CBCS SCHEME

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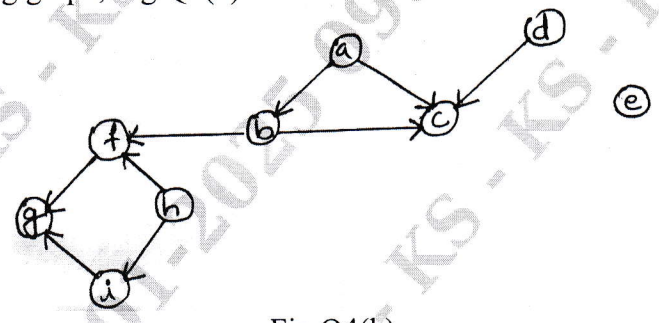
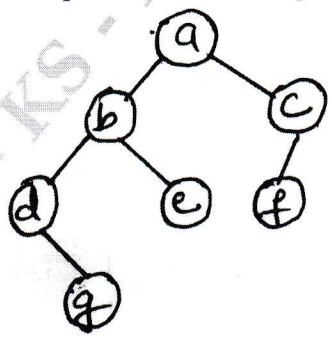
BCS401

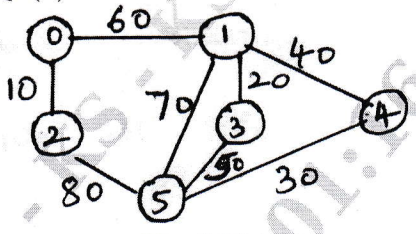
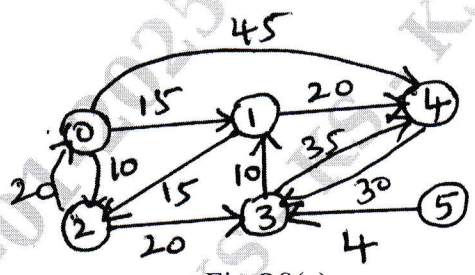
Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Analysis and Design of Algorithms

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Explain the various steps in algorithm design and analysis process with the flow diagram.	08	L1	CO1
	b.	Give formal and informal definitions of asymptotic notations.	06	L1	CO1
	c.	Explain the general plan of mathematical analysis of recursive algorithm with an example.	06	L1	CO1
		OR			
Q.2	a.	Design algorithm for tower of Hanoi problem and obtain time complexity.	10	L1	CO1
	b.	Write an algorithm to search an element in an array using sequential search. Discuss the best case, worst case and average case efficiency of this algorithm.	10	L1	CO1
		Module – 2			
Q.3	a.	Write an algorithm to sort the numbers using insertion sort. Discuss its efficiency.	10	L2	CO2
	b.	Design quick sort algorithm and obtain its best, average and worst case efficiency.	10	L2	CO2
		OR			
Q.4	a.	Write merge sort algorithm and sort the list E X A M P L E.	08	L2	CO2
	b.	Apply the DFS based algorithm to solve the topological sorting problem for the following graph, Fig.Q4(b)  Fig.Q4(b)	06	L3	CO2
	c.	Write algorithm for pre-order, post order and in order traversals of a tree. Write pre-order, in-order and post order for the given tree.  Fig.Q4(c)	06	L2	CO2

Module – 3

Q.5	**a.**	Define AVL tree. Construct AVL tree for the list 5, 6, 8, 3, 2, 4, 7.	**10**	**L3**	**CO3**
	b.	Define heap. Sort the following lists by heapsort: H E A P S O R T (in alphabetical order)	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Write the algorithm for comparison counting sort. Discuss its efficiency.	**10**	**L2**	**CO4**
	b.	Design Horspools algorithm for string matching. Apply Horspools algorithm to find the pattern BARBER on the text JIM_SAW_ME_IN_BARBERSHOP	**10**	**L3**	**CO4**
		Module – 4			
Q.7	**a.**	Write Warshall's algorithm and apply the same to compute transitive closure of a directed graph. $\begin{array}{c} \\ a \\ b \\ c \\ d \\ e \end{array}\begin{array}{c} \begin{array}{ccccc} a & b & c & d & e \end{array} \\ \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix} \end{array}$	**10**	**L3**	**CO3**
	b.	Construct minimum cost spanning tree using Kruskal's algorithm for the following graph, Fig.Q7(b).  Fig.Q7(b)	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Solve the following single source shortest path problem assuming vertex '5' as the source.  Fig.Q8(a)	**10**	**L3**	**CO4**
	b.	Write Huffman's algorithm. Construct Huffman tree and resulting code word for the following: Character: A, B, C, D, E, - Probability: 0.5, 0.35, 0.5, 0.1, 0.4, 0.2 Encode the text DAD_CBE.	**10**	**L4**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the following with example: (i) P problem (ii) NP problem	**06**	**L1**	**CO5**
	b.	What is decision tree? Construct decision tree for the three element insertion sort.	**08**	**L2**	**CO5**
	c.	Construct state space tree to solve 4 queens problem.	**06**	**L3**	**CO5**

OR

Q.10	**a.**	What is backtracking? Apply back tracking to solve the below instance of sum of subset problem: s = {3, 5, 6, 7}, d = 15	**10**	**L3**	**CO6**
	b.	Solve the following instance of knapsack problem using branch and bound technique knapsack capacity = 10.	**10**	**L4**	**CO6**

Item	Weight	Value
1	4	40
2	7	42
3	5	25
4	3	12

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CBCS SCHEME

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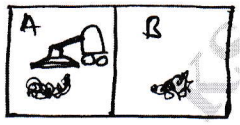
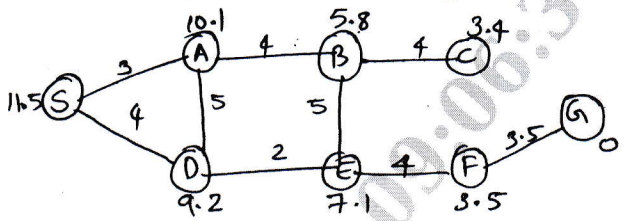
BAD402

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Artificial Intelligence

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Explain the significance of the Turing Test in AI. What abilities does a computer need to pass the turing test? Discuss why AI researchers have not focused extensively on passing the Turing test.	10	L2	CO1
	b.	Write the percept sequence for vacuum cleaner agent and tabulate the workflow of the same with respect to the scenario with location of square A and B as given in Fig.Q1(b).  Fig.Q1(b)	10	L3	CO1
		OR			
Q.2	a.	Compare simple reflex agents and model-based reflex agents, focusing on their perception processing, decision-making methods and explain how model-based agents address the limitations of simple reflex agents with their schematic diagrams.	10	L3	CO1
	b.	Analyze and discuss PEAS descriptor for the following applications in detail: i) Medical diagnosis s/m ii) Taxi driver iii) Interactive English tutor iv) Part picking robot v) Refinery controller.	10	L3	CO1
		Module – 2			
Q.3	a.	Define Toy problems and Real-world problems in the context of problem-solving approaches with an example for each type in detail.	10	L2	CO2
	b.	Compare and contrast the vacuum world problem and the 8-tile puzzle problems discussing their state representations, initial states, actions and goal tests.	10	L3	CO2
		OR			
Q.4	a.	Explain the components and architecture of a problem solving agent.	10	L2	CO2
	b.	Compare and contrast depth-first search with breadth-first search with examples.	10	L3	CO2
		Module – 3			
Q.5	a.	Outline a generic knowledge-based agent's program and discuss the difference between declarative and procedural approaches in the context of building knowledge-based agents.	10	L3	CO3

	b.	Apply A* search algorithm to find the solution path from the start node (S) to the goal node (G). The heuristic values (h) are provided with the nodes, and the travel costs (C) are provided with the edges as shown in Fig.Q5(b).  Fig.Q5(b)	10	L3	CO3
		OR			
Q.6	a.	Describe the Wumpus world environment and the PEAS specification for the knowledge based agent. Explain how does the agent navigate and make decisions based on percepts in this environment.	10	L2	CO3
	b.	Solve the following eight-tile puzzle using heuristic function approach and the tree diagram considering the initial and final states as specified. <table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td></td><td>4</td><td>5</td></tr><tr><td>7</td><td>8</td><td>6</td></tr><tr><td colspan="3">Initial State</td></tr></table> <table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td></td></tr><tr><td colspan="3">Final State</td></tr></table>	10	L2	CO3
		Module – 4			
Q.7	a.	Define universal and existential instantiations with examples. Prove the following using Backward and forward chaining : "As per the law, it is a crime for an American to sell weapons to hostile nations. Country E, an enemy of America, has some missiles and all the missiles were sold to it by Solan, who is an American citizen". Prove that "Solan is a criminal".	10	L2	CO4
	b.	Explain the following with respect to first-order logic: (i) Assertions and queries (ii) Numbers, sets and lists (iii) The wumpus world.	10	L2	CO4
		OR			
Q.8	a.	Apply predicate logic to translate and formalize the following statements: (first order logic) (i) Marcus was a man. (ii) Marcus was a Pompeian. (iii) All Pompeian were Romans. (iv) Caesar was a ruler. (v) All Romans were either loyal to Caesar or hated him. (vi) Everyone is loyal to someone. (vii) People only try to assassinate rulers they are not loyal to. (viii)Marcus tried to assassinate Caesar (ix) All men are people. (x) Some people are loyal to Marcus. In each case, provide the appropriate predicates, quantifiers, variables and logical connectives to represent the statements accurately in predicate logic notations.	10	L3	CO4
	b.	Explain backward chaining algorithm with an example.	10	L2	CO4

Module – 5					
Q.9	**a.**	In a city, 30% of the population owns a dog, while 70% owns a cat. Among dog owners, 80% take their dogs for daily walks and among cat owners, only 50% do so. If a person is observed walking their pet daily, calculate probability that this person owns a dog. State the Baye's theorem.	**10**	**L3**	**CO5**
	b.	Explain Expert Systems, detailing the characteristics, capabilities, incapabilities, components and provide two examples.	**10**	**L2**	**CO5**
OR					
Q.10	**a.**	Explain uncertain knowledge in the context of artificial intelligence. Discuss the challenges an agent focus when acting under uncertainty with the example of diagnosing a dental patient's toothache.	**10**	**L2**	**CO5**
	b.	Explain the concept of inference using full joint probability in the context of agents acting under uncertainty with an example of the following variables: Weather = {sunny, rain, cloudy, snow}, Cavity = {cavity, ¬cavity}. Also calculate the following : P(cavity v toothache), P(cavity | toothache), P(¬cavity | toothache), Given the following full joint distribution for the Toothache, Cavity, Catch world.	**10**	**L3**	**CO5**

	Toothache		¬Toothache	
	Catch	¬Catch	Catch	¬Catch
Cavity	0.108	0.012	0.072	0.008
¬Cavity	0.016	0.064	0.144	0.576

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CBCS SCHEME

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BCS403

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Database Management System

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	**a.**	Define the following terms: (i) Database (ii) Schema (iii) Entity (iv) DDL (v) Degree of a relationship	**05**	**L1**	**CO1**
	b.	Briefly explain characteristics of database approach.	**05**	**L2**	**CO1**
	c.	List and explain advantages of using DBMS approach.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Define the following terms: (i) Cardinality (ii) Weak entity (iii) Program data independence (iv) DML (v) Value sets	**05**	**L1**	**CO1**
	b.	Describe three-schema architecture. Why do we need mappings between schema levels?	**05**	**L2**	**CO1**
	c.	Explain different types of attributes in ER model with suitable example for each.	**10**	**L2**	**CO1**
		Module – 2			
Q.3	**a.**	With suitable example, explain the entity integrity and referential integrity constraints. Why each is considered important?	**05**	**L2**	**CO2**
	b.	Discuss equijoin and natural join with suitable example using relational algebra notation.	**05**	**L2**	**CO2**
	c.	Given the relational tables: (tables below)	**10**	**L3**	**CO2**

Employee:

EID	Name	DepID	Salary
1	Alice	10	5000
2	Bob	20	6000
3	Eve	20	6500

Department:

DeptID	DeptName
10	HR
20	IT
30	Sales

Project

PID	Project Name	DeptID
101	Project Alpha	10
102	Project Beta	20
103	Project Gamma	30

Write relational algebra expression for the following:

(i) Find the names and salaries of all employees in the 'IT' department.
(ii) Find the ID's and names of employees who are in the 'IT' department and have a salary greater than 6000.
(iii) Find the ID's and names of employees who are either in the 'HR' department or have a salary greater than 6000.
(iv) Find the names of employees who are not in the 'IT' department
(v) Find the names of employees along with their department names.

OR

Q.4	**a.**	Explain any two operations that change the state of relation in a database. Provide suitable examples.	**05**	**L2**	**CO2**
	b.	Discuss the aggregation functions and grouping in relational algebra with suitable examples.	**05**	**L2**	**CO2**
	c.	Given the relational tables: Student: SID | Name a | Alice b | Bob c | Carol Project: PID | Project Name p | Alpha q | Beta r | Gamma Language: LID | Language Name x | Python y | Java z | C++ Enrollment: SID | PID a | p a | q b | q c | r Write relational algebra expression for the following: (i) Rename the student table to Learner and display it. (ii) Find the students (learners) who are not enrolled in any project. (iii) Find the students who are enrolled in all projects. (iv) Find the students who are not enrolled in any project. (v) Find the students who are enrolled in both the 'Alpha' and 'Beta' projects.	**10**	**L3**	**CO2**

Module – 3

Q.5	**a.**	Explain Armstrong inference rules.	**05**	**L2**	**CO4**
	b.	What is the need for normalization? Explain 1NF, 2NF and 3NF with examples.	**05**	**L2**	**CO4**
	c.	What is functional dependency? Write an algorithm to find minimal cover for set of functional dependencies. Construct minimal cover M for set of functional dependencies which are: E = {B → A, D → A, AB → D}	**10**	**L3**	**CO4**

OR

Q.6	**a.**	Explain the types of update anomalies in SQL with an example.	**05**	**L2**	**CO4**
	b.	Explain types of JBBC drivers.	**05**	**L2**	**CO5**
	c.	Consider the schema R = ABCD, subjected to FDs F = {A →B, B →C}, and the non-binary partition D1 = {ACD, AB, BC}. State whether D1 is a lossless decomposition? [give all steps in detail].	**10**	**L3**	**CO4**

Module – 4

Q.7	**a.**	Define transaction. Discuss ACID properties.	**05**	**L2**	**CO5**
	b.	With a neat diagram, explain transition diagram of a transaction.	**05**	**L2**	**CO5**
	c.	Demonstrate working of assertion and triggers in SQL with example.	**10**	**L3**	**CO5**

OR

Q.8	**a.**	Explain cursor and its properties in embedded SQL with suitable example.	**05**	**L2**	**CO5**
	b.	Determine if the following schedule is serializable and explain your reasoning: i) T1 : R(X)W(X) T2 : R(X)W(X) T1 : COMMIT T2 : COMMIT ii) T1 : W(X)R(Y) T2 : R(X)W(Y) T1 : COMMIT T2 : COMMIT	**05**	**L2**	**CO5**

	c.	Consider the tables below: Sailors (<u>sid : integer</u>, sname : string, rating : integer, age : real) Boats (<u>bid : integer</u>, bname : string, color : string); Reserves (<u>sid : integer</u>, <u>bid : integer</u>, day : date) Write SQL queries for the following: (i) Write create table statement for reserves. (ii) Find all information of sailors who have reserved boat number 101. (iii) Find the names of sailors who have reserved at least one boat. (iv) Find the names of sailors who have reserved a red boat. (v) Find the average age of sailors for each rating level.	10	L3	CO5
Module – 5					
Q.9	a.	Explain the CAP theorem.	05	L2	CO6
	b.	What is NOSQL graph database? Explain Neo4j.	05	L2	CO6
	c.	Why concurrency control and recovery are needed in DBMS? Demonstrate with suitable examples types of problems that may occur when two simple transactions run concurrently.	10	L3	CO5
OR					
Q.10	a.	Explain basic operations CRUD in MongoDB.	05	L2	CO6
	b.	Explain deadlock prevention protocols.	05	L2	CO5
	c.	Briefly discuss the two-phase looking techniques f_0 concurrency control.	10	L3	CO5

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CBCS SCHEME

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BCS405A

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Discrete Mathematical Structures

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define a tautology. Prove that for any propositions p, q, r the compound propositions $\{(p \rightarrow q) \wedge (q \rightarrow r)\} \rightarrow (p \rightarrow r)$ is tautology.	06	L2	CO1
	b.	Establish the validity of the following argument using the rules of inference: $\{p \wedge (p \rightarrow q) \wedge (s \vee r) \wedge (r \rightarrow \sim q)\} \rightarrow (s \vee t)$	07	L2	CO1
	c.	For any two odd integers m and n, show that: (i) m + n is even (ii) mn is odd	07	L2	CO1
		OR			
Q.2	a.	Show that the compound proposition $[(p \vee q) \rightarrow r] \Leftrightarrow [(p \rightarrow r) \wedge (q \rightarrow r)]$ for primitive statements p, q, r is logically equivalent.	06	L2	CO1
	b.	Prove the following using law of logic: $p \rightarrow (q \rightarrow r) \Leftrightarrow (p \wedge q) \rightarrow r$	07	L2	CO1
	c.	Determine the truth value of each of the following quantified statements, the universe being the set of all non-zero integers: (i) $\exists x, \exists y, [xy = 1]$ (ii) $\exists x, \forall y, [xy = 1]$ (iii) $\forall x, \exists y, [xy = 1]$ (iv) $\exists x, \exists y, [(2x + y = 5) \wedge (x - 3y = -8)]$ (v) $\exists x, \exists y, [(3x - y = 17) \wedge (2x + 4y = 3)]$	07	L3	CO1
		Module – 2			
Q.3	a.	Prove that for each $n \in z^+$, $1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{6}$.	06	L2	CO2
	b.	Let $a_0 = 1$, $a_1 = 2$, $a_2 = 3$ and $a_n = a_{n-1} + a_{n-2} + a_{n-3}$ for $n \geq 3$, prove that $a_n \leq 3^n \ \forall \ n \in z^+$.	07	L2	CO2
	c.	How many positive integers n can be we form using the digits 3, 4, 4, 5, 5, 6, 7 if we want n to exceed 5,000,000?	07	L3	CO2
		OR			
Q.4	a.	By mathematical induction prove that $1.3 + 2.4 + \ldots + n(n+2) = \frac{n(n+1)(2n+7)}{6}$	06	L2	CO2
	b.	Find the number of permutations of the letters of the word ENGINEERING such that: (i) All the E's are together (ii) Arrangement begin with N (iii) All the vowels are adjacent.	07	L3	CO2
	c.	Find the coefficient of $a^2b^3c^2d^5$ in the expansion of $(a + 2b - 3c + 2d + 5)^{16}$.	07	L3	CO2
		Module – 3			
Q.5	a.	State pigeon hole principle. Prove that if 30 dictionaries in a library contain a total of 61,327 pages then atleast one of the dictionaries must have atleast 2045 pages.	06	L3	CO3
	b.	Let $f : R \rightarrow R$ be defined by $f(x) = \begin{cases} 3x - 5 & \text{if } x > 0 \\ 1 - 3x & \text{if } x \leq 0 \end{cases}$. Find $f^{-1}(0)$, $f^{-1}(1)$, $f^{-1}(-1)$, $f^{-1}(3)$, $f^{-1}(-6)$, $f^{-1}([-6, 5])$ and $f^{-1}([-5, 5])$	07	L2	CO3
	c.	Draw the Hasse diagram representing the positive divisor of 36.	07	L3	CO3

OR

Q.6	**a.**	Let A = {1, 2, 3, 4} and B = {1, 2, 3, 4, 5, 6}, (i) How many functions are there from A to B? (ii) How many of these are one to one? (iii) How many functions are there from B to A? (iv) How many of these are onto?	**06**	**L2**	**CO3**
	b.	Let f and g be functions from R to R defined by f(x) = ax + b and $g(x) = 1 - x + x^2$. If $(g \circ f)(x) = 9x^2 - 9x + 3$, determine a and b.	**07**	**L2**	**CO3**
	c.	Let A = {1, 2, 3, 4, 6} and R be a relation on A defined by aRb if and only if "a is multiple of b". Write down the relation R, relation matrix M(R) and draw the digraph. List out in degree and out degree.	**07**	**L3**	**CO3**

Module – 4

Q.7	**a.**	In how many ways 5 number of a's, 4 number of b's and 3 number of c's can be arranged so that all the identical letters are not in a single block?	**06**	**L3**	**CO4**
	b.	Determine the number of positive integers n such that $1 \le n \le 100$ and n is not divisible by 2, 3, or 5.	**07**	**L3**	**CO4**
	c.	Solve the recurrence relation $a_{n+2} - 3a_{n+1} + 2a_n = 0$, $a_0 = 1$, $a_1 = 6$.	**07**	**L2**	**CO4**

OR

Q.8	**a.**	In how many ways can the 26 letters of the English alphabet be permuted so that none of the patterns CAR, DOG, PUN or BYTE occurs?	**06**	**L3**	**CO4**
	b.	Five teachers T_1, T_2, T_3, T_4 are to be made class teachers for five classes, C_1, C_2, C_3, C_4, C_5, one teacher for each class. T_1 and T_2 do not wish to become the class teachers for C_1 or C_2, T_3 and T_4 for C_4 or C_5, and T_5 for C_3 or C_4 or C_5. In how many ways can the teachers be assigned the work? (Without displeasing any teacher)	**07**	**L3**	**CO4**
	c.	Solve the recurrence relation $F_{n+2} = F_{n+1} + F_n$ where $n \ge 0$ and $F_0 = 0$, $F_1 = 1$.	**07**	**L2**	**CO4**

Module – 5

Q.9	**a.**	If G be a set of all non zero real numbers and let $a * b = \frac{ab}{2}$ then show that (G, ∗) is an abelian group.	**06**	**L2**	**CO5**
	b.	Define Klein group and if A = {e, a, b, c} then show that this is a Klein-4 group.	**07**	**L2**	**CO5**
	c.	State and prove Lagrange's theorem.	**07**	**L2**	**CO5**

OR

Q.10	**a.**	If H and K are subgroups of group G, prove that $H \cap K$ is also a subgroup of G. Is $H \cup K$ a subgroup of G?	**06**	**L2**	**CO5**
	b.	Define cyclic group and show that (G, ∗) whose multiplication table is as given below is cyclic.	**07**	**L2**	**CO5**

∗	a	b	c	d	e	f
a	a	b	c	d	e	f
b	b	c	d	e	f	a
c	c	d	e	f	a	b
d	d	e	f	a	b	c
e	e	f	a	b	c	d
f	f	a	b	c	d	e

	c.	Let $G = S_4$, for $\alpha = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \end{pmatrix}$, find the subgroup $H = <\alpha>$. Determine the left cosets of H in G.	**07**	**L3**	**CO5**

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CBCS SCHEME

USN 1 R S 2 2 A I 0 1 1

BBOC407

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Biology for Engineers (CSE)

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	What is stem cell? Explain its types and list its applications.	**7**	**L2**	**CO1**
	b.	Explain in detail the properties and functions of nucleic acids.	**6**	**L2**	**CO1**
	c.	Explain the importance of special biomolecules.	**7**	**L2**	**CO1**
		OR			
Q.2	**a.**	What is a biomolecule? Explain the classifications of biomolecule.	**7**	**L2**	**CO1**
	b.	Explain the properties and functions of carbohydrates.	**6**	**L2**	**CO1**
	c.	Describe the structure and functions of a cell with a neat diagram.	**7**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	What is the role of lipids? Outline the process of obtaining biodiesel from lipids.	**7**	**L3**	**CO2**
	b.	Differentiate between PHA and PLA as a bioplastic materials.	**6**	**L4**	**CO1**
	c.	Explain the role of DNA vaccine for rabies and RNA vaccine for COVID-19.	**7**	**L2**	**CO1**
		OR			
Q.4	**a.**	What are the key properties, advantages and limitations of cellulose based water filters.	**7**	**L3**	**CO2**
	b.	How can DNA finger printing be applied to evaluate its effectiveness and reliability in forensic applications.	**6**	**L4**	**CO1**
	c.	Describe the use of meat analogue and plant protein as food.	**7**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Deliberate the functioning of brain as CPU system.	**7**	**L3**	**CO2**
	b.	Write a short note on spirometry and ventilator.	**6**	**L2**	**CO2**
	c.	Explain heart as pump system.	**7**	**L3**	**CO2**

		OR			
Q.6	**a.**	Explain eye as a camera system.	**7**	**L3**	**CO2**
	b.	Write a short note on cardiac pacemaker.	**6**	**L2**	**CO2**
	c.	Explain kidney as purification system.	**7**	**L3**	**CO2**
		Module – 4			
Q.7	**a.**	Describe the materials used and engineering applications of Velcro technology.	**7**	**L3**	**CO3**
	b.	Compare the process of photosynthesis to the functioning of photovoltaic cells.	**6**	**L4**	**CO3**
	c.	Explain the HBOCs and PFCs as human blood substituents.	**7**	**L3**	**CO3**
		OR			
Q.8	**a.**	Explain the terms lotus leaf effect and bird flying.	**7**	**L3**	**CO3**
	b.	Compare biological echolocation and technological echolocation highlighting their applications in navigation and detection.	**6**	**L4**	**CO3**
	c.	Explain the terms shark skin, swim suits and bullet train using biological concepts.	**7**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	Compare the functioning of electrical tongue and human tongue.	**7**	**L4**	**CO4**
	b.	Explain muscle cells as scaffold for tissue growth.	**6**	**L2**	**CO4**
	c.	Explain bioremediation and biomining via microbial surface adsorption.	**7**	**L2**	**CO4**
		OR			
Q.10	**a.**	Illustrate the basic steps of bioprinting process and list the various types of bioprinting techniques.	**7**	**L4**	**CO4**
	b.	Write a short note on: i) Importance of DNA origami ii) Self healing bioconcrete.	**6**	**L2**	**CO4**
	c.	Discuss the applications of artificial intelligence in the diagnosis of disease.	**7**	**L2**	**CO4**

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