JHARKHAND Rai University
RANCHI

PRACTICE SET

End Semester Examination – December 2025

Program: MCA **Subject: Discrete Mathematics**

Subject Code: 3CMT101 **Semester: Ist**

Course Outcomes:

After the successful completion of the course, the students will be able to:

CO1: Solve problems using logic, set theory, and proofs.

CO2: Apply relations, functions, and counting in problem modeling.

CO3: Use graph and tree algorithms for computation and optimization.

CO4: Implement algebraic and coding concepts in digital systems.

UNIT-I

Section: I (1 Marks)

1. If A={1,2,3} and B={3,4,5}, then A∩B=? **CO1 Understand LOT**
(a) {1, 2, 3, 4, 5} (b) {3} (c) {1, 2, 4, 5} (d) {1, 2, 5}

2. If n(A)=20, n(B)=15 , n(A∪B)=25, find n(A∩B). **CO1 Understand LOT**
(a) 5 (b) 10 (c) 15 (d) 20

3. The universal set U={1,2,3,4,5,6}, and A={2,4,6}. Then A′=? **CO1 Understand LOT**
(a) {1,3,5} (b) {2,4,6} (c) {1,2,3,4,5,6} (d) {3,5,7}

4. The power set of A={1,2} has how many elements? **CO1 Understand LOT**
(a) 2 (b) 3 (c) 4 (d) 5

5. If $A \subseteq B$ and $B \subseteq C$, then: **CO1 Remember LOT**

(a) $A \subseteq C$ (b) $C \subseteq A$ (c) $A = C$ (d) None of these

6. The Cartesian product $A \times B$ is empty if: **CO1 Remember LOT**

(a) $A = B$ (b) $A \neq B$ (c) Either A or B is empty (d) Both A and B are non-empty

7. The symbolic form of "p only if q" is: **CO1 Understand LOT**

(a) $p \rightarrow q$ (b) $q \rightarrow p$ (c) $p \leftrightarrow q$ (d) $\neg p \rightarrow q$

8. The disjunction of two statements is true if: **CO1 Remember LOT**

(a) Both are true (b) At least one is true (c) Both are false (d) Only one is true

9. A statement that is always true is called:

(a) Contradiction (b) Contingency (c) Tautology (d) Paradox

10. The negation of "$p \wedge q$" is:

(a) $\neg p \wedge \neg q$ (b) $\neg p \vee \neg q$ (c) $p \vee q$ (d) $\neg p \wedge q$

Section: II (10 Marks)

11. Prove the given identity by law of algebra (i) $(A \cup B) \cap (A \cup B^C) = A$ (ii) $A \cup (A \cap B) = A$ CO1 Apply HOT

12. Prove the given identity by law of algebra $(A \cap B) \cup (A^C \cap B) \cup (A \cap B^C) \cup (A^C \cap B^C) = U$ CO1 Apply HOT

13. From the following formula, find out Tautology, Contingency and Contradiction. Evaluate CO1 HOT

(i) $A \rightarrow A \wedge (A \vee B)$ (ii) $(p \wedge \sim q) \vee (\sim p \wedge q)$ (iii) $\sim(p \vee q) \vee (\sim p \vee \sim q)$

Section: III (20 Marks)

14. (a) Prove that $A - (B \cap C) = (A - B) \cup (A - C)$ CO1 Evaluate HOT

(b) Prove that $(A \times B) \cap (P \times Q) = (A \cap P) \times (B \cap Q)$. CO1 Evaluate HOT

15. (a) Construct the truth table for the following statement

(i) $(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow (p \rightarrow r))$ (ii) $p \leftrightarrow (\sim p \vee \sim q)$.

(b) Determine whether the following are equivalent, using bi-conditional statement.

(i) $p \leftrightarrow q \cong (p \wedge q) \vee (\sim p \wedge \sim q)$ (ii) $(p \rightarrow q) \rightarrow t \cong (p \wedge \sim q) \rightarrow t$. CO1 Evaluate HOT

UNIT-II

Section: I (1 Marks)

16. The Cartesian product A×B represents: Remember CO2 LOT
(a) The sum of elements in A and B (b) The difference of A and B (c) The set of all ordered pairs (a, b) where $a \in A, b \in B$ (d) None of these

17. A relation R is transitive if: Remember CO2 LOT
(a) $(a, b) \in R$ and $(b, c) \in R \Rightarrow (a, c) \in R$ (b) $(a, b) \in R \Rightarrow (b, a) \in R$ (c) $(a, a) \in R$
(d) None of these

18. **A relation R on A = {1,2,3} defined by R = {(1,1), (2,2), (3,3)} is:** Understand CO2 LOT
(a) Only symmetric (b) Only transitive (c) Reflexive, symmetric and transitive (d) None of these

19. The range of the relation R = {(1,2), (2,3), (3,4)} is: Understand CO2 LOT
(a) {1,2,3} (b) {2,3,4} (c) {1,2,3,4} (d) {3,4}

20. If R and S are relations on A, then R∘S (composition of R and S) is defined if:
Remember CO2 LOT
(a) Domain of R = Codomain of S (b) Codomain of R = Domain of S (c) Both A and B are equal (d) None of these

21. A function f: A → B is one-to-one (injective) if: **Remember CO2 LOT**
(a) Every element of A maps to one element of B (b) Two or more elements of A map to the same element of B (c) Different elements of A map to different elements of B (d) None of these

22. A function f: A → B is onto (surjective) if: **Remember CO2 LOT**
(a) Every element of A is related to every element of B (b) Every element of B is the image of some element of A (c) Both A and B are equal (d) None of these

23. If $f(x)=x^2$, then the function is: **Understand CO2 LOT**
(a) One-one (b) Many-one (c) Onto (d) Constant

24. If f: A → B and g: B → C, then the composition g∘f means: **Remember CO2 LOT**
(a) Apply f then g (b) Apply g then f (c) Apply both simultaneously (d) None of these

25. The domain of $f(x)=1/x-2$ is: **Understand CO2 LOT**
(a) All real numbers (b) All real numbers except 2 (c) All integers (d) Only 2

Section: II (10 Marks)

26. Let X = {a, b, c}. Define f: X → X such that f = {(a, b), (b, a), (c, c)}. Find Evaluate CO2 HOT

(a) f^{-1} (b) f^2 (c) f^3 (d) f^4

27. Let A ={ 1, 2, 3, 4, 6, 8, 9, 12, 18, 24}be ordered by relation 'x divides y' show that relation be partial order relation and also draw Hasse diagram. Evaluate CO2 HOT

28. Let f: R → R be a function defined by f(x) = px + q ∀ x ∈ R. Also fof = I_R find the value of p and q. Evaluate CO2 HOT

Section: III (20 Marks)

29. (a) Consider the function f, g : R → R defined by $f(x) = x^2 + 3x + 1$, g(x) = 2x – 3 Evaluate CO2 HOT

Find the composition function (a) fof (b) fog (c) gof

(b) Consider a set A = {2, 3, 6, 12, 24, and 36}. Is the relation 'divides' a partial order? Draw its Hasse diagram. Evaluate CO2 HOT

30. (a) If R be a relation in the set of integers Z defined by R = {(x, y) : x, y ∈Z and x – y is divisible by 3} Evaluate CO2 HOT

(b) If f : A → B is one – to – one onto function, then (i) f^{-1}o f = I_A (ii) f o f^{-1} = I_B Evaluate CO2 HOT

UNIT-III

Section: I (5 Marks)

31. **Asimple graph is one that: CO3 Remember LOT**
(a) Has no loops or multiple edges (b) Has at least one loop (c) Has multiple edges only (d) Is directed

32. **The degree of a vertex in an undirected graph is: CO3 Remember LOT**
(a) The number of edges incident to it (b) The number of vertices adjacent to it (c) The number of self-loops (d) Both A and B

33. **In a complete graph with n vertices, the number of edges is: CO3 Remember LOT**
(a) n (b)n(n-1) (c) n(n−1)/2 (d) 2n

34. **A connected graph is one in which: CO3 Remember LOT**
(a) Every vertex is connected to at least one other vertex (b) There is a path between every pair of vertices (c) It has no edges (d) It has loops only

35. **A bipartite graph is a graph whose vertex set can be divided into two disjoint sets such that: CO3 Remember LOT**

(a) No two vertices in the same set are adjacent (b) All vertices are adjacent (c) Each vertex has a loop (d) None of these

36. **A tree is a connected graph that has: CO3 Remember LOT**
(a) Exactly one cycle (b) No cycles (c) Two or more cycles (d) Isolated vertices

37. A tree with n vertices has how many edges? CO3 Remember LOT
(a) n^2 (b) $n-1$ (c) $n+1$ (d) $2n-1$

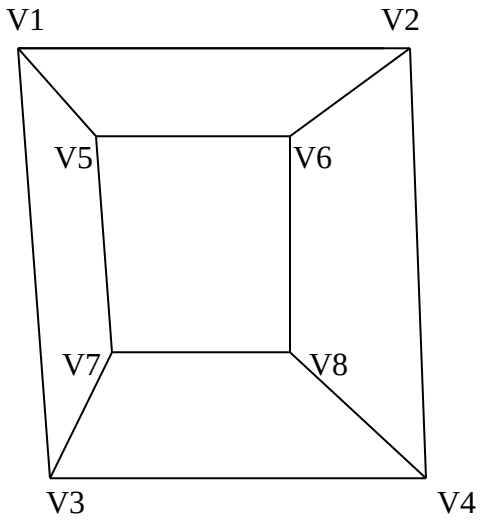
38. A **rooted tree** has: **CO3 Remember LOT**
(a) A special vertex called the root (b) No root (c) Two roots (d) Cycles

39. The **maximum number of nodes** in a binary tree of height h is: **CO3 Remember LOT**
(a) 2h (b) h^2 (c) $2^{h+1}-1$ (d) 2^h-1

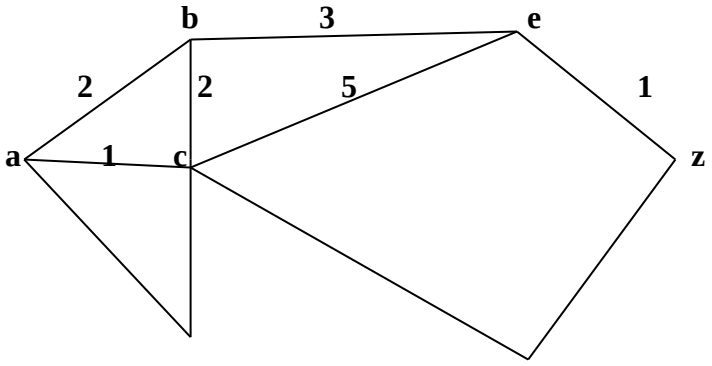
40. A **spanning tree** of a connected graph with n vertices has: **CO3 Remember LOT**
(a) n edges (b) n−1edges (c) n+1 edges (d) None of these

Section: II (10 Marks)

41. Show the given graph is bipartite graph or not. Evaluate CO3 HOT

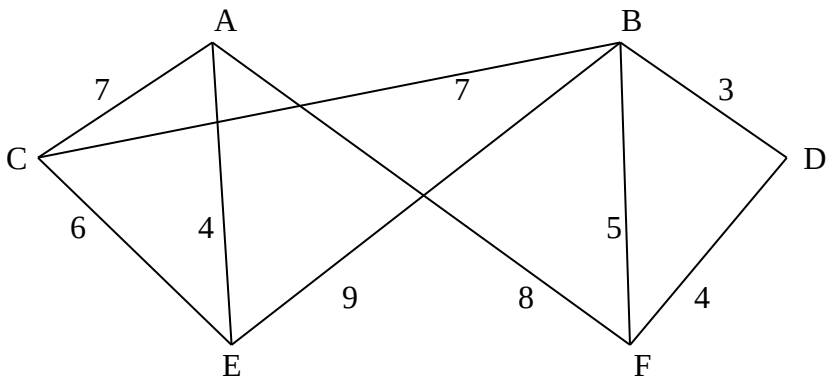


42. Find the shortest path between a to z in the graph shown in figure. Evaluate CO3 HOT



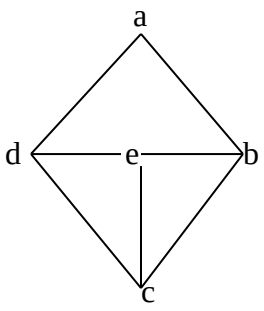
4 **2** **7** **3**

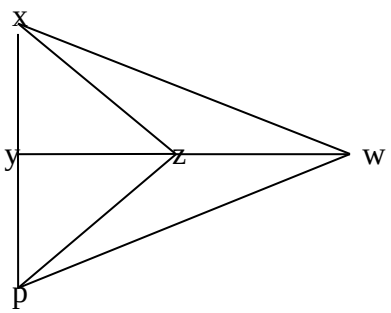
43. Find a minimum spanning tree of the labeled connected graph shown in figure CO3 Evaluate HOT



Section: III (20 Marks)

44. (a) Show that the given graph is isomorphic. Also write matrix form of both graph. Evaluate CO3 HOT

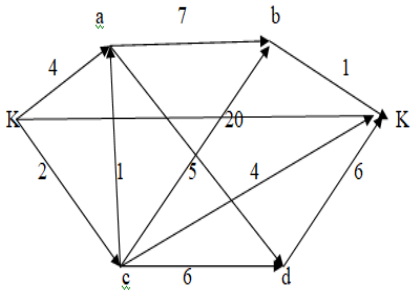




(b) Draw the graph of given matrix. CO3 Evaluate HOT

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \end{bmatrix}$$

45. (a) Find the shortest path between K and L in the graph shown in figure by using Dijkatra's Algorithm. CO3 Evaluate HOT



(b) Define incidence matrix representation and draw graph of given matrix . CO3 Evaluate HOT

$$A = \begin{bmatrix} 0 & 0 & 1 & -1 & 1 \\ -1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 \\ 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 0 \end{bmatrix}$$

UNIT-IV

Section: I (5 Marks)

46. A group (G, *) is said to be Abelian if **Remember CO4 LOT**

(a) It is finite (b) Every element is its own inverse (c) is commutative (d) It has an identity element

47. The identity element in a group is always **Remember CO4 LOT**

(a) Unique (b) May or may not exist (c) Infinite (d) Not unique

48. If (G, *) is a group, then for every a ∈ G, the inverse of a is **Understand CO4 LOT**

(a) a^2 (b) a (c) The element a^{-1} such that $a*a^{-1}=e$ (d) None of these

49. Which of the following is not a group under ordinary multiplication? **Remember CO4 LOT**

(a) Set of integers (b) Set of nonzero real numbers (c) Set of nonzero rational numbers (d) Set of nonzero complex numbers

50. The Boolean expression A+ $\bar{A}$B simplifies to **Understand CO4 LOT**

(a) A+B (b) A (c) B (d) 1

51. In Boolean algebra, the complement of A is denoted by **Remember CO4 LOT**

(a) –A (b) A^{-} (c) A′ D) Both B and C

52. The dual of the Boolean expression A+0=A is **Understand CO4 LOT**

(a) A·0=A (b) A·1=A (c) A+1=1 (d) A+0=0

53. The Boolean identity A+AB=A is known as **Remember CO4 LOT**

(a) Absorption law (b) Idempotent law (c) Associative law (d) Distributive law

54. The number of possible Boolean functions for two variables is **Understand CO4 LOT**

(a) 2 (b) 4 (c) 8 (d) 16

55. A+A^{-}B=? **Understand CO4 LOT**

(a) A+B (b) B (c) A (d) 1

Section: II (10 Marks)

56. Consider an algebraic system (G, *), where G is the set of all non – zero real number and * is a binary operation defined by a*b = ab/4. Show that (g, *) is an Abelian group. Evaluate CO4 HOT

57. Find the inverse of the permutation. Evaluate CO4 HOT

$$\begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 1 & 5 & 4 \end{pmatrix}$$

58. A, B, and C represent three switches in an on position and A', B' and C' represent the same three switches in an off position construct a switching circuit representing the Boolean expression (A + B) (A' + C) + B (B' + C).Using the laws of Boolean algebra, show that the above expression is equivalent to AC + B, and construct an equivalent switching circuit. Evaluate CO4 HOT

Section: III (20 Marks)

59. (a) Let G = {(a, b) | a, b ∈ R, a ≠ 0} Define a binary operation * on G by

(a, b)*(c, d) = (ac, b c + d) for all (a, b), (c, d) ∈ G, Show that (g, *) is a group. Evaluate CO4 HOT

(b) Show that the given matrices are multiplicative Abelian group. Evaluate CO4 HOT

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}, \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

60. (a) State and prove De-Morgan theorem with truth table. Evaluate CO4 HOT

(b) Explain Exclusive –OR and Exclusive –NOR gate with truth table and logic diagram. Evaluate CO4 HOT

CO Wise

CO	Q. No	Marks
CO1	1 to 15	80
CO2	16 to 30	80
CO3	31 to 45	80
CO4	46 to 60	80
Total		**320**

Unit Wise

Unit	Q. No	Marks
Unit 1	1 to 15	80
Unit 2	16 to 30	80
Unit 3	31 to 45	80
Unit 4	46 to 60	80
Unit 5		
Total		**320**

Blooms Taxonomy Level (BTL) Wise

BTL	Q. No	Marks
LOT	1 to 10, 16 to 25, 31 to 40, 46 to 55	40
HOT	11 to 15, 26 to 30, 41 to 45, 56 to 60	280
Total		**320**

Prepared By: Wakil Kumar

Disclaimer: - This is a Practice set for end semester exam.. The Question in End term examination will differ from the Practice set. This Practice set is meant for practice only.