

Semester II

Discrete Mathematics

Course Code	Teaching hours per week				Credits	Exam Hours	Course Type	CIE Marks	ESE Marks
	L	T	P	R					
26ANNPC201	2	1	0	0	3	2 Hrs. 30 Mins	Theory	40	60

1. **Preamble** : Discrete Mathematics forms the mathematical foundation for computer science and engineering. It introduces students to the study of mathematical structures that are algorithms, data structures, automata theory, database theory, cryptography and modern computational models.

2. **Prerequisites** : Nil

Syllabus

Module Number	Syllabus Description	Contact Hours
1	Sets – Basic concepts, subsets, power set, set operations, Venn diagrams, Cartesian product. Functions – Definition, domain, range, injective, surjective, bijective, inverse, composition. Relations – Representation, properties (reflexive, symmetric, transitive, antisymmetric), equivalence relations, partial orderings. Hasse diagrams – Visualization of partial orders (no algorithms).	8
2	Propositional Logic – Statements, connectives, truth tables, tautologies, contradictions, equivalence, implication. Predicate Logic – Predicates, quantifiers, simple quantified statements. Proof Techniques – Direct, Contraposition, Contradiction, counterexample, Mathematical induction - Simple applications of weak and strong induction.	10
3	Counting Principles – Sum and product rules, permutations and combinations, Pigeonhole principle. Principle of Inclusion-Exclusion (basic cases). Recurrence Relations – Simple linear recurrence relations with constant coefficients (first and second order). Generating Functions – Concept and use in solving simple recurrences.	9
4	Binary Operations – Closure, identity, inverse, associative and commutative properties. Semigroups and Monoids – Basic definitions and examples.	10

Module Number	Syllabus Description	Contact Hours
	Groups – Definition, elementary properties, subgroups, cyclic and permutation groups, Lagrange's theorem (statement only). Rings and Fields – Basic introduction and simple examples relevant to computing.	
Total hours		37

3. Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE) :

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE) :

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

4. Course Outcomes

At the end of the course students should be able to:

Course Outcomes		Blooms Taxonomy Level
CO1	Apply concepts of sets, relations, functions and logic to represent discrete mathematical structures relevant to computing.	K3

Course Outcomes		Blooms Taxonomy Level
CO2	Utilize logical reasoning, proof techniques and induction methods to validate propositions and mathematical arguments.	K3
CO3	Solve combinatorial and recurrence-based problems using counting principles, recurrence relations and generating functions.	K3
CO4	Illustrate the properties and applications of algebraic structures such as semigroups, monoids, groups, rings and fields in computing contexts.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

5. Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), - : No Correlation

6. Text Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Discrete Mathematics and Its Applications	Kenneth H. Rosen,	McGraw Hill,	8/e, 2019
2	Discrete and Combinatorial Mathematics	Ralph P. Grimaldi,	Pearson Education,	5/e, 2004
3	Discrete Mathematics with Applications	Thomas Koshy, D	Academic Press	1/e, 2004

7. Reference Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Discrete Mathematical Structures with Applications to Computer Science	Tremblay & Manohar,	McGraw Hill	1/e, 2003
2	Schaum's Outline of Discrete Mathematics	Seymour Lipschutz & Marc Lipson,	McGraw Hill	3/e, 2017

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
3	Discrete Mathematical Structures	Bernard Kolman, Robert C. Busby, Sharan Cutler Ross	Pearson Education	6/e, 2008
4	Discrete Mathematics	Richard Johnsonbaugh,	Pearson Education Asia	5/e, 2002

8. Video Links or any other Reference Materials

Sl No	Details Like Weblink, Publication Details	Module
1	https://ocw.mit.edu/courses/6-042j-mathematics-for-computer-science-fall-2010/	1
2	https://web.stanford.edu/class/archive/cs/cs103/cs103.1192/	2
3	https://ocw.mit.edu/courses/18-200b-principles-of-combinatorics-fall-2020/	3
4	https://nptel.ac.in/courses/111106131/	4

9. MODEL QUESTION PAPER

MODEL QUESTION PAPER			
FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY(FISAT) (Autonomous) SECOND SEMESTER B. TECH DEGREE EXAMINATION (2026 Scheme)			
Course Code: 26ANNPC201			
Course Name: Discrete Mathematics			
Programme : CSE/CSD			
Max. Marks: 60		Duration: 2 hours 30 minutes	
PART A			
<i>(Answer all questions. Each question carries 3 marks)</i>		CO	Marks
1	Let $X = \{1, 2, 3, 4\}$ and $f = \{(1, 2), (2, 3), (3, 4), (4, 1)\}$. Find f^2 , f^3 , and f^4 .	CO1	(3)
2	Draw the Hasse diagram representing the partial ordering “divides” on the set $\{1, 2, 3, 4, 6, 8, 12\}$.	CO1	(3)
3	Check whether the following statements are equivalent or not: $(p \Rightarrow q) \wedge (p \Rightarrow r) \Leftrightarrow p \Rightarrow (q \wedge r)$.	CO2	(3)
4	Represent the statement “All men are mortal, Socrates is a man, hence Socrates is mortal” in logical form and prove its validity.	CO2	(3)
5	Prove by induction that $n^3 + 2n$ is divisible by 3 for all $n \geq 1$.	CO3	(3)
6	Define recurrence relation. Give an example and solve $a_{n+1} = 2a_n + 1$, with $a_0=0$.	CO3	(3)

7	Define a group. Verify whether $(\mathbb{Z}_6, +_6)$ is an abelian group or not.	CO4	(3)
8	Define Lagrange's theorem and state its significance in group theory.	CO4	(3)
PART B			
<i>(Answer any one full question from each module, each question carries 9 marks)</i>			
Module - 1		CO	Marks
9	a) Let $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$ and define a relation R on A by xRy if $(x-y)$ is a multiple of 3. Verify whether R is an equivalence relation and determine the equivalence classes and partition of A .	CO1	(5)
	b) Let $X = \{2, 3, 6, 12, 24, 36\}$ and define $x \leq y$ if x divides y . Draw the Hasse diagram and find maximal and minimal elements.	CO1	(4)
10	a) Let $A = \{1, 2, 3, 4, 5\}$ and $B = \{2, 4, 6, 8, 10\}$. Define a function $f:A \rightarrow B$ by $f(x) = 2x$. Find the inverse of $f(x)$ and prove that $f(x)$ is bijective.	CO1	(5)
	b) Let $A = \{1, 2, 3, 4, 6, 12\}$ with the relation "divides". Draw the Hasse diagram for $(A, \text{divides})$, identify the maximal, minimal, greatest and least elements, and check whether it is a lattice.	CO1	(4)
Module - 2		CO	Marks
11	a) Show that $((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$ is a tautology using a truth table.	CO2	(5)
	b) Prove by contrapositive that "If x^2 is even, then x is even."	CO2	(4)
12	a) Using rules of inference, prove that from premises $p \rightarrow q, q \rightarrow r, \neg r$ one can conclude $\neg p$.	CO2	(5)
	b) Represent the English statements "All students are brilliant" and "Some students are not brilliant" in predicate logic using quantifiers, and write their negations in symbolic form.	CO2	(4)
Module - 3		CO	Marks
13	a) Use mathematical induction to prove that $1^2 + 2^2 + 3^2 + \dots + n^2 = n(n+1)(2n+1)/6$.	CO3	(5)
	b) Solve the recurrence relation $a_{n+2} - 4a_{n+1} + 4a_n = 2^n$, with $a_0=1, a_1=1$.	CO3	(4)
14	a) Prove by mathematical induction that $n(n+1)(n+2)(n+3)$ is divisible by 24 for all positive integers n .	CO3	(5)
	b) Solve the recurrence relation $a_{n+2} - 3a_{n+1} + 2a_n = 2^n$, with $a_0=3, a_1=6$.	CO3	(4)
Module - 4		CO	Marks
15	a) Prove that the set Q^* of all positive rational numbers forms an abelian group under the operation $a * b = ab/2$.	CO4	(4)

	b)	State and prove Lagrange's theorem. Illustrate with an example.	CO4	(5)
16	a)	Show that the set $G = \{1, -1, i, -i\}$ under multiplication forms a cyclic group. Find the order of each element and identify all generators.	CO4	(5)
	b)	Let $H = \{1, a^2\}$ be a subgroup of $G = \{1, a, a^2, a^3\}$ where $a^4 = 1$. Find all left cosets of H in G and verify Lagrange's theorem.	CO4	(4)

