MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)

Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi

Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Model Question Paper

First Semester MCA Degree Examination, 2025-26
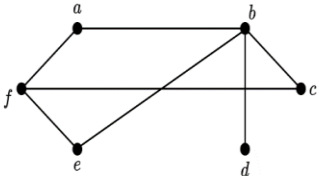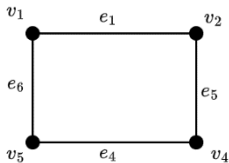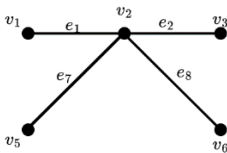
Mathematical Foundation for Computer Applications

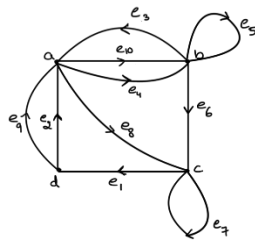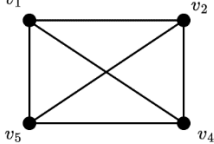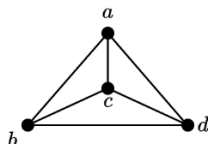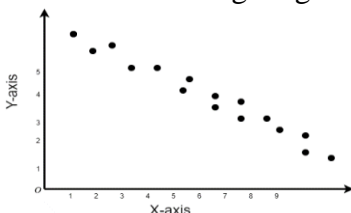**Time: 3 Hours**   **Max. Marks: 100**

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

		Module -1	**M**	**L**	**C**
Q1	a.	Suppose a hostel library has 12 books on Java, 10 books on neural networks, 16 books on C++ and 11 books on Python. Using set theory, i. Determine the number of ways in which student can choose a book. ii. Determine the number of ways in which student can choose a book of Java or Python. iii. Determine the number of ways of choosing a book each of C++ and neural networks.	06	L3	CO1
	b.	Find the number of permutations of the English letters in which none of the pattern's ABC, EFG, PQRS or XYZ occurs?	07	L3	CO2
	c.	Consider a simple Finite State Machine with the states P, Q, R, S, T, U and transitions $P \rightarrow 0 \rightarrow Q, P \rightarrow 1 \rightarrow R, Q \rightarrow 0 \rightarrow Q, Q \rightarrow 1 \rightarrow S, R \rightarrow 0 \rightarrow Q,$ $R \rightarrow 1 \rightarrow S, S \rightarrow 0 \rightarrow S, \ S \rightarrow 1 \rightarrow S, T \rightarrow 0 \rightarrow Q, T \rightarrow 1 \rightarrow R, U \rightarrow 0 \rightarrow S,$ $U \rightarrow 1 \rightarrow S$. Determine a relation to simplify the FSM based on equivalent transition while preserving its behavior.	07	L3	CO3
		OR			

Q2	a.	Let $A = \{1,2,3,4\}$ and $B = \{a, b, c, d\}$. Let
		 $f_1 = \{(1, b), (2, b), (3, c), (4, c)\} \ f_2 = \{(1, c), (2, d), (3, a), (4, c)\}$
		 be two functions from A to B.
		   i. Determine the pre-image of c under f_1, image of 2 under f_2.
		   ii. Determine whether f_1 is one-one, f_2 is onto.
		   iii. Determine the domain, co-domain of f_1.
			06	L3	CO1

	b.	Let $A = \{1, 2, 3, 4, 5, 6\}$ be a set and R be a relation on A be defined by $R = \{(1,1), (1,2), (2,1), (2, 2), (3,3), (4,4), (5,5), (6,6), (3, 4), (4, 3), (4, 5), (4, 5), (3, 5), (5, 3)\}$.
		   i. Represent the relation using a digraph and relation matrix.
		   ii. Examine whether R is an equivalence relation or not.
			07	L3	CO2

	c.	There are 500 employees in a company, out of which 193 know Hindi, 200 know Kannada, and 120 know neither Hindi nor Kannada. Apply appropriate principle to determine the number of employees who know both Kannada and Hindi. Also determine the number of students who know only Kannada.	07	L3	CO3
		Module- 2			
Q3	a.	i. Determine whether or not the following are proposition. a. $x + 2 = 11$ b. Mysore is the capital of Karnataka.	06	L3	CO1

		ii. Negate the statement "My phone has atleast 32GB of memory" iii. In each of the following determine all the possible combination of truth values of the variables p, q, r so that the following hold (a) $p \vee q \vee r$ is false (b) $p \Rightarrow (q \vee r)$ is false			
	b.	Determine whether the compound proposition $\left((p \vee \neg q) \Rightarrow r\right) \Rightarrow \left(p \Rightarrow (q \wedge r)\right)$ is a tautology or contradiction?	07	L3	CO2
	c.	Apply appropriate laws of logic / rules of inference to determine whether the following argument is valid or not. "No people who live in city A or city B are educated", "Anjali is educated" leads to the conclusion "Anjali does not live in city B".	07	L3	CO3
OR					
Q4	a.	i. Let $P(x):"x$ is an integer" be a propositional function. Determine the truth value of $P(2.4)$ ii. Let p and q be the propositions "It is sunny" and "We plan a trip" respectively. Determine the corresponding propositions in words. (a) $p \Rightarrow q$ (b) $\neg q \Rightarrow \neg p$. iii. Determine whether the argument is valid or not. $$\frac{\begin{array}{c} q \\ p \Rightarrow q \end{array}}{\therefore \quad p}$$	06	L3	CO1
	b.	Apply laws of logic / rule of inference, to verify whether $[(\neg p \vee \neg q) \Rightarrow (p \wedge q \wedge r)] \equiv p \wedge q$ is logical equivalence or not.	07	L3	CO2
	c.	Apply appropriate laws of logic / rules of inference to verify whether the hypotheses " If I study, I will not fail in the examination", "If I do not watch TV in the evenings, I will study", "I failed in the examination" lead to the conclusion "I have watched TV in the evenings".	07	L3	CO3
Module - 3					
Q5	a.	Determine the following: i. the degree of vertex b. ii. a cut vertex and a bridge. iii. the pendant vertices. iv. spanning tree for the given graph. v. a path of length 3 from f to c.	06	L3	CO1
	b.	Consider the graphs **Graph G_1** **Graph G_2** Determine the following: i. the incidence matrix of G_1 ii. $G_2 - \{e_7\}$ iii. $G_1 - \{v_1\}$ iv. the graph $G_1 \cup G_2$.	07	L3	CO2
	c.	Develop a graph model for the list of airline routes connecting various cities as follows: Airline route connecting cities A and E, A and C, E and C, E and F, C and F, C and B, F and B. Also, determine adjacency matrix and develop the graph model to know the airline routes which are not connected to various cities.	07	L3	CO3
OR					

Q6	a.	Consider the graph. i) Determine parallel edges and loops. ii)Determine the indegree of b, c. iii)Determine whether there is a path from c to b iv) Determine the vertices which are adjacent to b	06	L3	CO1
	b.	i. Determine whether or not, the following graphs are isomorphic Graph G_1 Graph G_2 ii. Determine all the adjacent vertices and the degree of each vertex of graph G_1, G_2.	07	L3	CO2
	c.	A person A is planning to organize a social event by inviting a group of people who are connected through a social network. It is observed that A and B, B and C, B and D, D and C, C and E, D and E are connected through this network. Model this using a graph. Determine the adjacency matrix and develop a graph model to know the people who are not connected to each other in social network.	07	L3	CO3

Module - 4

Q7	a.	i. Construct scatter diagrams which depict negative and zero correlation. ii. Given the slope of regression lines $b_{xy} = -1$, $b_{yx} = -1$, find r and determine whether the correlation is positive or negative. iii. Determine whether the slopes of regression lines can be of opposite sign.	06	L3	CO1
	b.	Fit a parabola $y = a + bx + cx^2$ to the given data table below	07	L3	CO2

x	10	12	15	23	20
y	14	17	23	25	21

	c.	The following table shows the number of motor registrations in a certain territory for a term of 5 years and the sale of motor tyres by a firm in that territory for the same period. Determine the regression equation to estimate the sale of tyres when motors registration is known. Also estimate sale of tyres when registration is 850.	07	L3	CO3

Year	1	2	3	4	5
Motor registration	600	630	720	750	800
Number of Tyres sold	1250	1100	1300	1350	1500

OR

Q8	a.	i. In the following diagram, determine the sign of the correlation coefficient. ii. Give a scatter diagram for which correlation coefficient between variables is positive. iii. Whether or not -3.5, -0.5 can be a correlation coefficient for any set of data?	06	L3	CO1

	b.	Find the correlation coefficient for the following two groups. Also determine lines of regression.	07	L3	CO2

x	9	8	7	6	5	4	3	2	1
y	15	16	14	13	11	12	10	8	9

	c.	If P is the pull required to lift a load W by means of a pulley block. Find a linear law of the form $P = mW + c$ connecting P and W using the following data where P and W are taken in $kg\ wt$, Compute P when $W = 150\ kg\ wt$.	07	L3	CO3

W	50	70	100	120
P	12	15	21	25

Module - 5

Q9	a.	A fair coin was tossed two times. Given that the first toss resulted in heads. Determine
		   i. sample space S for the given scenario.
		   ii. random variable for the event that both tosses came up heads.
		   iii. random variable for the event that the first toss came up heads.
			06	L3	CO1

	b.	Let A and B be two events such that $P(A) = 0.3$, $P(B) = 0.5$ and $P(A \cup B) = 0.7$. Find
		   i. $P(A \mid B)$
		   ii. $P(\bar{A} \cup \bar{B})$
			07	L3	CO2

	c.	A company has two plants to manufacture scooters. Plant 1 manufactures 80% of the scooters and plant 2 manufactures 20%. At plant 1, 85 out of 100 scooters are rated standard quality or better. At plant 2, only 65 out of 100 scooters are rated standard quality or better.
		  i. Determine the probability that scooter selected at random came from plant 1, if it is known that scooter is of standard quality.
		  ii. Determine the probability that the scooter came from plant 2, if it is known that scooter is of standard quality.
			07	L3	CO3

OR

Q10	a.	Tickets are numbered from 1 to 20. They are well shuffled and a ticket is drawn at random. The following be few events
		A: getting an even number, B: getting a number which is multiple of 5, C: getting a number which is greater than 15.
		   i. Construct a Venn diagram representing these events.
		   ii. Determine whether A and B are mutually exclusive. Justify your answer.
		   iii. Determine a ticket number which is favorable to all the events $A, B,\ C$.
		   iv. Give the mathematical expression to find the probability of getting an even number given that it is a multiple of 5.
			06	L3	CO1

	b.	Let X, Y, Z be mutually exclusive and collectively exhaustive events with probabilities being equally likely. Let B be any arbitrary event with conditional probabilities $P(B|X) = 0.02$, $P(B|Y) = 0.07$, $P(B|Z) = 0.12$.
		   i. Determine $P(Y \cap B)$.
		   ii. Determine $P(Y|B)$ using Baye's theorem.
			07	L3	CO2

	c.	A box of 100 mobiles containing mobiles contains 10 mobiles with defect type A, 5 mobiles with defect type B and 2 mobiles with both types of defects. Find the probabilities that
		  i. A mobile drawn has a type B defect under the condition that it has a type A defect.
		  ii. A mobile drawn has no type B defect under the condition that it has no type A defect.
			07	L3	CO3

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