25U112 (Pages: 2) Name : .....

Reg. No : .....

FIRST SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025

(FYUGP)

(Regular/Supplementary/Improvement)

CC24UMAT1MN104 - MATHEMATICAL LOGIC, SET THEORY AND COMBINATORICS

(Mathematics - Minor Course)

(2024 Admission onwards)

Time: 2.0 Hours Maximum: 70 Marks

Credit: 4

Part A (Short answer questions)

Answer ***all*** questions. Each question carries 3 marks.

1. State hypothetical syllogism , disjunctive syllogism and law of detachment in logical validation . [Level:1] [CO1]

2. Let $A = \{1, 2, 3, 4, 5\}$. Determine the truth value of each of the following statements: [Level:2] [CO1]
   1. $(\exists x \in A)(x + 3 = 10)$
   2. $(\exists x \in A)(x + 3 < 5)$
   3. $(\forall x \in A)(x + 3 < 10)$

3. Define complement of a set. Draw the set Venn diagram of the complement of a set A. [Level:2] [CO2]

4. Is the collection $\{\{a, \ldots, n\}, \{y, \ldots, z\}, \{0, 3\}, \{1, 2, 4, \ldots, 9\}\}$ is a partition of $\{a, \ldots, z, 0, \ldots, 9\}$. [Level:2] [CO2]

5. Define div function $g(x, y)$. [Level:1] [CO3]

6. Define an exponential function with base a. [Level:1] [CO3]

7. Define row matrix and column matrix. [Level:1] [CO4]

8. Find the probability of obtaining at least one head when three coin are tossed. [Level:2] [CO5]

9. A card is drawn at random from a standard deck of cards. Find the probability of obtaining: [Level:2] [CO5]
   1. A club or a diamond.
   2. A king or a queen.

10. An eight bit word is called a byte. Find the number of bytes with their second bit 0 or the third bit 1. [Level:2] [CO5]

(Ceiling: 24 Marks)

Part B (Paragraph questions/Problem)

Answer ***all*** questions. Each question carries 6 marks.

11. Let p be "It is cold" and let q be "It is raining". Give a verbal sentence which describes each of the following statements: [Level:3] [CO1]
    1. $\sim p$
    2. $p \wedge q$
    3. $p \vee q$
    4. $q \vee \sim p$

12. Show that the propositions $\sim (p \wedge q)$ and $\sim p \vee \sim q$ are logically equivalent. [Level:2] [CO1]

13. Rewrite each set using listing method: [Level:2] [CO2]
    1. The set of solutions of the equation $x^2 - 5x + 6 = 0$.
    2. The set of letters of the word GOOGOL.
    3. The set of months with exactly 31 days.

14. Define the infinite rays $(-\infty, a]$, $[a, \infty)$, $(-\infty, a)$and(a, ∞) in set builder form. [Level:2] [CO2]

15. With an example show that $range(f) \neq codomain(f)$. [Level:2] [CO3]

16. If$f(x) = 2x + 3$ and $g(x) = x^2 - 1$ find$(f + g)(x)$ and $(fg)(x)$. [Level:2] [CO3]

17. A committee consists of nine members. Find the number of subcommittees that can be formed of each size 2, 5, 6. [Level:3] [CO5]

18. (a) Find the number of ways ten beads can be arranged in a bangle. [Level:3] [CO5]
    (b) Prove that the cyclic permutations of n distinct items is $(n-1)!$.
    (c) Find the number of words that can be formed by scrambling the letters of the word WELFARE.

(Ceiling: 36 Marks)

Part C (Essay questions)

Answer any ***one*** question. The question carries 10 marks.

19. (a) Determine whether or not $p \vee (\sim p)$ is a tautology. [Level:2] [CO1]
    (b) Determine whether or not $p \vee \sim (p \wedge q)$ is a tautology.
    (c) Determine whether or not $(p \wedge q) \wedge \sim (p \vee q)$ is a contradiction.

20. Let A, B and C be three finite sets prove that [Level:2] [CO2]
    $|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |B \cap C| - |A \cap C| + |A \cap B \cap C|$.

(1 × 10 = 10 Marks)

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