CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **22MCA11**

First Semester MCA Degree Examination, Dec.2024/Jan.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.
3. Use of statistical table is permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define Union and Intersection of two sets, and give a proper example.	**06**	**L3**	**CO1**
	b.	For any two sets state and prove De Morgan's laws.	**06**	**L3**	**CO1**
	c.	Find the eigen values and eigen vectors of the matrix $A = \begin{pmatrix} 2 & 1 & -2 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$	**08**	**L3**	**CO1**
		OR			
Q.2	**a.**	Let A = {1, 2, 3, 7} , B = {1, 2, 3, 4} , C = { x / x is a positive integer and $x^2 \leq 9$ } Compute the following : (i) $A \cup (B - C)$ (ii) $(A - B) \cap C$ (iii) $(A \cup B) - (B \cap C)$	**06**	**L3**	**CO1**
	b.	(i) Explain the pigeonhole principle. (ii) Let ΔABC be an equilateral triangle of side 1 unit show that if we select 10 points in the interior of the triangle, there must be at least two points whose distance apart is less than 1/3.	**06**	**L3**	**CO1**
	c.	In a hostel of strength 70, 40 of them knew Kannada, 35 knew Hindi and 15 of them knew both. Find out the following : (i) How many of them know atleast one of the languages? (ii) How many know neither Kannada nor Hindi? (iii) How many of them knew only Kannada?	**08**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Show that $[(p \rightarrow r) \wedge (q \rightarrow r)] \rightarrow [(p \vee q) \rightarrow r]$ is a tautology.	**06**	**L2**	**CO3**
	b.	Prove the statement. "The square of an even integer is an even integer" by the method of contradiction.	**06**	**L2**	**CO3**
	c.	What is a proposition? Let p and q be the propositions of "swimming in the new jersy seashore is allowed and sharks have been near the sea shore". Express each of the following compound propositions as an English sentence: (i) $p \rightarrow \sim q$ (ii) $\sim p \rightarrow \sim q$ (iii) $p \leftrightarrow q$	**08**	**L2**	**CO3**

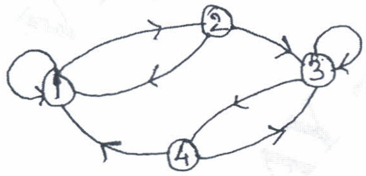
<table>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.4</td><td>a.</td><td>If A = { 1, 2, 3, 4, 5 } is the universal set, determine the truth values of each of the following statements:
(i) $\forall x \in A, (x + 2 < 10)$ (ii) $\forall x \in A, (x \not> 5)(x + 2 = 10)$
(iii) $\forall x \in A, (x^2 \leq 25)$</td><td>06</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>What is the truth value of $\forall x (x^2 \geq x)$
(i) If the domain contains of all real numbers
(ii) If the domain contains of all integers</td><td>06</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Verify the principle of duality for the given logical equivalence
$[\sim(p \wedge q) \rightarrow \sim p \vee (\sim p \vee q)] \Leftrightarrow \sim p \vee q$</td><td>08</td><td>L2</td><td>CO3</td></tr>
<tr><td colspan="6">Module – 3</td></tr>
<tr><td>Q.5</td><td>a.</td><td>Let A = {1, 2, 3, 4} and R = {(1, 3), (1, 1), (3, 1), (1, 2), (3, 3), (4, 4)} be a relation on A. Determine (i) R is reflexive (ii) symmetric (iii) Transitive</td><td>06</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>Let A = {1, 2, 3, 4, 5}. Define relation R on A×A by (x_1, y_1) R (x_2, y_2) if and only if $x_1 + y_1 = x_2 + y_2$. Determine partition of A×A induced by R.</td><td>06</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>c.</td><td>Determine the relations R and the associated matrix by examining each of the following diagrams:
(i)


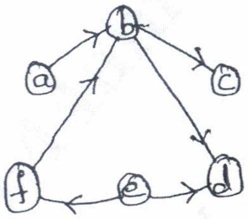
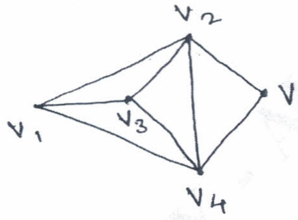
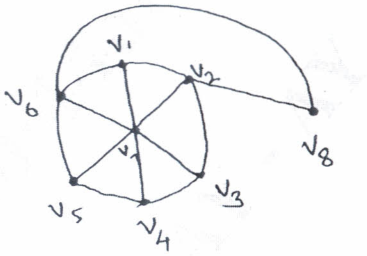
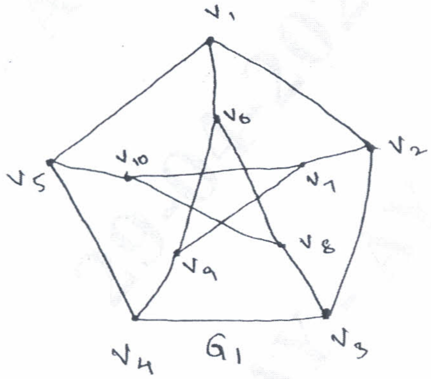
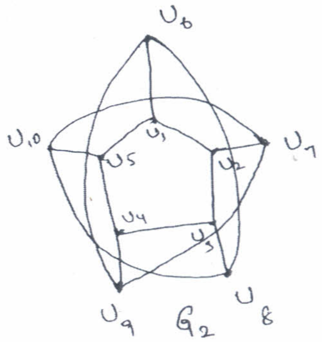
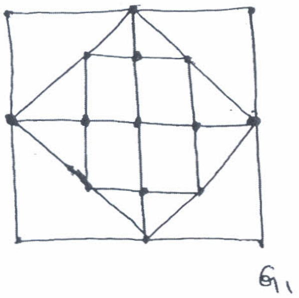
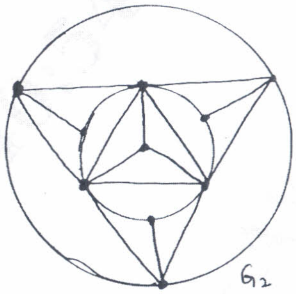
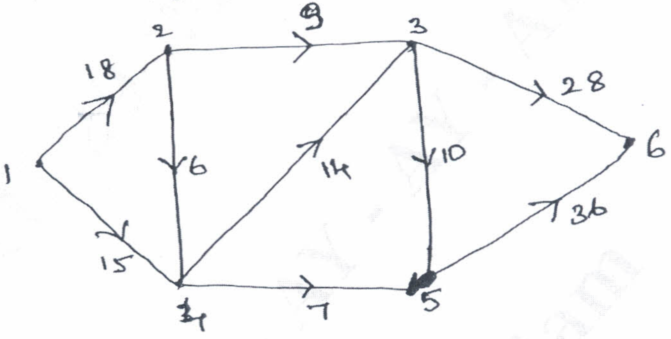
Fig.Q5(c)(i)
(ii)


Fig.Q5(c)(ii)</td><td>08</td><td>L3</td><td>CO1</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.6</td><td>a.</td><td>Define Partitions and equivalence class with examples.</td><td>06</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>Draw the Hasse diagram representing the partial ordering
{(a, b) / a divided b} on { 1, 2, 3, 4, 6, 8, 12 }</td><td>06</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>c.</td><td>Draw Hasse diagram for all the positive integer divisors of 72.</td><td>08</td><td>L3</td><td>CO1</td></tr>
<tr><td colspan="6">Module – 4</td></tr>
<tr><td>Q.7</td><td>a.</td><td>The probability distribution function P(X) of a variable X is given by the following table :
<table>
<tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>P(X)</td><td>K</td><td>3K</td><td>5K</td><td>7K</td><td>9K</td><td>11K</td><td>13K</td></tr>
</table>
(i) Find K value
(ii) Find $P(X < 4)$, $P(X \geq 5)$ and $P(3 < X \leq 6)$
(iii) Find mean
(iv) Find variance</td><td>12</td><td>L3</td><td>CO2</td></tr>
<tr><td></td><td>b.</td><td>The probability that a pen manufactured by a company will be defective is 1/10 if 12 such pens are manufactured. Find the probability that (i) Exactly two will be defective (ii) atleast two will be defective (iii) None will be defective.</td><td>08</td><td>L3</td><td>CO2</td></tr>
</table>

		OR			
Q.8	**a.**	Find the constant K such that $f(x) = \begin{cases} Kx^2 & , \quad 0 < x < 3 \\ 0 & , \quad \text{otherwise} \end{cases}$ is a pdf. Also compute (i) $P(1 < x < 2)$ (ii) $P(x \le 1)$ (iii) $P(x > 1)$ (iv) Mean (v) Variance.	**12**	**L3**	**CO2**
	b.	For the standard normal distribution of a random variable z, evaluate the following : (i) $P(0 \le z \le 1.45)$ (ii) $P(-3.40 \le z \le 2.65)$ (iii) $P(-2.55 \le z \le -0.8)$ (iv) $P(z \le -3.35)$	**08**	**L3**	**CO2**
		Module – 5			
Q.9	**a.**	Define the following with suitable examples: (i) Simple Graph (ii) K-Regular graph (iii) Bi-Partite graph	**06**	**L2**	**CO4**
	b.	Define vertex coloring and find the vertex chromatic number for the following graphs: (i)  Fig.Q9(b)(i) (ii)  Fig.Q9(b)(ii)	**06**	**L2**	**CO4**
	c.	Define isomorphism of graph and verify whether given graphs are isomorphic to each other. (i)  Fig.Q9(c)(i) (ii)  Fig.Q9(c)(ii)	**08**	**L2**	**CO4**
		OR			
Q.10	**a.**	Define with suitable examples : (i) Hamilton path (ii) Euler's path (iii) Planar graph	**06**	**L2**	**CO4**

	b.	Verify Euler's formula for the planar graphs given below: (i)  Fig.Q10(b)(i) (ii)  Fig.Q10(b)(ii)	**06**	**L2**	**CO4**
	c.	Using Dijkstra's algorithm, find the shortest path and its weight from the vertex 1 to each of the other vertices 2, 3, 4, 5, 6 in the weighted and directed graph (Network) given below.  Fig.Q10(c)	**08**	**L2**	**CO4**

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