION A

1. (i) Distinguish between supervised learning and unsupervised learning. Illustrate with an example. (5)

(ii) Define Concept Learning. How the concept learning can be viewed as the task of searching? (5)

P.T.O.

(iii) Calculate the output y of a single layer neural network with three input neuron and one output neuron. The input feature vector is (x1, x2, x3) = (0.8, 0.6, 0.4) and weight values are [w1, w2, w3] = [0.2, 0.1, –0.3] and bias = 0.35. Use binary Sigmoid function as activation function. (5)

(iv) Distinguish between overfitting and underfitting. How it can affect model generalization? (5)

(v) Using an example discuss how new features can be constructed by forming Cartesian production of existing features. What are the implications of this approach? (5)

(vi) Suppose that the probability of five events are P(first) = 0.5 and P(second) = P(third) = P(fourth) = P(Fifth) = 0.125. Calculate its entropy. (5)

(vii) Use K-means clustering to cluster the following data into two groups :

{2, 4, 10, 12, 3, 20, 30, 11, 25}

Assume cluster centroid are m1=2 and m2=4. The distance function used is Euclidean distance. (5)

SECTION B

2. (i) Find the least square regression line for the given dataset using the normal equation method. Show computation at each step.

x1	x2	y
1	9	14
2	1	7
3	2	12
4	3	16
5	4	20

(4)

(ii) Consider the dataset given below having two input variables x1, x2 and one output variable y. Update the coefficients θ_0, θ_1 and θ_2 using gradient descent for the logistic regression model. Assume the learning rate = 0.3 and the initial values of coefficients as $\theta_0 = -0.5$, $\theta_1 = 1$, and $\theta_2 = -1$. Perform one iteration of gradient descent.

(6)

x1	1	3	8	6
x2	2	5	3	2
y	0	0	1	1

3. (i) State Bayes Theorem.

(2)

(ii) Consider the training data in the following table where Play is a class attribute.

Humidity	Sunny	Wind	Play
L	N	S	N
H	N	W	Y
H	N	W	N
H	Y	S	Y
H	N	W	Y
L	Y	S	N

Build a Naive Bayes Classifier using the above data. Estimate the class label for day (Humidity=L, Sunny=N, Wind=W) using the above classifier. (8)

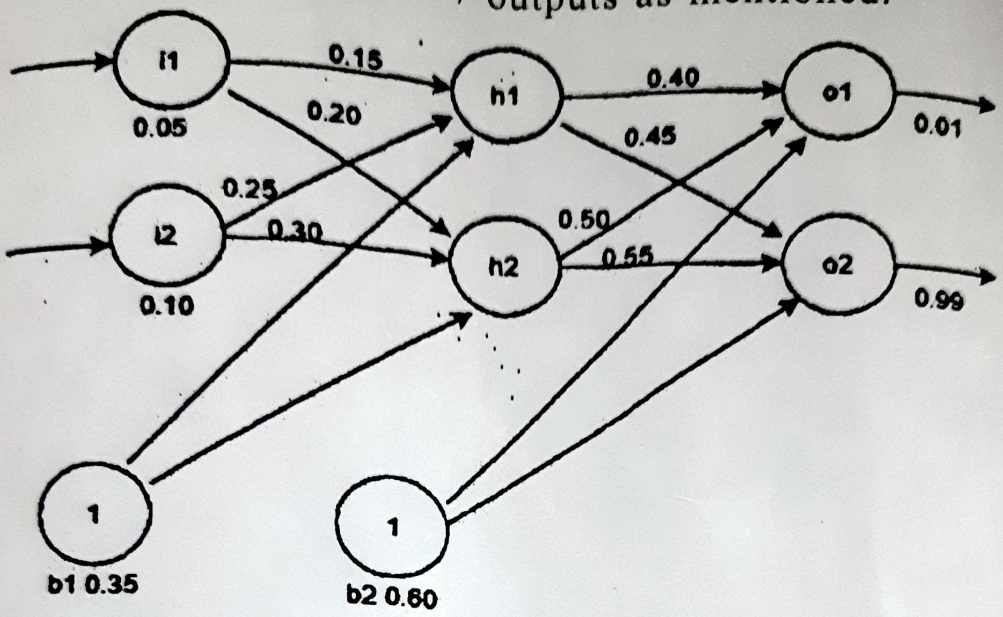
4. (i) Differentiate between Standard and Stochastic Gradient Descent. (4)

(ii) Identify the first splitting attribute for decision tree with the following dataset using ID3 algorithm :

Field	Experience	Hired
IT	Coding	No
IT	Coding	No
IT	Administration	Yes
IT	Administration	Yes
Business	Coding	Yes
Business	Coding	Yes
Business	Administration	No
Business	Administration	No

(6)

5. Consider the following neural network with initial weights, biases, and training input / outputs as mentioned.



Given the inputs i1 = 0.05, i2 = 0.10, determine the values of output nodes o1 and o2. Also calculate the prediction error E_{total} if the actual output values o1 and o2 are 0.01 and 0.99 respectively. Use Sigmoid as the activation function for the hidden as well as the output layers. (10)

(i) What is the difference between K-means clustering and K-Nearest Neighbor classifier? (4)

(ii) Discuss steps used by Principal Component Analysis to extract important features. (6)

(i) Given the set of values $X = (3, 9, 11, 5, 2)^T$ and $Y = (1, 8, 11, 4, 3)^T$. Evaluate the regression coefficients using ordinary least square method. (4)

(ii) Assume a total of 1,000 patients are tested for influenza; 900 are found to be healthy, while 100 are found to be sick. A test resulted in 60 being positive and 40 being negative for the sick persons. The same test was positive for 120 and negative for 780 in healthy adults. Construct a confusion matrix for the data and determine precision and recall. (6)

8. (i) What is regularization? What is the effect of the following on the model?

(a) The regularization parameter (λ) is zero

(b) The regularization parameter (λ) is very large (4)

(ii) State the mathematical formulation of the SVM problem. Give an outline of the method used for solving the classification problem using SVM. (6)

[This question paper contains 8 printed pages.]

Your Roll No.....

B

Sr. No. of Question Paper : 731

Unique Paper Code : 32341201

Name of the Paper : Programming in Java

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

Semester : II (DSC-1) (Admissions 2019)

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. If required, you may make suitable assumptions and state them clearly.
6. **The data types of variables/data members/arrays and return types of the methods/member methods should be assumed suitably unless explicitly mentioned.**

P.T.O.

SECTION A

1. (a) Write the output(s) of the following Java code snippets :

(i)
```
class AddBytes {
    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);
    }
}
```

(3)

(ii)
```
class Operators {
    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);
    }
}
```

(5)

(iii)
```
class Parent {
    public Parent(int i) {
        System.out.println(5);
    }
}
class Child extends Parent {
    public Child(int i) {
```

```
            super(i);
            System.out.println(10);
        }
    }
    public class QPDemo {
        public static void main(String[] args) {
         Child c = new Child(5);
        }
    }
```

(5)

(iv)
```
class ArrayLoop {
    public static void main(String[] args) {
        int arr[][] =  { {52, 21, 60},
                         {34, 56, 95},
                         {16, 11, 31},
                         {93, 17, 85}
                       };
        for(int i=0, j=0; i<3 && j<3; i++)
            System.out.print(arr[i][j] + " ");
        System.out.println();
        for(int i=1, j=1; i<3 && j<3; j++)
            System.out.print(arr[i][j] + " ");
        System.out.println();
        for(int i=0, j=2; i<3 && j<3; j+=2)
            System.out.println(arr[i][j] + " ");
    }
}
```

(5)

(b) Define a recursive Java method **recMeth**(...) to calculate the product of digits of a number **n** passed as an argument to the method. (5)

(c) Write a program in Java (using *try-with-resources* functionality) to read a file "**SourceFile.txt**" and copy only those lines that contain both the characters '#' and '@' to another file "**DestFile.txt**". (5)

(d) Define a Java class **ObjReturn** having a data member **a** of the type float. Define a parameterized constructor to initialize **a**. Define a method **decOb()** that extracts the decimal part of **a** and stores it as a data member of another object of the same class. The method then returns the new object. (5)

(e) Write a program in Java to create a frame using Java AWT. Implement **mouseEntered()** and **mouseClicked()** events such that: (5)

(i) Size of the frame should be doubled when mouse enters it.

(ii) Background colour of the frame changes to **'YELLOW'** when mouse is clicked inside the frame.

SECTION B

2. (a) Write a program in Java that accepts a string through command line and works as follows : (6)

- If the number of arguments is zero, the exception raised should be handled by the program and a message **"Error 01: No valid argument!"** is displayed on the screen and the program ends.
- If the number of arguments is greater than that required, a message **"Error 02 : The number of arguments is more than that required!"** is displayed on the screen and the program ends.
- If an argument (string) contains a digit, the string is printed on the screen otherwise the string is written to a file named **"StoredString.txt"**.

(b) What are packages in Java? What Java statement should be written in a file named **PackTest.java** assuming that a class named **PackTest** is saved inside the **pack1** package? (4)

3. Define the following user-defined methods in Java with appropriate parameters and return values to perform the tasks as mentioned against their names : (5×2=10)

(i) **strComp(...)**: The method accepts two strings as arguments and returns the one whose length is shorter. If both strings are of equal length, the one that is placed earlier in the alphabetical order is returned.

(ii) `getAverage(...)`: The method accepts a 2D array, number of rows and number of columns as parameters and returns the average of all values in the array.

4. (a) Which of the following are valid declarations? (5)

(i) `int i = 0xCAFE;`

(ii) `boolean b = 0;`

(iii) `char c = 'B';`

(iv) `byte b = 128;`

(v) `char c = "A";`

(b) What are automatic type conversion rules in java? Explain each with an example. (5)

5. Write a program in Java to create a stack of integers, populate it with data and display the data on the screen. The program defines the following structures for the same :

- An interface `Stack` with prototypes of two methods `push()` and `pop()`. The interface also has a default method `clearStack()` that empties the stack.
- A class `StackClass` which implements the interface `Stack`. The class has two private data

members- an array of integers **arrStack** and an integer **top**. The class also provides a parameterized constructor, a display method to display the array elements and appropriate definitions to the methods of the interface.

- A driver class **StackDemo** with a **main()** method to create an object of the class **StackClass** with 5 elements and invoke all the methods. (10)

6. (a) Explain the term polymorphism. How does Java support run time polymorphism? Illustrate with an example. (4)

(b) Write a program in Java that accepts a number from the user and calculates factorial of the number. If the entered number is negative, a user defined exception is generated, else the square of the number is printed. (6)

7. (a) Write Java statements/prototype for the following tasks : (2×3=6)

(i) a method that accepts a 2D array of integers, a string object and returns a character.

(ii) a while loop that reads lines of text from the keyboard and prints them on screen until the key combination Ctrl+z is entered.

(iii) a try catch block to handle opening of a file in read mode.

(b) Differentiate between **paint()** and **repaint()** methods defined by AWT. (4)

8. Using Java Swing, write a program in Java to do the following : (10)

- Create a frame titled **"Frame Message"** having two buttons captioned **"Click It"** and **"Erase It"** respectively. When a user clicks on the button **"Click It"** a message **"Button has been clicked"** is displayed on the frame and when the button **"Erase It"** is clicked, the message gets erased from the frame.

- Create two buttons named **'RED'** and **'BLUE'**. When a button is pressed the background color should be set to the color named by the button's label.

- Using appropriate adapter class, display the message:

"Typed character is: <typedCharacter>" in the frame window when user types any key.

(6th) B.Sc.

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2729 **A**

Unique Paper Code : 62343635

Name of the Paper : System Administration and Maintenance

Name of the Course : **B.A. (Prog.)**

Semester : VI

Duration : 2 Hours Maximum Marks : 25

Instructions for Candidates

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

1. (a) List two features of LINUX kernel. (2×5=10)

   (b) Explain the difference between LINUX and DOS operating systems.

P.T.O.

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2729 **A**

Unique Paper Code : 62343635

Name of the Paper : System Administration and Maintenance

Name of the Course : **B.A. (Prog.)**

Semester : VI

Duration : 2 Hours Maximum Marks : 25

Instructions for Candidates

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

1. (a) List two features of LINUX kernel. (2×5=10)

   (b) Explain the difference between LINUX and DOS operating systems.

P.T.O.

(c) Explain the significance of using username and password while logging into a system.

(d) Explain the use of the cat command in LINUX.

(e) Write the syntax of chmod command. Give two examples.

2. (a) What are the different functions of operating system? (3)

(b) Differentiate between IPv4 and IPv6. (2)

3. Explain use of the following commands : (1×5=5)

(a) mkdir

(b) echo

(c) cal

(d) kill

(e) rm

4. (a) Write any three commands used for process management. (3)

(b) Write the steps to copy a file from one directory to another directory, in LINUX. (2)

5. (a) Differentiate between FAT and NTFS. (3)

(b) What is the use of a remote desktop? (2)

6. (a) What is the difference between cd and cd..? (2)

(b) What action will be performed on execution of the following commands : (3)

(i) $ date –u

(ii) $ ls –a

(iii) $ man

7. (a) Which command in LINUX is used to test network connection? (1)

(b) Explain the use of following network tools :

(i) ipconfig

(ii) netstat (2×2=4)

[This question paper contains 5 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2653 **A**

Unique Paper Code : 62345625_OC

Name of the Paper : Multimedia and Web Designing

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

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 **five** questions from Question **2** to **9**.

1. (a) Define multimedia. (2)

(b) What is color pallete? (2)

(c) Explain the structure of URL with an example. (3)

(d) What do you mean by sample size in terms of digital audio? (2

P.T.O.

(e) Describe hypermedia and hypertext with example. (4)

(f) What is 3-D Modeling? (2)

(g) What is auto tracing? (2)

(h) Explain the inline method of applying style sheet to an HTML document. (2)

(i) Describe animating text in multimedia. (2)

(j) Describe any two attributes of <font> tag in HTML. (2)

(k) Explain the <hr> tag in HTML. (2)

2. (a) What do you understand by MIDI Audio? How is it different from Digital Audio? (6)

(b) Why is Cascading Style Sheet (CSS) preferred over the deprecated HTML? (4)

3. (a) Describe the software commonly used in making multimedia projects. (7)

(b) Explain various ways to make your text look attractive. (3)

4. (a) Describe various methods of delivering multimedia. (4)

(b) Which input and output devices are the most suitable for the image, audio and video component in Multimedia. Justify. (6)

5. (a) Create an Admission form in HTML as per the details given below :

(i) Name and address of the applicant appearing in text box

(ii) Courses applied for as radio button (Any 3 courses)

(iii) Use check boxes to mention 3 Hobbies

(iv) Use text area for comments

(v) Use Drop down box for mention the state (Any 5 states)

(vi) Submit button for submitting the form

(vii) Use Reset button for resetting the form. (7)

(b) Explain the <img> tag in HTML and any 2 attributes. (3)

6. (a) Differentiate between vector drawn and bitmap images. (6)

(b) How are frames created in HTML? Explain with suitable HTML code. (4)

7. (a) Write HTML code to create the following table : (7)

XYZ Ltd Company Sales During 2021-2022

Year	Sales		
	Delhi	Mumbai	Total
2021	Rs. 10 crore	Rs. 5 crore	Rs. 15 crore
2022	Rs. 20 crore	Rs. 12 crore	Rs. 32 crore

(b) Describe XML in multimedia with example. (3)

8. (a) Differentiate between :

(i) Kinematics vs Inverse Kinematics

(ii) Cell padding vs Cell spacing

(iii) Interlacing and Progressive Scan (6)

(b) Explain the techniques used in cel animation. (4)

9. (a) What do you understand by internal and external linking in HTML? Explain with examples. (5)

(b) Explain 2D, 2-1/2 and 3 D Animation in detail. (5)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1628 A

Unique Paper Code : 42347610

Name of the Paper : Computer Networks

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

Semester : VI

Duration : 3 Hours Maximum Marks : 75

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

SECTION A

1. (a) What is a WAN in computer networks? Explain with an example. 2

(b) Which layer provides 2
i. user services such as electronic mail, remote file access and transfer.
ii. transmission of bit streams across Physical media.

(c) What is zero compression in IPv6 Colon Hexadecimal Notation? Write the address AB0F:0:0:0:0:0:0:C8 using Zero compression. 2

P.T.O.

(d) In which mode of communication can data flow in one direction only? Give an example. 2

(e) List different characteristics of a data communication system. 2

(f) How will you differentiate between a single-bit error with a burst error? explain with an example. 3

(g) What is the bandwidth-delay product of a link with a bandwidth of 50 kbps and a one-way transit time of 300 msec? Calculate the optimum window sizes for a sliding window protocol for the link. 3

(h) Briefly explain how a repeater extends a LAN. Is it an analog or a digital device? 3

(i) What is byte stuffing? How does it solve the problem of resynchronization after an error occurs? Given the output after byte-stuffing: FLAG A B ESC ESC C ESC ESC ESC FLAG ESC FLAG D F FLAG. What is the original data? 3

(j) In which type of communication, the media needs to be dedicated between devices. How is it better than the others? 3

SECTION B

(Attempt any five)

2. (a) Explain OSI reference model and compare it with TCP/IP model. 6

(b) Differentiate the following transmission technologies: 4

1. Broadcasting
2. Point to Point

3. (a) Explain the four characteristics and five components of a data communication system diagramatically. 6

(b) For each of the following four networks, discuss the consequences if a connection fails. 4

i. Seven devices arranged in a bus topology
ii. Six devices arranged in a star topology (not counting the hub)
iii. Ten devices arranged in a mesh topology
iv. Five devices arranged in a ring topology

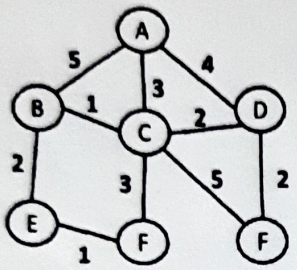
4. (a) Write short notes on :- 6

i. Radio transmission
ii, Microwave transmission
iii, Infrared wave transmission

(b) Write down the comparison between fiber-optics and twisted-pair cable. 4

5. (a) Suppose that a message 1100 1001 0011 1010 is transmitted using Internet Checksum (4-bit word). What is the value of the checksum? What kind of errors will not be detected by this Checksum? Give an example. 6

(b) Given the following network topology, construct a sink tree for router A keeping the optimality principle in mind. 4



6. (a) Create a system of 3 LANs with 4 bridges. the bridges (B1 to B4) connect the LAN as follows: 6
i. B1 connects LAN1 and LAN2
ii. B2 connects LAN1 and LAN3
iii. B3 connects LAN2 and LAN3
iv. B4 connects LAN1, LAN2 and LAN3
Choose B1 as the root bridge. Show the forwarding and blocking ports after applying the spanning tree procedure.

(b) Which one has more overhead, a router or a switch? Explain your answer. 4

7. (a) Assume you are given the assignment of setting three different computer labs with 100 machines, 48 machines, and 53 machines in each lab. You talked to the network administrator and was given 128.198.63.0/24 subnet for these three labs. What are the three subnets address and three gateway IP addresses you would like to assign to those three subnets? What is the broadcast address for these three subnets? 6

(b) Distinguish between the data and the control connection in the File Transfer Protocol. 4

8. (a) What are connection-oriented and connectionless services? Explain each with an example? 6

(b) Explain the connection between a Web page and HTML. 4

9. (a) Differentiate the following: 6
i. Flow control and Error control
ii. Switches and Gateways

(b) Why is caching an important optimization for web access? Describe the steps taken by a browser to determine whether to use an item from its cache or not. 4

Comp. Sc.