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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

MCA

SEM: I - THEORY EXAMINATION (2025-2026)

Subject Discrete Mathematics

Time: 3 Hours

Max. Marks:100

General Instructions:**IMP:** Verify that you have received question paper with correct course, code, branch etc.

1. This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION – A

20

1. Attempt all parts:-

- 1-a. For $A = \{1,2,3\}$, $B = \{2,3,4\}$, find $A - B$.(CO1,K1) 1
- i. $\{1,4\}$
 - ii. $\{2,3\}$
 - iii. $\{1,2,3,4\}$
 - iv. $\{1\}$
- 1-b. If $f(x) = 2x+1$, find $f(3)$.(CO1,K1) 1
- i. 5
 - ii. 7
 - iii. 6
 - iv. 9
- 1-c. _____ is a poset with every pair of elements has both a least upper bound and a greatest lower bound. (CO2,K1) 1
- i. Lattice
 - ii. Walk
 - iii. Trail
 - iv. Sub-lattice
- 1-d. What is the number of edges present in a complete graph having n vertices? (CO2,K1) 1
- i. $\frac{n(n+1)}{2}$

- ii. $\frac{n(n-1)}{2}$
- iii. $2n$
- iv. n

- 1-e. A group is always a _____, _____ and _____.(CO3,K1) 1
- i. abelian group, semigroup, and algebraic structure
 - ii. monoid, semigroup, and algebraic structure
 - iii. monoid, semigroup, and abelian group
 - iv. monoid, abelian group, and algebraic structure
- 1-f. A permutation is:(CO3,K1) 1
- i. A combination
 - ii. A mapping of a set onto itself
 - iii. A subset
 - iv. A relation only
- 1-g. If $P \rightarrow Q$ and $Q \rightarrow R$ are true, which must be true?(CO4,K3) 1
- i. $P \rightarrow R$
 - ii. $R \rightarrow Q$
 - iii. $P \rightarrow Q$
 - iv. $\neg P \vee \neg R$
- 1-h. Quantifier \exists is called _____ quantifier.(CO4,K1) 1
- i. *Existential*
 - ii. Universal
 - iii. *Both*
 - iv. *None*
- 1-i. The order of the recurrence $a_n = a_{n-1} + a_{n-2}$ is:(CO5,K1) 1
- i. 3
 - ii. 2
 - iii. 1
 - iv. 0
- 1-j. Hypothesis test checks:(CO5,K1) 1
- i. *Sample averages*
 - ii. Population parameters using sample data
 - iii. *Time series data*
 - iv. Polynomial coefficients

2. Attempt all parts:-

- 2.a. Define relation and state properties of relations. (CO1,K1) 2
- 2.b. Define a graph and give a suitable example. (CO2,K1) 2
- 2.c. Define group and explain the properties of group.(CO3,K1) 2
- 2.d. Explain tautology and contradiction. Using a truth table, give one example that clearly shows a tautology and a contradiction.(CO4,K2) 2
- 2.e. Explain Pigeonhole principle. (CO5,K2) 2

SECTION – B

30

3. Attempt all parts:-

- 3.a. Answer any one of the following-

- 3-a.i If $A = \{3, 5, 7, 9, 11\}$, $B = \{7, 9, 11, 13\}$, $C = \{11, 13, 15\}$ (CO1,K2) Find $A \cap (B \cup C)$ and $B \cap (A \cup C)$ (CO1,K2) 6
- 3-a.ii In a survey of 60 people, it was found that 25 read Magazine A, 26 read B & 26 read C. 9 read both A & C, 11 read both A & B, 8 read both B & C and 8 read no magazine at all. Find the number of people: a) Who read all three magazines b) Who read exactly one magazine(CO1,K3) 6
- 3.b. Answer any one of the following-
- 3-b.i Define Partial order relation. Determine whether the poset (R, \leq) with $R = \{2, 4, 6, 8\}$ and \leq defined as the relation "divides" is a lattice.(CO2,K3) 6
- 3-b.ii Define Binary Tree and Tree Traversal. Differentiate BFS and DFS with an Example.(CO2,K3) 6
- 3.c. Answer any one of the following-
- 3-c.i Define Group. Show that the set $G = \{i, -i\}$ is a group with respect to multiplication.(CO3,K3) 6
- 3-c.ii Show that the union of two sub groups of a group G need not be a sub group of G .(CO3,K4) 6
- 3.d. Answer any one of the following-
- 3-d.i Prove that: $[(p \rightarrow q) \wedge (q \rightarrow r)] \rightarrow [p \rightarrow r]$ is a tautology.(CO4,K2) 6
- 3-d.ii The following table shows the percentage distribution of 720 students of a college according to their favourite subject: .(CO4,K3) 6
- | Favourite Subject | Mathematics | Physics | Chemistry | Biology | English | Others |
|-------------------|-------------|---------|-----------|---------|---------|--------|
| Percentage (%) | 30% | 20% | 15% | 15% | 12% | 8% |
- i. Calculate the central angle (in degrees) for each subject to draw a pie-chart.
ii. Which subject has the largest sector and which has the smallest sector in the pie-chart?
- 3.e. Answer any one of the following-
- 3-e.i Solve the recurrence relation $a_n + a_{n-1} - 6a_{n-2} = 0$, where $n \geq 0$ and $a_0 = 1$ and $a_1 = 2$.(CO5,K3) 6
- 3-e.ii (i) Find the number of ways to arrange the letters in the word "COMBINATORICS."(ii) Determine the number of ways to distribute 10 identical candies to 4 children.(CO5,K3) 6

SECTION – C

50

4. Answer any one of the following-

- 4-a. Define equivalence relation. On the set $\{1,2,3,4\}$ define a relation:(CO1,K3) 10

$$R = \{(1,1), (2,2), (3,3), (4,4), (1,2), (2,1)\}$$

1. Verify whether R is an equivalence relation.
2. List all equivalence classes.

- 4-b. Using mathematical induction to prove that: (CO1,K3) 10
(i) $1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$
(ii) $7^n - 1$ is divisible by 6, $\forall n \in \mathbb{N}$

5. Answer any one of the following-

- 5-a. Define Lattice and Complement Lattice. Consider the Lattice 10

$D_{30} = \{1, 2, 3, 4, 5, 6, 10, 15, 30\}$ under the order divisibility. a) Find the Complement of 2 and 10, if Exist. b) Find the Lower Bound and Upper Bound of D_{30} .(CO2,K4)

5-b. Explain BFS and DFS Traversal. Given the Inorder traversal: G D H B E A F C and the postorder Traversal: D H G E B F C A, Construct the Binary tree, Draw it neatly, and determine the Preorder Traversal.(CO2,K3) 10

6. Answer any one of the following-

6-a. Let $G = \{0, 1, 2, 3, 4, 5\}$ is a set, prove that G is an abelian group under operation $+_6$ (Additive Modulo 6).(CO3,K4) 10

6-b. State the trapezoidal rule and Simpson's 1/3 rule. Approximate the following integrals using the trapezoidal rule: (CO3,K3) 10

(i) $\int_{0.5}^1 x^4 dx$

7. Answer any one of the following-

7-a. (i) Prove that $p \leftrightarrow q$ is logical equivalent to $(p \wedge q) \vee (\neg p \wedge \neg q)$ 10

(ii) Symbolize the following statements:

(a) "All lions are fierce."

(b) "Some lions do not drink coffee."

(c) "Some fierce creatures do not drink coffee."(CO4,K3)

7-b. The following data gives the values of variables X and Y:(CO4,K3) 10

X	:	2	4	6	8	10
Y	:	5	7	9	10	13

(i) Find the regression equation of Y on X.

(ii) Find the regression equation of X on Y.

8. Answer any one of the following-

8-a. Define Recurrence relation and types of recurrence relation. Solve the solution of the recurrence relation $a_n = -3a_{n-1} - 3a_{n-2} - a_{n-3}$ with $a_0=1, a_1=-2$ and $a_2=-1$?(CO5,K3) 10

8-b. Define Counting principle. There are 5 engineers, 4 advocates and 6 doctors in an organization. In how many ways can a committee of 4 members be formed from these people? In how many ways can a committee of 4 members be formed containing 2 engineer and 2 doctors? In how many ways can a committee of 3 members be formed containing exactly 2 advocates?(CO5,K3) 10