CBCS SCHEME

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22MCA11

First Semester MCA Degree Examination, June/July 2025
Mathematical Foundation for Computer Applications

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.

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		Module – 1	M	L	C
Q.1	a.	Illustrate with an example for each and define the following : i) Null set ii) Proper subset iii) Universal set.	6	L2	CO1
	b.	Explain the Pigeonhole principle. Prove that in any set of 29 persons at least five persons must have been born on the same day of the week.	6	L2	CO1
	c.	Find all the Eigen values and Eigen vectors of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$	8	L1	CO1
		OR			
Q.2	a.	Prove that for any 3 sets A, B and C i) $A \cap (B - C) = (A \cap B) - C$ ii) $(A - B) \cap (A - C) = A - (B \cup C)$	6	L5	CO1
	b.	In a class of 52 students, 30 are studying C++, 28 are studying python and 13 are studying both languages. How many in this class are studying at least one of these languages? How many are studying neither of these languages?	7	L1	CO1
	c.	Prove that Associative laws of set theory.	7	L2	CO1
		Module – 2			
Q.3	a.	Explain the following along with truth table : i) Exclusive OR ii) Conditional statement	6	L3	CO2
	b.	Prove that $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are logically equivalent.	7	L3	CO5
	c.	Identify converse, inverse and contra-positive of the statement "If a triangle is not isosceles, then it is not equilateral"	7	L3	CO3
		OR			
Q.4	a.	Determine the truth values for each of the following, if p, q are the primitive statements for which the implication $p \to q$ is false : i) $\neg p \vee q$ ii) $q \to p$ iii) $\neg p \to \neg q$	6	L3	CO5
	b.	Determine the direct proof, indirect proof and proof by contradiction for "If n is even then n + 9 is odd".	8	L3	CO5

			M	L	C
	c.	Explain tautology and contradiction.	2	L3	CO2
	d.	Prove that the following arguments are valid : $p \to q$ $\neg r \to \neg q$ p $\therefore r$	4	L3	CO5
		Module – 3			
Q.5	a.	If A = {1, 2, 3}, B = {2, 3, 4}, C = {3, 4, 5} verify that $A \times (B \cup C) = (A \times B) \cup (A \times C)$	6	L5	CO6
	b.	Let A = {1, 2, 3, 4, 6} and R be relation on A defined by aRb if and only if a is a multiple of b i) Represent the relation R as a matrix ii) Draw the digraph of R iii) Determine the in-degree and out-degree of the vertices in the diagraph.	7	L5	CO6
	c.	Let R = {(1, 1), (2, 2), (2, 3), (3, 2), (4, 2), (4, 4)} be the relation on the set A = {1, 2, 3, 4}. Determine whether R is reflexive, symmetric, transitive and anti-symmetric.	7	L5	CO6
		OR			
Q.6	a.	Let R be the relation represented by the matrix $M_R = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$ Find the matrix representing : i) R^{-1} ii) $\overline{R}$ iii) R^2	6	L2	CO6
	b.	Verify that R = {(1, 1), (2, 2), (3, 3), (4, 4), (1, 2), (2, 1)} is an equivalence relation on the set A = {1, 2, 3, 4}. Find the corresponding partition of A.	7	L5	CO6
	c.	Let A = {1, 2, 3, 4, 6, 8, 12}. On A, define the partial ordering relation R by xRy if and only if x/y. Draw the Hasse diagram for R.	7	L2	CO6
		Module – 4			
Q.7	a.	A random variable X has the probability distribution as given in the table. i) Find K ii) Evaluate $P(X < 4)$, $P(X \geq 5)$, $P(3 < X \leq 6)$ iii) Find the minimum value of K, so that $P(X \leq 2) > 0.3$.	6	L5	CO2

X	0	1	2	3	4	5	6
P(X)	K	3K	5K	7K	9K	11K	13K

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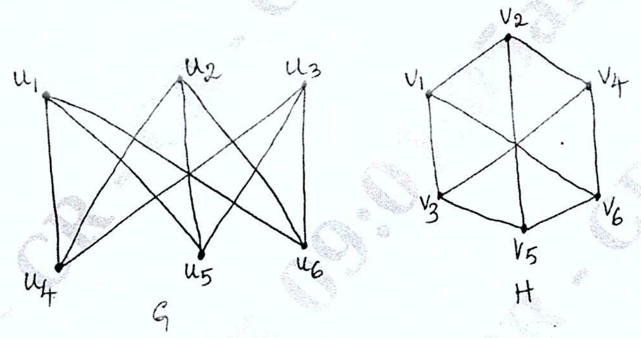
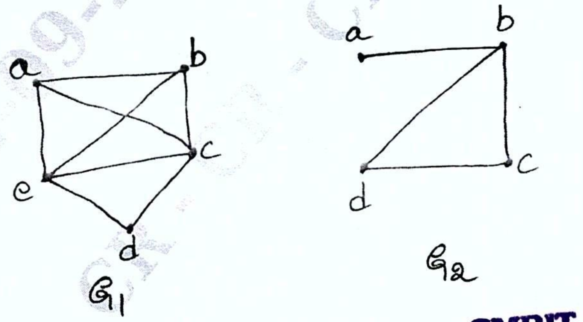
			M	L	C
	b.	In sampling a large number of parts manufacturing by a company, the mean number of defectives in samples of 20 is 2. Out of 1000 such samples how many would be expected to contain at least 3 defective parts.	7	L5	CO2

	c.	The number of kilometers that a car owner get with a certain type of battery is exponentially distributed with mean as 30,000 Kms. Find the probability that one of the type will last for i) atleast 15000 Kms ii) atmost 22500 Kms.	7	L5	CO2
		OR			
Q.8	a.	A random variable X takes the values $-3, -2, -1, 0, 1, 2, 3$ such that : $P(X = -3) = P(X = -2) = P(X = -1) = P(X = 1) = P(X = 2) = P(X = 3)$ and $P(X = 0) = P(X < 0)$. Find the probability distribution.	6	L5	CO2
	b.	The probability that a person aged 60 years will have upto 70 is 0.65, what is the probability that out of the 10 persons aged 60 at least 7 of them will line upto 70.	7	L5	CO2
	c.	At a certain city bus stop, three buses arrive per hour on an average. Assuming that the time between successive arrivals is exponentially distributed. Find the probability that the time between the arrival of successive buses is i) less than 10 minutes ii) atleast 30 minutes.	7	L5	CO2
		Module – 5			
Q.9	a.	Illustrate with an example for each and define the following : i) Complete bipartite graph ii) Planar graph iii) Simple graph	6	L2	CO4
	b.	Verify whether the following graphs are isomorphic :  Fig Q9(b)	7	L5	CO4
	c.	Determine which of the following simple graphs have a Hamilton circuit? If the graph does not have Hamilton circuit find Hamilton path.  Fig Q9(c)	7	L5	CO4

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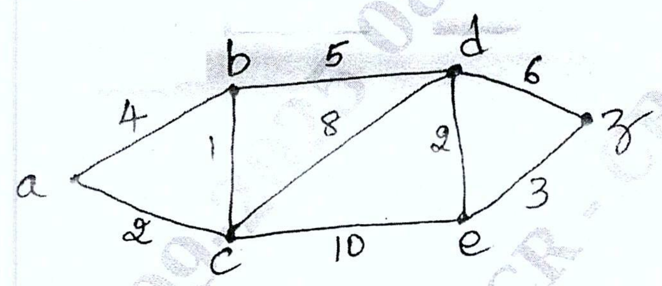
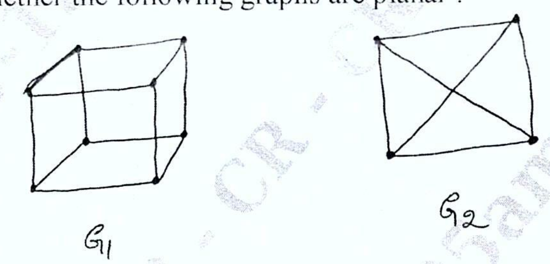
		OR			
Q.10	a.	Illustrate with an example for each and define the following : i) Euler circuit ii) Chromatic number of a graph iii) Hamilton path	6	L2	CO4
	b.	Use Dijkstra's algorithm to find the shortest path and its length between the vertices a and z in the weighted graph shown below :  Fig Q 10(b)	7	L5	CO4
	c.	Determine whether the following graphs are planar :  Fig Q10(c)	7	L5	CO4

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