COMPUTER SCIENCE & ENGINEERING

QUESTION BANK

Course Title: DISCRETE MATHEMATICS
Course Code: 25CS301
Regulation: NR25

COURSE OBJECTIVES

- Introduces elementary discrete mathematics for Computer Science and Engineering.
- Covers formal logic notation, methods of proof, induction, sets, relations, graph theory, permutations and combinations, counting principles, recurrence relations and generating functions.

COURSE OUTCOMES

- **CO1:** Understand and construct precise mathematical proofs.
- **CO2:** Apply logic and set theory to formulate precise statements.
- **CO3:** Analyze and solve counting problems on finite and discrete structures.
- **CO4:** Describe and manipulate sequences.
- **CO5:** Apply graph theory in solving computing problems.

UNIT – IV

ELEMENTARY COMBINATORICS

Syllabus: Basics of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficient, Binomial and Multinomial Theorems, Principle of Inclusion–Exclusion.

PART – A

SHORT ANSWER QUESTIONS

S.No.	Questions	BT	CO	PO
1	How many different outfits can you create if you have 3 shirts and 2 pairs of pants?	L3	CO3	PO2
2	If 7 cars carry 26 passengers, prove that at least one car must have four or more passengers.	L3	CO3	PO2
3	Find the number of arrangements of the letters of **TALLAHASSEE** in which no two A's are adjacent.	L4	CO3	PO2
4	Find the number of positive integer solutions of the equation $x_1 + x_2 + x_3 = 17$.	L3	CO3	PO2
5	In how many ways can 20 identical books be placed on 5 different shelves?	L3	CO3	PO2
6	Find the number of distinct permutations of the letters of the word **MISSISSIPPI**.	L3	CO3	PO2
7	How many ways can the letters of **BANANA** be arranged if all the A's must be together?	L3	CO3	PO2
8	State the Generalized Pigeonhole Principle.	L1	CO3	PO1
9	State the Principle of Inclusion–Exclusion.	L1	CO3	PO1
10	State the Multinomial Theorem.	L1	CO3	PO1
11	Explain the difference between permutations and combinations with a suitable example.	L2	CO3	PO1
12	State the Binomial Theorem and write its general term.	L1	CO3	PO1
13	How many 5-digit numbers can be formed using the digits 1, 2, 3, 4, 5 and 6 without repetition?	L3	CO3	PO2
14	In how many ways can 6 people be seated around a circular table?	L3	CO3	PO2
15	Using the Pigeonhole Principle, show that among any 13 people, at least two were born in the same month.	L3	CO3	PO2
16	Find the coefficient of $x^5y^4z^3$ in the expansion of $(x + y + z)^{12}$.	L3	CO3	PO2

PART – B

LONG ANSWER QUESTIONS

S.No.	Questions	BT	CO	PO
17	A committee of 8 students is to be selected from a class consisting of 19 freshmen and 34 sophomores. (a) In how many ways can 3 freshmen and 5 sophomores be selected? (b) In how many ways can a committee with exactly 1 freshman be selected? (c) In how many ways can a committee with at most 1 freshman be selected?	L3	CO3	PO2
18	Find the coefficient of: (a) x^9y^3 in the expansion of $(x+2y)^{12}$; (b) x^5y^2 in the expansion of $(2x-3y)^7$.	L3	CO3	PO2
19	State and prove the Principle of Inclusion–Exclusion for two and three finite sets.	L2	CO3	PO1
20	Find the number of non-negative integer solutions of $x_1+x_2+x_3+x_4+x_5=30$, subject to x_2 being even and x_3 being odd.	L4	CO3	PO2
21	In how many ways can 10 identical marbles be distributed among 6 distinct containers? Explain the counting principle used.	L3	CO3	PO2
22	What is the number of ways of choosing 4 cards from a standard pack of 52 playing cards? Of these, find the number of ways in which: (a) all four cards are of the same suit, (b) the four cards belong to four different suits, and (c) two cards are red and two cards are black.	L4	CO3	PO2
23	How many distinct arrangements can be made using all the letters of the word **ENGINEERING**?	L3	CO3	PO2
24	Find the number of ways of selecting a committee of 5 from 8 men and 6 women if the committee must contain at least 2 women.	L4	CO3	PO2
25	Use the Principle of Inclusion–Exclusion to determine the number of integers from 1 to 100 that are divisible by 2, 3 or 5.	L4	CO3	PO2
26	How many 5-digit numbers can be formed from the digits 0, 1, 2, 3, 4 and 5 if repetition is allowed?	L3	CO3	PO2
27	Find the number of ways of arranging the letters of the word **TALLAHASSEE** such that no two A's are adjacent.	L4	CO3	PO2
28	Find the number of positive integer solutions of $x_1+x_2+x_3+x_4=20$.	L3	CO3	PO2
29	Find the coefficient of $x^4y^5z^3$ in the expansion of $(x+y+z)^{12}$ using the Multinomial Theorem.	L3	CO3	PO2

S.No.	Questions	BT	CO	PO
30	A group consists of 10 students. In how many ways can a captain, vice-captain and secretary be selected? Explain why the problem involves permutations rather than combinations.	L3	CO3	PO2
31	In how many ways can 8 people be seated in a row if two particular people must always sit together?	L4	CO3	PO2
32	In how many ways can 7 men and 5 women be arranged in a row if no two women are together?	L4	CO3	PO2
33	Find the number of ways of choosing 5 objects from 12 distinct objects if two particular objects cannot be selected together.	L4	CO3	PO2
34	Using the Generalized Pigeonhole Principle, prove that if 25 students are assigned to 6 classrooms, then at least one classroom contains at least 5 students.	L3	CO3	PO2
35	Find the number of distinct permutations of the letters of **MISSISSIPPI** and determine how many of them have all the S's together.	L4	CO3	PO2
36	Find the number of ways of distributing 12 identical objects among 5 distinct boxes when each box must contain at least one object.	L3	CO3	PO2

BLOOM'S TAXONOMY LEVELS

BT Level	Description
L1	Remember
L2	Understand
L3	Apply
L4	Analyze

CO–PO ALIGNMENT FOR UNIT-IV

CO3: Analyze and solve counting problems on finite and discrete structures.

PO1: Engineering knowledge – Apply mathematical and engineering knowledge to solve problems.

PO2: Problem analysis – Identify, formulate and analyze problems using appropriate mathematical principles.

Therefore, **Unit-IV questions are primarily mapped to CO3**, with major emphasis on **PO1 and PO2**.

UNIT-IV TOPIC-WISE COVERAGE

Unit-IV Topic	Question Numbers
Basics of Counting	1, 13, 15, 26, 30, 34
Permutations	6, 13, 14, 23, 30, 31, 32, 35
Combinations	4, 17, 22, 24, 28, 33
Repetitions	5, 6, 7, 21, 23, 35, 36
Constrained Repetitions	3, 7, 27, 31, 32, 33, 35
Pigeonhole Principle	2, 8, 15, 34
Binomial Coefficients	12, 18, 29
Binomial Theorem	12, 18
Multinomial Theorem	10, 29
Principle of Inclusion–Exclusion	9, 19, 25

TEXT BOOKS

1. **Discrete Mathematical Structures with Applications to Computer Science** – J. P. Tremblay and R. Manohar, McGraw-Hill, 1st Edition.
2. **Discrete Mathematics for Computer Scientists and Mathematicians** – Joe L. Mott, Abraham Kandel and Theodore P. Baker, Prentice Hall of India, 2nd Edition.

REFERENCE BOOKS

1. **Discrete and Combinatorial Mathematics – An Applied Introduction** – Ralph P. Grimaldi, Pearson Education, 5th Edition.
2. **Discrete Mathematical Structures** – Kolman, Busby and Ross, Tata McGraw-Hill.