CBCS SCHEME

USN

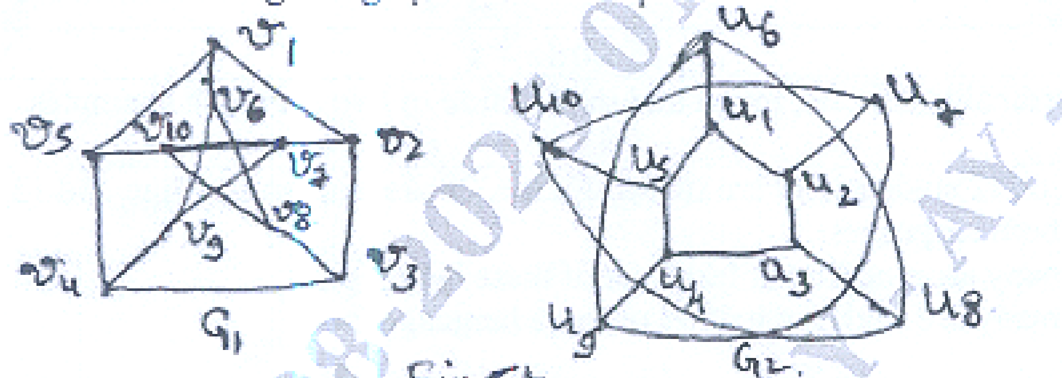
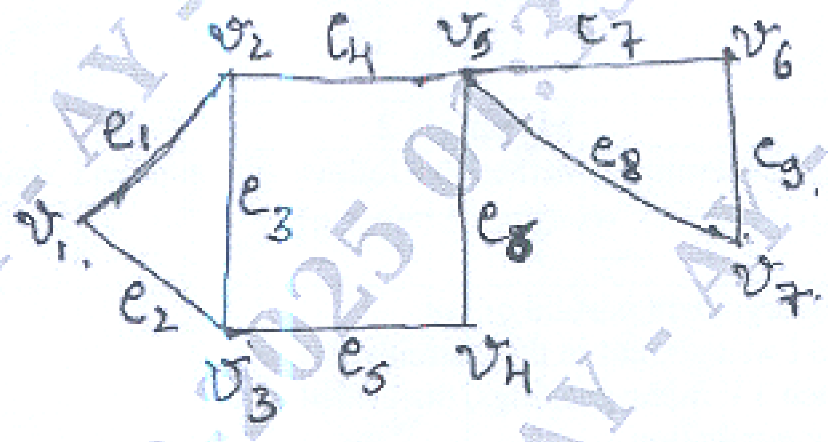
MMC102

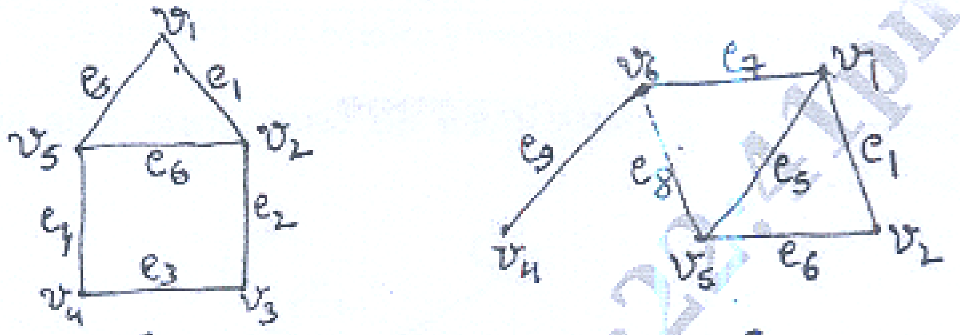
First Semester MCA Degree Examination, June/July 2025
Discrete Mathematics & Graph Theory

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 cardinality of a set, union and intersection of two sets with examples.	6	L1	CO1
	b.	In a class of 52 students, 30 are studying C++, 28 are studying python and 13 are studying both languages. (i) How many are studying at least one of these languages? (ii) How many are studying neither of these languages?	8	L3	CO1
	c.	If $A = \begin{bmatrix} 1 & 3 \\ 2 & 1 \end{bmatrix} and B = \begin{bmatrix} 2 & 1 \\ 3 & 1 \end{bmatrix}$ then verify that $(A+B)^T = A^T + B^T$	6	L2	CO1
		OR			
Q.2	a.	A drawer contains 6 black socks and 6 brown socks. A man takes out socks randomly in the dark. (i) How many socks must he take out to be sure that he has at least 2 socks of the same color? (ii) How many socks must he take out to be sure that he has at least 2black socks?	7	L3	CO1
	b.	State and prove D'Morgan laws for sets	5	L2	CO1
	c.	Find the eigen values and corresponding eigen vectors of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$	8	L2	CO1
		Module – 2			
Q.3	a.	Define a Tautology. Determine whether the following compound statement is a tautology or not. $\{(p \vee q) \rightarrow r\} \leftrightarrow \{\neg r \rightarrow \neg(p \vee q)\}$	7	L2	CO1
	b.	Test if the following argument is valid or not. If I study, then I will not fail in the examination. If I do not watch TV in the evenings, then I will study. I failed in the examination. $\therefore$ I must have watched TV in the evenings.	7	L3	CO1
	c.	Write the converse, Inverse and Contrapositive of the statement "If it is raining then home team wins".	6	L2	CO1
		OR			
Q.4	a.	Using the laws of logic, prove the following logical equivalence: $[(\neg p \vee \neg q) \wedge (F_0 \vee p) \wedge p] \Leftrightarrow p \wedge \neg q$.	8	L3	CO1
	b.	Write symbolically and obtain the negation of the statement " All integers are rational numbers and some rational numbers are not integers".	6	L2	CO1

	c.	Prove the following argument by direct and Indirect methods. "If m is an even integer, then m + 9 is odd".	6	L3	CO1
Module – 3					
Q.5	a.	Define the following with suitable examples (i) Regular graph (ii) Bipartite graph (iii) Degree of a vertex (iv) Pendant vertex and (v) Disconnected graph.	10	L1	CO2
	b.	Show that the following two graphs are Isomorphic  Fig 5b.	10	L2	CO2
OR					
Q.6	a.	Determine $\|V\|$ for the graph $G = (V, E)$ in the following cases: (i) G is a cubic graph with 9 edges (ii) G has 10 edges with two vertices of degree 4 and the others of degree 3. (iii) G is a regular graph with 15 edges (iv) 16 edges and all vertices of degree 4	10	L2	CO2
	b.	From the graph shown below, find (i) a walk from v2 to v4 which is not a trail (ii) a trail from v2 to v4 which is not a path (iii) a closed walk from v2 to v2 which is not a circuit (iv) a circuit from v2 to v2 which is not a cycle  Fig 6b:	10	L2	CO2
Module – 4					
Q.7	a.	Exhibit the following: (i) A graph which has both an Euler circuit and a Hamilton cycle (ii) A graph which has an Euler circuit but no Hamilton cycle. (iii) A graph which has a Hamilton cycle but no Euler circuit. (iv) A graph which has neither an Euler circuit nor a Hamilton cycle	10	L2	CO2

<table>
<tr><td></td><td>b.</td><td>Find the ring sum of the graphs G1 and G2 shown below


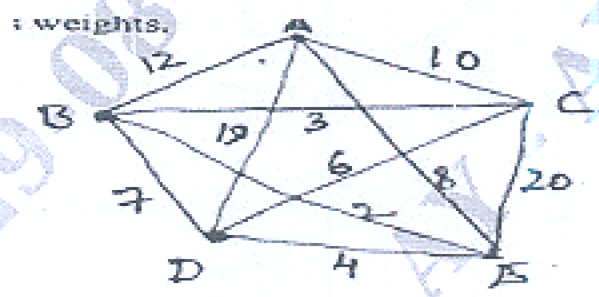
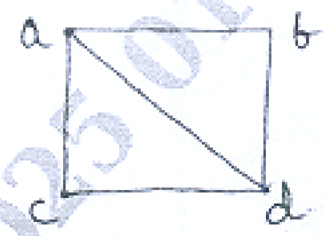
G_1 Fig 3b G_2</td><td>6</td><td>L2</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>Define complement of a graph with an example.</td><td>4</td><td>L1</td><td>CO2</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.8</td><td>a.</td><td>Find the shortest possible route, so that salesman covers all the cities starting from city A and returns to A. Cities are denoted by vertices in the following graph and distances are given as weights.

</td><td>10</td><td>L3</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Let $A = \{1,2,3,4,5,6\}$ be a set and a binary relation on A is defined as xRy iff y=2x.
(i) Write down R as a set of ordered pairs
(ii) Draw the directed graph of R
(iii) Determine the in-degrees and out-degrees of each vertex.</td><td>10</td><td>L2</td><td>CO2</td></tr>
<tr><td colspan="6">Module – 5</td></tr>
<tr><td>Q.9</td><td>a.</td><td>Define Chromatic number of a graph. Find the chromatic polynomial and hence obtain the chromatic number of the following graph.


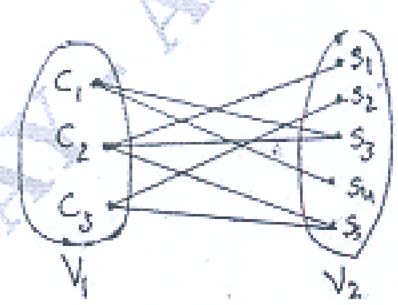
Fig 9a.</td><td>10</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Five senators s1 , s2 , s3 , s4 , and s5 are members of three committees, c1 , c2 , and c3 . The membership is shown in the following figure. One member from each committee is to be represented in a super-committee Is it possible to send one distinct representative from each of the committees? If so, give an example.


Fig 9b.</td><td>10</td><td>L3</td><td>CO4</td></tr>
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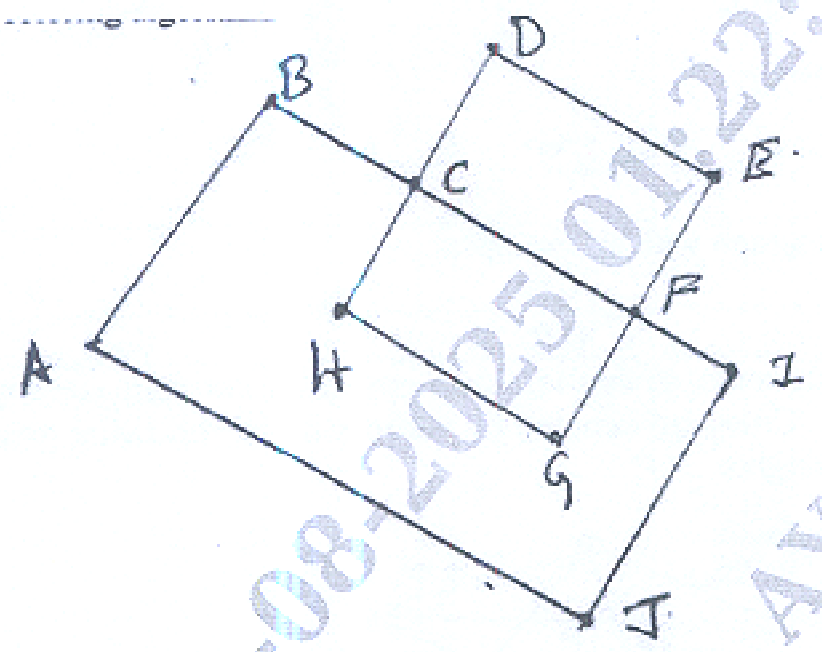
		OR			
Q.10	a.	Show that every planar map can be properly colored with five colors	10	L2	CO4
	b.	Explain Greedy coloring algorithm. Color the below graph using the Greedy coloring algorithm.  Fig 10b.	10	L3	CO3

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