UNITED INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

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Periyanaickenpalayam, Coimbatore – 641020

BACHELOR OF TECHNOLOGY

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

QUESTION BANK

II YEAR

ODD SEMESTER

ACADEMIC YEAR 2024 – 2025

INDEX

HEAD OF THE DEPARTMENT

ACOE **PRINCIPAL** **CHAIRMAN**

MA3354

DISCRETE MATHEMATICS

UNIT I
LOGIC AND PROOFS

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers –Rules of inference - Introduction to proofs – Proof methods and strategy.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Show that ¬ (P→Q) and P∧¬Q are equivalent.	1	2	2
2.	Construct the truth table for the compound proposition (p →q)→(q→p).	1	1	2
3.	What are the negations of the statements $\forall x(x^2 > x)$ *and* $\exists x(x^2 = 2)$?	1	1	2
4.	Express the following statement using predicators and quantifiers, "All men are mortal".	1	1	2
5.	Verify P∨Q→P is a Tautology.	1	2	2
6.	Construct truth table for $(p \wedge \neg q) \rightarrow q$.	1	2	2
7.	Using truth table, show that $p \vee \neg(p \wedge q)$ is a tautology.	1	1	2
8.	Define PCNF and PDNF .	1	1	2
	PART B			
1.	Show that $P \rightarrow (Q \rightarrow R)$ and $(P \wedge Q) \rightarrow R$ are logically equivalent using truth table.	1	2	8
2.	Using indirect method of proof, derive $P \rightarrow \neg S$ from $P \rightarrow (Q \vee R)$, $Q \rightarrow \neg P$, $S \rightarrow \neg R$, P.	1	3	8
3.	Show that $\forall x(P(x) \rightarrow Q(x)), \forall x(R(x) \rightarrow \neg Q(x)) \Rightarrow \forall x(R(x) \rightarrow \neg P(x))$.	1	2	8
4.	Show that $(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$.	1	2	8
5.	Without constructing the truth table find the PDNF and PCNF of P→(Q∧R)∧(¬P→(¬Q∧¬R))	1	3	8
6.	Show that $p \vee (q \wedge r)$ *and* $(p \vee q) \wedge (p \vee r)$ are logically equivalent.	1	2	8
7.	Find the PDNF of the statement, $(q \vee (p \wedge r)) \wedge \neg((p \vee r) \wedge q)$.	1	3	8

UNIT II

COMBINATORICS

Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Find the first four terms of the sequence defined by the recurrence relation and initial condition $a_n = a_{n-1}^2$, $a_1 = 2$.	2	1	2
2.	State the Pigeonhole principle.	2	2	2
3.	Find the recurrence relation satisfying the equation $y_n = A(3)^n + B(-4)^n$	2	1	2
4.	In how many ways can the letters of the word MISSISSIPPI be arranged?	2	1	2
5.	If 9 colours are used to paint 100 houses, show that at least 12 houses will be of the same colour.	2	1	2
6.	Solve the recurrence relation $y(k)-8y(k-1)+16y(k-2)=0$ for $k \geq 2$,where y(2) = 16 and y(3) = 80 .	2	1	2
7.	If $nc_5 = 20nc_4$, find 'n'.	2	1	2
8.	In how many ways can 5 persons be selected from amongst 10 persons ?	2	2	2
	PART B			
1.	Using mathematical induction to show that $1^2 + 2^2 + 3^2 + \cdots \ldots . . + n^2 = \frac{n(n+1)(2n+1)}{6}$ whenever n is a positive integer.	2	3	8
2.	Use mathematical induction to show that $1+2+3+....+n = \frac{n(n+1)}{2}$.	2	3	8
3.	Solve the recurrence relation $a_n = 8a_{n-1} - 16a_{n-2}$ for $n \geq 2$, $a_0 = 16$, $a_1 = 80$.	2	2	8
4.	Solve the recurrence relation $a_n = 6a_{n-1} - 9a_{n-2}, n \geq 2, a_0 = 2$, $a_1 = 3$.	2	2	8
5.	In a survey of 100 students, it was found that 40 studied Mathematics, 64 studied Physics,5 studied Chemistry, 1 studied all the three subjects, 25 studied Mathematics and Physics, 3 studied Mathematics and Chemistry, 20	2	4	8

	studied Physics and Chemistry. Use the principle of inclusion and exclusion, find the number of students who studied Chemistry only and the number who studied none of these subjects?			
6.	From a club consisting of 6 men and 7 women, in how many ways can we select a committee of i) 3 men and 4 women ii) 4 persons which has at least one woman iii) 4 persons that has at most one man.	2	4	8

UNIT III

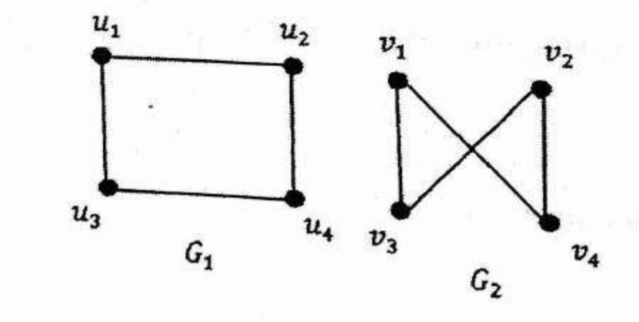
GRAPHS

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

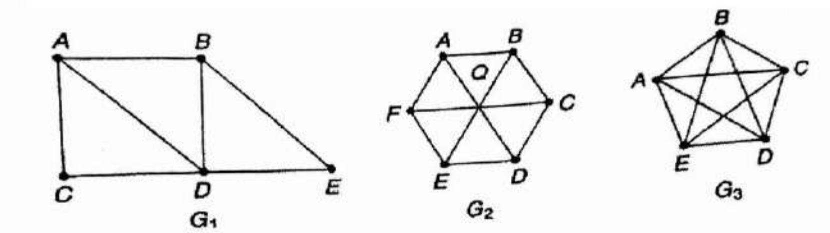
Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define a complete graph with example.	3	1	2
2.	What is meant by simple graph? Give an example.	3	1	2
3.	Define a regular graph with example.	3	2	2
4.	State the handshaking theorem.	3	1	2
5.	Draw the graph represented by the given adjacency matrix $\begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$.	3	2	2
6.	Define Pseudo graph.	3	1	2
7.	Give an example of a graph which is Eulerian but not Hamiltonian.	3	1	2
8.	Draw the graph with 5 vertices A,B,C,D,E such that deg(A) = 3 , B is an odd vertex , deg(C) = 2 and D and E are adjacent.	3	2	2

PART B

1.	In any graph G, prove that the total number of odd-degree vertices is even.	3	2	8
2.	Prove that maximum number of edges in a simple disconnected graph G with 'n' vertices and 'k' Components is $\frac{(n-k)(n-k+1)}{2}$.	3	2	16
3.	Determine whether the following graphs G1 and G2 are isomorphic.	3	4	8



4.	Find an Euler path or an Euler circuit, if it exists in each of the three graphs below. If it does not exist, explain why?	3	4	8



5.	Draw the graph with the adjacency matrix $\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$ with respect to the ordering of A, B, C, D.	3	4	8

UNIT IV

ALGEBRAIC STRUCTURES

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Definitions and examples of Rings and Fields.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define a Ring.	4	1	2
2.	Define monoid.	4	1	2
3.	Prove that if G is abelian group then for all $a,b \in G$ $(a*b)^2 = a^2 * b^2$.	4	2	2
4.	Define a field.	4	1	2
5.	Prove that identity element is unique in a group.	4	1	2
6.	State any two properties of a group.	4	1	2
7.	Define semi groups and monoids.	4	1	2
8.	Define a commutative ring.	4	2	2
	PART B			
1.	State and prove Lagrange's theorem.	4	2	8
2.	Show that the intersection of two normal subgroup of a group (G,*) is a normal subgroup of (G,*).	4	2	8
3.	Let (G, *) be a group, then prove that (i) For each $a \in G, (a^{-1})^{-1} = a$ (ii) For all, $a, b \in G, (a * b)^{-1} = b^{-1} * a^{-1}$ for all $a, b \in G$.	4	4	8
4.	Show that Kernal of a group homomorphism is a normal subgroup of the group.	4	2	16
5.	Show that the set Z_4 = { 0,1,2,3 } is a commutative ring with respect to the binary operations additive modulo ($+_4$) and multiplicative modulo (X_4).	4	4	16

6.	Show that the set of integers Z with the binary operations ⨁ and ʘ defined by a⨁b = a+b-1 and a ʘ b = a+b-ab for $a, b \in Z$ is a commutative ring with identity.	4	4	16
7.	Show that the set of all non-zero real numbers is an abelian group under the operation * defined by $a * b = \frac{ab}{2}$.	4	4	8

UNIT V

LATTICES AND BOOLEAN ALGEBRA

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems– Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra – Sub Boolean Algebra – Boolean Homomorphism

Q.No	Question	CO	BTL	Marks
	PART A			
1.	State DeMorgan's law in Boolean Algebra.	5	1	2
2.	Draw a Hasse diagram of $D_{20} = \{1,2,4,5,10,20\}$.	5	1	2
3.	Prove that $(a')' = a$ for all $a \in B$ where B is a Boolean Algebra.	5	1	2
4.	Draw a Hasse diagram of $D_{12} = \{1,2,3,4,6,12\}$.	5	2	2
5.	State the distributive inequalities in Lattice.	5	1	2
6.	Define Boolean algebra.	5	2	2
7.	Define a lattice. Give suitable example.	5	1	2
8.	Define Sub lattices.	5	2	2
	PART B			
1.	State and Prove De Morgan's law in Boolean Algebra.	5	4	8
2.	In a Boolean Algebra, prove that the following statements are equivalent. (i) $a + b = b$ (ii) $a.b = a$ (iii) $a' + b = 1$ (iv) $a.b' = 0$.	5	3	8
3.	In a Boolean Algebra show that $ab' + a'b = 0$ if and only if $a = b$.	5	3	8
4.	Prove that every chain is a distributive lattice.	5	4	8

5.	Let $(L, \leq)$ be a lattice. For any $a, b, c \in L$ the following properties called isotonicity hold. If $b \leq c$ then (i) $a * b \leq a * c$ (ii) $a \oplus b \leq a \oplus c$.	5	3	8
6.	Let $(L, \leq)$ be a lattice. For any $a, b, c \in L$ the following inequalities hold. (i) $a \oplus (b * c) \leq (a \oplus b) * (a \oplus c)$ (ii) $a * (b \oplus c) \geq (a * b) \oplus (a * c)$	5	4	8

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CS3351

DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION

UNIT I

COMBINATIONAL LOGIC

Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers - De-multiplexers.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	List the four possible elementary operations simple binary addition consists of.	1	1	2
2.	Simplify the following Boolean function and draw the logic diagram. F = x'y' + xy + x'y	1	3	2
3.	Define combinational circuits.	1	3	2
4.	Compare the function of decoder and encoder and Convert a two-to-four-line decoder with enable input to 1:4 demultiplexer	1	2	2
5.	What is priority encoder?	1	3	2
6.	How would you design the logic diagram of a 2-bit multiplier?What is magnitude comparator?	1	2	2
7.	Convert binary code to grey code 11101.	1	3	2
8.	Evaluate the logic circuit of a 2-bit comparator.	1	3	2
	PART B			
1.	Consider, F1 = xyz′ + wx′y′ + (x′ + z + w) (x′ + z + w′) + xyz + wx′y , F2 = xy + wx′ + x′ + z i) Without using K-Map, show F1 can be simplified to F2 by algebraic means. (8) ii) Implement F2 using NAND gates only. Assume all variables are available in both true and complement form. (8)	1	5	16
2.	Design a combinational circuit with three inputs, x, y and z and three outputs, A, B and C. When the binary input is 0, 1, 2 or 3 the binary output is one greater than the input. When the binary input is 4, 5, 6 or 7, the binary output is one less than the input.	1	5	16
3.	Design a 4 bit adder / subtractor circuit and explain.	1	5	16
4.	Design 4-bit magnitude comparator with three outputs: A>B, A<B and A=B.	1	5	16

UNIT II

SEQUENTIAL LOGIC

Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Outline the difference between a synchronous sequential circuit and an asynchronous sequential circuit.	2	1	2
2.	How does ripple counter differ from synchronous counter?	2	2	2
3.	How do you eliminate the race around condition in a JK flip-flop?	2	1	2
4.	How do you eliminate the race around condition in a JK flip-flop?	2	2	2
5.	Define a latch and a FF.	2	1	2
6.	Mention the different types of shift registers.	2	1	2
7.	Define the terms: state table and state assignment.	2	1	2
8.	Define the terms: state table and state assignment.	2	2	2
	PART B			
1.	Design and implementation of SR FF using NOR gate.	2	5	16
2.	Explain in detail about 4 bit Johnson counter.	2	5	16
3.	A sequential circuit with two D FFs A and B, two inputs X and Y, and one output Z is specified by the following input equations: A (t + 1) = x'y + xA B (t + 1) = x'B + xA Z = B	2	5	16
4.	Explain the operation of 4 bit bidirectional shift register.	2	5	16

UNIT III

COMPUTER FUNDAMENTALS

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is Von Neumann bottleneck?	3	1	2
2.	Classify the instructions based on the operations they perform and give one example of each category.	3	2	2
3.	Why are the most frequently used variables stored in registers?	3	2	2
4.	List the decision making instructions supported by MIPS assembly language.	3	1	2
5.	What is instruction set architecture?	3	2	2
6.	What do you mean by little endian?	3	2	2
7.	List the types of addressing modes.	3	1	2
8.	What are the various types of operations required for instructions?	3	2	2
	PART B			
1.	Explain the fundamental units of a stored program digital computer, along with a block diagram.	3	4	16
2.	Explain ISA architecture with the help of neat diagram and list the instructions supported by IAS computer.	3	4	16
3.	Discuss about instruction cycle	3	4	16
4.	Define addressing mode. Classify addressing modes and explain in each type with examples.	3	5	16

UNIT IV

PROCESSOR

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control,Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	List the operations involved in instruction cycle.	4	1	2
2.	Draw the data path segment for arithmetic-logic instructions.	4	1	2
3.	What is the ideal speed-up expected in a pipelined architecture with 'n' stages? Justify your answer.	4	2	2
4.	What do you mean by pipelining? List its types.	4	1	2
5.	Differentiate between the static and dynamic techniques.	4	2	2
6.	What is branch hazard?	4	1	2
7.	What is meant by speculative execution?	4	1	2
8.	Differentiate data hazards and control hazards.	4	2	2
	PART B			
1.	Outline the difference between hardwired control and micro programmed control	4	4	16
2.	Explain the basic MIPS implementation with necessary multiplexers and control lines	4	5	16
3.	Why is branch prediction algorithm needed? Differentiate between the static and dynamic techniques.	4	4	16
4.	What are pipeline hazards? Outline the types of pipeline hazards.	4	4	16

UNIT V

MEMORY AND I/O

Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is a direct-mapped cache?	5	1	2
2.	What is hit time?	5	1	2
3.	Which signal is used to notify the processor that the transfer is completed? Define.	5	1	2
4.	Mention the modes of DMA transfer.	5	1	2
5.	Outline of interrupt driven I/O.	5	2	2
6.	What is memory mapped I/O?	5	2	2
7.	Define supervisor / kernel / executive state.	5	1	2
8.	State the advantages of virtual memory?	5	2	2
	PART B			
1.	Present an outline of virtual address, physical address, address translation, segmentation, page table, swap space and page fault.	5	4	16
2.	Elucidate interconnection standards.	5	4	16
3.	Outline a direct memory access with a diagram.	5	4	16
4.	Describe the various mechanisms for accessing I/O devices	5	4	16

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AD3391

DATABASE DESIGN AND MANAGEMENT

UNIT I
CONCEPTUAL DATA MODELING

Database environment – Database system development lifecycle – Requirements collection – Database design -- Entity-Relationship model – Enhanced-ER model – UML class diagrams.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Compare file system and DBMS	1	2	2
2.	Define database environment	1	1	2
3.	Define sequence diagram and why do we use it	1	1	2
4.	List the characteristics of DBMS	1	1	2
5.	Demonstrate the concept of specialization in ER diagram	1	2	2
6.	Define entity-relationship model.	1	1	2
7.	Explain limitations of ER model. How do you overcome this.	1	2	2
8.	Define data model. List various data models.	1	1	2
	PART B			
1.	(i) State and explain the database system development life cycle with an example (ii) Define UML and Explain the various types of Diagrams	1	2	8 8
2.	(i) Explain the 3-schema architecture of DBMS, why do we need mapping between different schema level (ii) Explain the architecture of DBMS	1	2	8 8
3.	Compare database vs file processing system?	1	2	16
4.	Explain the components DBMS	1	2	16

UNIT II

RELATIONAL MODEL AND SQL

Relational model concepts -- Integrity constraints -- SQL Data manipulation – SQL Data definition – Views -- SQL programming. .

Q.No	Question	CO	BTL	Marks
	PART A			
1.	List the category of SQL command	2	1	2
2.	Summarize why do we need view in SQL	2	2	2
3.	Outline the term relation schema	2	2	2
4.	Define Data Dictionary	2	1	2
5.	Define subquery.	2	1	2
6.	Summarize the characteristics of primary key?	2	2	2
7.	What is the syntax for creating a table in SQL?	2	1	2
8.	Define view.	2	1	2
	PART B			
1.	Explain DDL and DML commands in detail with examples	2	2	16
2.	(i) Explain about join and its function (ii) Explain data types in database	2	2	8 8
3.	(i) Explain Transaction control command (ii) Explain Nested query	2	2	8 8
4.	(i) Explain Aggregate function (ii) Explain Group by and ordering by	2	2	8 8

UNIT III

RELATIONAL DATABASE DESIGN AND NORMALIZATION

ER and EER-to-Relational mapping – Update anomalies – Functional dependencies – Inference rules – Minimal cover – Properties of relational decomposition – Normalization (upto BCNF).

Q.No	Question	CO	BTL	Marks
PART A				
1.	Compare between ER model EER model	3	2	2
2.	Explain normalization of data	3	2	2
3.	Describe BCNF normal form	3	2	2
4.	List the desirable properties of decomposition	3	1	2
5.	State the anamolies of 1NF.	3	1	2
6.	Define Boyce codd normal form. Why BCNF Stricter then 3NF.	3	1	2
7.	Define weak and strong entity sets.	3	1	2
8.	What is meant by normalization of data and Denormalization.	3	1	2
PART B				
1.	What is Normalization? Explain in detail about all Normal Form	3	2	16
2.	Explain in detail about Functional Dependencies. Briefly discuss about the Functional Dependency Concepts.	3	2	16
3.	Explain the properties of relational decomposition.	3	2	16
4.	Design and draw an E-R diagram for university database	3	6	16

UNIT IV

TRANSACTION MANAGEMENT

Transaction concepts – properties – Schedules – Serializability – Concurrency Control – Two phase locking techniques

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Discuss ACID properties	4	2	2
2.	State the different modes of lock	4	1	2
3.	Discuss why lock and unlock be atomic operations.	4	2	2
4.	Compare between serial schedule and serializable schedule.	4	4	2
5.	List out the transaction states.	4	1	2
6.	State the two operations for accessing data in transaction.	4	1	2
7.	What is the last update problem?	4	1	2
8.	State the three problems that any concurrency control mechanism must address.	4	1	2
	PART B			
1.	Discuss the violations caused by lost update, dirty read and non-repeatable read problem with example	4	2	16
2.	Explain lock-based protocol with example	4	2	16
3.	Explain in detail about two phase locking protocol in concurrency control	4	2	16
4.	Discuss state transition diagram for a database transaction and explain the flow	4	2	16

UNIT V

OBJECT RELATIONAL AND NO-SQL DATABASES

Mapping EER to ODB schema – Object identifier – reference types – rowtypes – UDTs – Subtypes and supertypes – user-defined routines – Collection types – Object Query Language; No-SQL: CAP theorem – Document-based: MongoDB data model and CRUD operations; Column-based: Hbase data model and CRUD operations.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	State the two kinds of new data type supported in object database systems	5	1	2
2.	Discuss when to use SQL and NOSQL	5	2	2
3.	Compare between subtypes and supertypes	5	4	2
4.	Describe the advantage of object-oriented model	5	2	2
5.	Explain HBase data model.	5	2	2
6.	What are the main CRUD operations in HBase	5	1	2
7.	State CAP in Brewer's CAP theorem	5	1	2
8.	Which server handles read and write requests in HBase	5	1	2
	PART B			
1.	Explain mapping an EER schema to an ODB schema in detail	5	2	16
2.	Explain the CRUD operations of MongoBD	5	2	16
3.	Explain in detail about object data model with diagram	5	2	16
4.	Write short notes on CAP theorem	5	2	16

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AD3351
DESIGN AND ANALYSIS OF ALGORITHM

UNIT I
INTRODUCTION

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types–Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework - Asymptotic Notations and their properties – Empirical analysis - Mathematical analysis of Recursive and Non- recursive algorithms – Visualization.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define Algorithm.	1	2	2
2.	Differentiate Sequential and Parallel Algorithm	1	2	2
3.	What is the Best and worst case running time of selection Sortin	1	2	2
4.	Give the Euclid's Algorithm for Computing gcd (m,n)	1	2	2
5.	Compare the order of growth n(n-1)/2 and n^2	1	2	2
6.	Define recursion.	1	2	2
7.	How do you measure the efficiency of an Algorithm?	1	2	2
8.	Give the diagram representation of Notion of algorithm.	1	2	2
	PART B			
1.	Explain about Asymptotic Notations in detail	1	2	16
2.	What is an Algorithm? and Indicates the steps for analyzing the efficiency of an algorithm with an example?	1	2	16
3.	Elaborate asymptotic analysis of an algorithm with an example. List out the steps in mathematical analysis of non recursive algorithms.	1	2	16
4.	i)Devise a non-recursive algorithm for the element uniqueness problem: check whether all the elements in a given array of n elements are distinct Analyze its efficiency. ii) Compute the factorial function F(n) = n! for an arbitrary nonnegative integer n with the recursive algorithm and analyze its efficiency	1	3	16

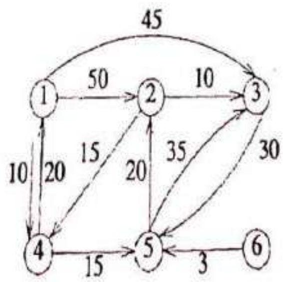
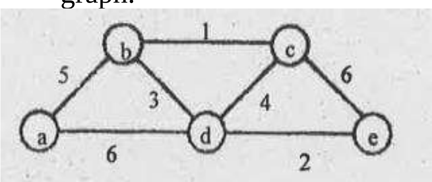
UNIT II
BRUTE FORCE AND DIVIDE AND CONQUER

Brute Force – String Matching - Exhaustive Search - Traveling Salesman Problem - Knapsack Problem - Assignment problem. Divide and Conquer Methodology – Multiplication of Large Integers and Strassen's Matrix Multiplication – Closest-Pair and Convex - Hull Problems. Decreaseand Conquer: - Topological Sorting – Transform and Conquer: Presorting – Heaps and Heap Sort.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What is brute force Approach?	2	2	2
2.	List the Major variations of decrease and conquor technique.	2	1	2
3.	Give the General Plan for Divide and Conquer Algorithms	2	2	2
4.	What is Knapsack problem?	2	2	2
5.	Derive the complexity of binary search.	2	2	2
6.	State the Convex Hull Problem	2	2	2
7.	What is exhaustive search?	2	2	2
8.	State the Closest Pair Problem	2	2	2
	PART B			
1.	Analyze the number of comparisons made by the brute force algorithm for string matching when applied to a text with a length of 10,000 characters and a pattern of 5 characters. How does the time complexity grow with larger inputs?	2	3	16
2.	Explain in detail about Heap Construction and Heap sort Algorithm.	2	2	16
3.	Explain the Concept of Closest-Pair Problem and Convex – Hull Problems with their Best, Average, Worst Case Analysis.	2	3	16
4.	What is Decrease and Conquer Methodology? How will Topological sorting work based on that?	2	3	16

UNIT III
DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE

Dynamic programming – Principle of optimality - Coin changing problem – Warshall’s and Floyd‘s algorithms – Optimal Binary Search Trees - Multi stage graph - Knapsack Problem and Memory functions. Greedy Technique – Dijkstra’s algorithm - Huffman Trees and codes - 0/1 Knapsack problem.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	State the principle of optimality.	3	1	2
2.	Show the recurrence relation of divide and conquer.	3	2	2
3.	Define multistage graph.	3	2	2
4.	Compare Dynamic programming and Greedy method.	3	2	2
5.	How dynamic programming is used to solve knapsack problem.	3	3	2
6.	Write the method for computing Bionomial coefficient.	3	2	2
7.	Give the Floyd’s algorithm	3	2	2
8.	Write some applications of traveling salesperson problem.	3	2	2
	PART B			
1.	Explain how greedy approach is used in Dijikstra’s algorithm for finding the single source shortest paths for the given graph. 	3	3	16
2.	Explain how greedy approach is used in Dijikstra’s algorithm for finding the single source shortest paths for the given graph. 	3	3	16

Q.No	Question	CO	BTL	Marks
3.	Write the Huffman's algorithm. Construct the Huffman's tree for the following data and obtain its Huffman code.	3	3	16
4.	Explain memory function method for the knapsack problem and give the algorithm.	3	3	16

Character	A	B	C	D	E	F
Probability	0.5	0.35	0.5	0.1	0.4	0.2

UNIT IV

ITERATIVE IMPROVEMENT

The Simplex Method-The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs- The Stable marriage Problem.

Q.No	Question	CO	BTL	Marks

PART A

Q.No	Question	CO	BTL	Marks
1.	State the principle of Duality.	4	2	2
2.	Define Iterative improvement technique.	4	2	2
3.	State Bipartite graph.	4	2	2
4.	State Ford Fulkerson Method.	4	2	2
5.	Define Simplex Method	4	2	2
6.	Write short notes on the Maximum-Flow problem	4	2	2
7.	Define the constraint in the context of maximum flow problem	4	2	2
8.	What are the essential properties of a flow graph ?	4	2	2

PART B

Q.No	Question	CO	BTL	Marks
1.	Write the Huffman's algorithm. Construct the Huffman's tree for the following string and obtain its Huffman code: Eerie eyes seen near lake.	4	3	8
2.	Trace the simplex method on the following problems.	4	3	16

Maximize p=2x-3y=4z
Subject to 4x-3y+z<=3
x+y+z<=10
2x+y-z<=10 where x,y and z are non negative.

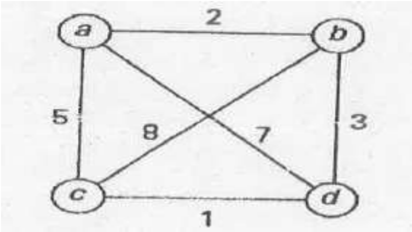
3.	Write the stable marriage algorithm and trace it with an instance. Analyze its running time complexity.	4	3	16
4.	Outline the pseudo code for Maximum Matching Bipartite graph.	4	2	16

UNIT V

LIMITATIONS OF ALGORITHM POWER

Lower - Bound Arguments - P, NP, NP- Complete and NP Hard Problems. Backtracking – N- Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem – Traveling Salesman Problem - Approximation Algorithms for NP-Hard Problems – Traveling Salesman problem – Knapsack problem.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define NP completeness and Np hard.	5	2	2
2.	Differentiate feasible and optimal solution.	5	2	2
3.	State the reason for terminating search path at the current node in branch and bound algorithm.	5	2	2
4.	List out the memory functions used in dynamic programming.	5	1	2
5.	Write the pseudo code for Floyd’s algorithm.	5	3	2
6.	State the advantage of backtracking algorithm.	5	1	2
7.	What are the factors that influence the efficiency of the backtracking algorithm?	5	1	2
8.	Define the Hamiltonian cycle.	5	1	2
	PART B			
1.	Apply Branch and Bound algorithm to solve the Travelling Salesman problem for	5	3	16



2.	Outline the steps to find approximate solution to NP- Hard optimization problems using approximation algorithms with an example.	5	2	16
3.	Explain the differences between P,NP, NP-Complete , and NP-Hard problems. Provide examples for each class. How does this classification help in understanding the complexity of computational problems?	5	3	16
4.	Solve the following instance of the knapsack problem by the branch and bound algorithm:	5	3	16

item	weight	value
1	10	₹100
2	7	₹63
3	8	₹56
4	4	₹12

$W = 16$

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AD3301

DATA EXPLORATION AND VISUALIZATION

UNIT I

EXPLORATORY DATA ANALYSIS

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques - Grouping Datasets - data aggregation – Pivot tables and cross-tabulations.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define Exploratory Data Analysis (EDA)?	1	1	2
2.	Name two software tools commonly used for EDA?	1	1	2
3.	Define data transformation techniques in EDA?	1	1	2
4.	What is the purpose of merging databases in EDA?	1	1	2
5.	Define data aggregation in EDA?	1	1	2
6.	Why is cross-tabulation useful in EDA?	1	1	2
7.	Define the term "data normalization" in EDA?	1	1	2
8.	Why are pivot tables and cross-tabulations useful in summarizing data?	1	1	2
	PART B			
1.	Explain the Purpose of EDA.	1	1	16
2.	Describe Data Transformation in EDA	1	1	16
3.	Explore the Significance of Grouping Datasets and how it aids in focused analysis.	1	1	16
4.	Illustrate the Application of Pivot Tables.	1	4	16

UNIT II

VISUALIZING USING MATPLOTLIB

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Explain the role of legends in plots	2	1	2
2.	Define Subplots in Matplotlib	2	1	2
3.	What is the purpose of text and annotation in plots?	2	1	2
4.	Define Three-Dimensional Plotting in Matplotlib	2	1	2
5.	What is Geographic Data Visualization with Basemap?	2	1	2
6.	Differentiate between Line Plots and Contour Plots	2	2	2
7.	How does Matplotlib handle 3D plotting?	2	1	2
8.	What is the advantage of using Seaborn for visualization?	2	1	2
	PART B			
1.	Illustrate the Use of Scatter Plots in Visualizing Relationships?	2	4	16
2.	Describe the role of legends in plots and provide examples to illustrate how they contribute to making plots more informative and interpretable?	2	1	16
3.	Provide a step-by-step illustration of how to create subplots in Matplotlib?	2	1	16
4.	Explain the Process of Geographic Data Visualization with Basemap?	2	1	16

UNIT III

UNIVARIATE ANALYSIS

Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	What are Numerical Summaries of Level and Spread?	3	1	2
2.	Differentiate between Scaling and Standardizing?	3	2	2
3.	Explain the Concept of Inequality in Data?	3	1	2
4.	Differentiate between Range and Standard Deviation?	3	2	2
5.	Explain the Role of Boxplots in Data Visualization?	3	1	2
6.	Define Skewness in a Distribution?	3	1	2
7.	What is the Purpose of Time Series Smoothing Techniques?	3	1	2
8.	Define Outliers in a Dataset?	3	1	2
	PART B			
1.	Explain the Significance of Numerical Summaries in Single Variable Analysis?	3	1	16
2.	Describe the Role of Interquartile Range (IQR) in Data Analysis?	3	1	16
3.	Explain the Purpose of Time Series Smoothing Techniques?	3	1	16
4.	Explain how it offers a relative measure of variability and its interpretation in different scenarios?	3	1	16

UNIT IV

BIVARIATE ANALYSIS

Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define Relationships between Two Variables?	4	1	2
2.	What is the Purpose of Analyzing Contingency Tables?	4	1	2
3.	Define Contingency Tables in Statistics?	4	1	2
4.	How do Scatterplots Facilitate Relationship Visualization?	4	1	2
5.	Differentiate between Batch Handling and Data Aggregation?	4	2	2
6.	Define the Role of Scatterplots in Exploratory Data Analysis?	4	1	2
7.	How do Transformations Improve Linearity in Regression?	4	1	2
8.	Define the Concept of Data Transformation in Regression Analysis?	4	1	2
	PART B			
1.	Illustrate the construction and interpretation of percentage tables?	4	4	16
2.	Describe the process of analyzing contingency tables and its applications?	4	1	16
3.	Explain the concept of transformations in data analysis and provide examples?	4	1	16
4.	Explain how patterns and trends are identified through scatterplot analysis?	4	1	16

UNIT V

MULTIVARIATE AND TIME SERIES ANALYSIS

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Differentiate Between Two-Variable and Three-Variable Contingency Tables?	5	2	2
2.	Explain the Significance of Longitudinal Data in Analysis?	5	1	2
3.	Describe the Fundamentals of Time Series Analysis (TSA)?	5	1	2
4.	Explain the Importance of Data Cleaning in Time Series Analysis?	5	1	2
5.	What are the Characteristics of Seasonality in Time Series Data?	5	1	2
6.	Explain the Concept of Grouping in Time Series Analysis?	5	1	2
7.	Define the Concept of Resampling Frequency in Time Series Analysis?	5	1	2
8.	What is Resampling in the Context of Time Series Analysis?	5	1	2
	PART B			
1.	Describe the Application of Three-Variable Contingency Tables?	5	1	16
2.	Explain the construction and interpretation of three-variable contingency tables?	5	1	16
3.	Illustrate the Steps of Time Series Analysis?	5	4	16
4.	Illustrate the Importance of Resampling in Time Series Analysis?	5	4	16

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AL3391

ARTIFICIAL INTELLIGENCE

UNIT I

INTELLIGENT AGENTS

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define an intelligent agent.	1	1	2
2.	Classify environments based on their observability.	1	2	2
3.	List the characteristics of a rational agent.	1	1	2
4.	State the difference between deterministic and stochastic environments.	1	2	2
5.	Identify the four types of agent structures in AI.	1	1	2
6.	Compare model-based agents with simple reflex agents.	1	2	2
7.	Recall any two uninformed search strategies.	1	1	2
8.	Outline the steps involved in the Breadth-First Search (BFS) algorithm.	1	2	2
	PART B			
1.	Demonstrate how different types of agents interact with various environments using real-world examples.	1	3	16
2.	Examine the impact of environmental factors on the rationality of an intelligent agent and differentiate between different environment types.	1	4	16
3.	Justify the effectiveness of different uninformed search strategies in solving a given problem and assess their advantages and limitations.	1	5	16
4.	Design a real-world problem and develop a search strategy using uninformed search techniques to find an optimal solution.	1	6	16

UNIT II

PROBLEM SOLVING

Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define a heuristic function in search algorithms.	2	1	2
2.	How does heuristics improve search efficiency?	2	2	2
3.	Identify two examples of local search algorithms.	2	1	2
4.	State how local search differs from uninformed search strategies.	2	2	2
5.	List two local search techniques used in continuous space.	2	4	2
6.	Summarize the challenges of performing search in continuous spaces.	2	2	2
7.	Recall what non-deterministic actions mean in AI search.	2	1	2
8.	Classify different strategies used for searching in partially observable	2	2	2
	PART B			
1.	Implement a heuristic search algorithm to solve a real-world problem and illustrate its efficiency compared to uninformed search strategies.	2	3	16
2.	Examine different local search techniques and compare their effectiveness in solving optimization problems with and without constraints.	2	4	16
3.	Assess the challenges faced when performing search in non-deterministic and partially observable environments, and justify the use of specific techniques to handle uncertainty.	2	5	16
4.	Critique the role of online search agents in unknown environments and evaluate their performance in real-time decision-making scenarios	2	5	16

UNIT III

GAME PLAYING AND CSP

Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define game theory in the context of artificial intelligence.	3	1	2
2.	State the significance of making optimal decisions in competitive games.	3	2	2
3.	Identify the purpose of alpha-beta pruning in minimax search.	3	1	2
4.	What is the working principle of Monte-Carlo Tree Search (MCTS).	3	2	2
5.	List two characteristics of stochastic games.	3	1	2
6.	Differentiate between fully observable and partially observable games with examples.	3	2	2
7.	Recall any two techniques used for solving constraint satisfaction problems (CSP).	3	1	2
8.	Summarize the role of backtracking in solving CSPs.	3	2	2
	PART B			
1.	Demonstrate the application of game theory in AI by solving a two-player game using the minimax algorithm.	3	3	16
2.	Examine the working of alpha-beta pruning and Monte-Carlo Tree Search (MCTS) in decision-making and compare their advantages and limitations.	3	4	16
3.	Assess the challenges in designing AI for stochastic and partially observable games, and justify the use of suitable strategies to handle uncertainty.	3	5	16
4.	Analyze different constraint satisfaction techniques such as backtracking, constraint propagation, and local search, and evaluate their efficiency in solving CSPs.	3	5	16

UNIT IV

LOGICAL REASONING

Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining –

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define a knowledge-based agent	4	1	2
2.	How propositional logic is used in knowledge-based agents?	4	2	2
3.	List two methods used for propositional theorem proving.	4	1	2
4.	What is the role of model checking in propositional logic.	4	2	2
5.	Identify the components of an agent based on propositional logic.	4	1	2
6.	Illustrate how a simple agent can use propositional logic for decision-making.	4	2	2
7.	Recall the basic syntax components of first-order logic.	4	1	2
8.	Differentiate forward chaining and backward chaining in first-order logic.	4	2	2
	PART B			
1.	Demonstrate how a knowledge-based agent uses propositional logic to make decisions with a real-world example.	4	3	16
2.	Implement an intelligent agent using propositional logic and illustrate how it can perform reasoning in an uncertain environment.	4	3	16
3.	Examine different propositional theorem proving techniques and compare their effectiveness with propositional model checking.	4	4	16
4.	Analyze the role of forward chaining and backward chaining in first-order logic and evaluate their efficiency in knowledge representation.	4	4	16

UNIT V

PROBABILISITIC REASONING

Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks. backward chaining – resolution.

Q.No	Question	CO	BTL	Marks
	PART A			
1.	Define Bayesian inference in the context of AI.	5	1	2
2.	How is uncertainty handled in probabilistic reasoning?	5	2	2
3.	List the assumptions made in a Naïve Bayes model.	5	1	2
4.	State an application of the Naïve Bayes classifier in real-world scenarios.	5	2	2
5.	Identify the components of a Bayesian Network (BN).	5	1	2
6.	Illustrate how probabilistic reasoning is performed using a Bayesian Network.	5	2	2
7.	Recall any two methods used for exact inference in Bayesian Networks.	5	1	2
8.	Differentiate between exact and approximate inference in Bayesian Networks.	5	2	2
	PART B			
1.	Apply Bayesian inference to a real-world problem and demonstrate how it helps in decision-making under uncertainty.	5	3	16
2.	Implement a Naïve Bayes classifier for a given dataset and illustrate its effectiveness in classification tasks.	5	3	16
3.	Examine the structure of Bayesian Networks and compare exact and approximate inference methods with examples.	5	4	16
4.	Assess the role of causal networks in AI and justify their importance in probabilistic reasoning for decision-making.	5	5	16

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