

Reg No.: _____

Name: _____



Jyothi Engineering College(Autonomous)

B. Tech Degree S2 (R) Examination, May 2026(2025 Scheme)

25CST205 - DISCRETE MATHEMATICS

Total Mark: 60



AD, CS, CY

PART A

(Answer All Questions. Each question carries 3 marks)

1. Show that divisibility is a partial ordering on set of positive integers. CO4 (3)
2. Suppose that the relations R_1 and R_2 on a set A are represented by the matrices CO2 (3)
 $M_{R_1} = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$ and $M_{R_2} = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}$ what are the matrices representing $R_1 \cup R_2$ and $R_1 \cap R_2$. Is M_{R_1} reflexive or not ?
3. Let $Q(x)$ be the statement " $x + 1 > 2x$ " if the domain consists of all integers, what are the truth values of $\forall x Q(x)$ CO1 (3)
4. Construct a truth table for the compound proposition $(p \rightarrow q) \rightarrow (q \rightarrow p)$ CO1 (3)
5. Let f_n be the n^{th} Fibonacci number. Prove that $f_1 + f_3 + \dots + f_{2n-1} = f_{2n}$, n is a positive integer. CO5 (3)
6. Find the generating function for the sequence $1, 1, 1, 1, 1, 1, \dots$ CO5 (3)
7. Verify whether \mathbb{Z} (set of integers) is a group under subtraction. CO6 (3)
8. Let S_3 be the set of all permutations of 3 elements. Let $\sigma = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{pmatrix}$ and $\tau = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{pmatrix}$ be two permutations in S_3 . Find the compositions $\sigma\tau$ and $\tau\sigma$ and determine if permutation composition is commutative in this case. CO6 (3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module - 1

9. a) Answer these questions for the poset $(\{3, 5, 9, 15, 24, 45\}, /)$. CO2 (5)
 - a) Find the maximal elements.
 - b) Find the minimal elements.
 - c) Find all upper bounds of $\{3, 5\}$. If exist find the least upper bound of $\{3, 5\}$.
 - d) Find all lower bounds of $\{15, 45\}$.
- b) Prove the De Morgan law $\overline{A \cap B} = \overline{A} \cup \overline{B}$. CO2 (4)

OR

10. a) Show that set of positive rational number is countable. CO2 (5)
- b) Draw a Hasse diagram for $(D_{21}, /)$. CO4 (4)

Module - 2

11. a) Using a truth table, show that $((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$ is a tautology. CO1 (5)

- b) Show that at least 4 of any 22 days must fall on the same day of the week by using a proof of contradiction. CO1 (4)

OR

12. a) Show that the premises “A student in this class has not read the book,” and “Everyone in this class passed the first exam” imply the conclusion “Someone who passed the first exam has not read the book.” CO1 (5)
- b) Prove that the sum of rational numbers is rational. CO1 (4)

Module - 3

13. a) Find the solution of the recurrence relation $a_n = 3a_{n-1} + 2n$ with the initial condition $a_1 = 3$. CO5 (5)
- b) Find a recurrence relation for
- the number of ways to climb n stairs if the person climbing the stairs can take one stair or two stairs at a time.
 - What are the initial conditions and in how many ways can this person climb a flight of eight stairs?

OR

14. a) Find the solution to the recurrence relation $a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3}$ with the initial conditions $a_0 = 2, a_1 = 5, a_2 = 15$. CO5 (5)
- b) Use mathematical induction to prove that $n^3 - n$ is divisible by 3 whenever n is a positive integer. CO5 (4)

Module - 4

15. a) Find all subgroups of the cyclic group $(\mathbb{Z}_{12}, \oplus)$, where \oplus denotes addition modulo 12, and identify their generators. CO6 (5)
- b) Define group homomorphism. Let $f : (\mathbb{R}, +) \mapsto (\mathbb{R}^+, *)$ be defined by $f(x) = e^x$. Show that f is a group homomorphism. CO6 (4)

OR

16. a) Find all the distinct left cosets of $H = \{ 0, 4, 8 \}$ in $G = (\mathbb{Z}_{12}, \oplus)$, where \oplus denotes addition modulo 12. Are they same as right cosets? Also determine a partition of G . CO6 (5)
- b) Prove that a group G is abelian if and only if $(ab)^{-1} = a^{-1}b^{-1}, \forall a, b \in G$. CO6 (4)
