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**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**  
(An Autonomous Institute Affiliated to AKTU, Lucknow)

**B.Tech**

**SEM: I - THEORY EXAMINATION (2025 - 2026)**

**Subject: Discrete Mathematics**

**Time: 3 Hours**

**Max. Marks: 100**

**General Instructions:**

**IMP:** Verify that you have received the question paper with the 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**

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1. Attempt all parts:-

- 1-a. \_\_\_\_\_ is used to implement the Boolean functions. (CO1, K1) 1
- (a) Logical notations
- (b) Arithmetic logics
- (c) Logic gates
- (d) Expressions
- 1-b. Minimization of function  $F(A,B,C) = A*B*(B+C)$  is \_\_\_\_\_ (CO1, K1) 1
- (a) AC
- (b) B+C
- (c) B`
- (d) AB
- 1-c. The monoid is a? (CO2, K1) 1
- (a) a non-abelian group
- (b) groupoid
- (c) A group
- (d) a commutative group
- 1-d. Which of the following two sets are equal? (CO2, K1) 1
- (a)  $A = \{1, 2\}$  and  $B = \{1\}$
- (b)  $A = \{1, 2\}$  and  $B = \{1, 2, 3\}$
- (c)  $A = \{1, 2, 3\}$  and  $B = \{2, 1, 3\}$
- (d)  $A = \{1, 2, 4\}$  and  $B = \{1, 2, 3\}$
- 1-e. If an event can occur in 'm' different ways, following which another event can 1

occur in 'n' different ways, then the total numbers of occurrence of the events in the given order is \_\_\_\_\_ (CO3, K1)

- (a)  $m+n$
- (b)  $m-n$
- (c)  $m*n$
- (d)  $m/n$

1-f. A drawer contains 12 red and 12 blue socks, all unmatched. A person takes socks out at random in the dark. How many socks must he take out to be sure that he has at least two blue socks? (CO3, K1) 1

- (a) 18
- (b) 35
- (c) 28
- (d) 14

1-g. The maximum degree of any vertex in a simple graph with n vertices is (CO4, K1) 1

- (a)  $n-1$
- (b)  $n+1$
- (c)  $2n-1$
- (d)  $n$

1-h. A graph G is called a ..... if it is a connected acyclic graph (CO4, K1) 1

- (a) Cyclic graph
- (b) Regular graph
- (c) Tree
- (d) Not a graph

1-i. In a disjunction, even if one of the statements is false, the whole disjunction is still... (CO5, K1) 1

- (a) FALSE
- (b) Negated
- (c) TRUE
- (d) Both true and false

1-j. Let P: We should be honest., Q: We should be dedicated., R: We should be overconfident. Then 'We should be honest or dedicated but not overconfident.' is best represented by? (CO5, K1) 1

- (a)  $\sim P \vee \sim Q \vee R$
- (b)  $P \wedge \sim Q \wedge R$
- (c)  $P \vee Q \wedge R$
- (d)  $P \vee Q \wedge \sim R$

2. Attempt all parts:-

2.a. Find the complement of the following Boolean expression:  $xy'+x'z$ . (CO1, K2) 2

2.b. Define power set. (CO2, K2) 2

2.c. What do you mean by recurrence relation? (CO3, K2) 2

2.d. What is in-degree and out-degree in a vertex? (CO4, K2) 2

2.e. Define Predicate. (CO5, K1) 2

**SECTION-B** 30

3. Attempt all parts:-

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

3.a.(i) Find K-map and simplify the expression:  $AB'+A'B+A'B'$ . (CO1, K3) 6

3.a.(ii) Explain AND gate with the help of truth table and diagram. (CO1, K2) 6

3.b. Answer any one of the following:-

3.b.(i) Let  $A=\{2,3,5\}$  and  $B=\{6,8,10\}$  and define a binary relation R from A to B as follows:  $\forall (x,y) \in A \times B, (x,y) \in R \Leftrightarrow x/y$  (x divides y). Write each R and  $R^{-1}$  as a set of ordered pairs. (CO2, K3) 6

3.b.(ii) Give an example of a relation that is both symmetric and antisymmetric. (CO2, K2) 6

3.c. Answer any one of the following:-

3.c.(i) What is 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  $a_2=-1$ ? (CO3, K3) 6

3.c.(ii) Show that  $1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}, n \geq 1$  by mathematical induction. (CO3, K3) 6

3.d. Answer any one of the following:-

3.d.(i) Define Hamiltonian graph with suitable example. (CO4, K2) 6

3.d.(ii) Form a binary search tree for the data 16,24,7,5,8,20,40,3 in the given order. (CO4, K2) 6

3.e. Answer any one of the following:-

3.e.(i) Write the negation of each of the following statements: (CO5, K3) 6

a) He swims if and only if the water is warm.

b) This computer program is correct if and only if, it produces the correct answer for all possible sets of input data.

3.e.(ii) Show that contrapositives are logically equivalent; that is  $\sim q \Rightarrow \sim p \equiv p \Rightarrow q$ . (CO5, K3) 6

**SECTION-C** 50

4. Answer any one of the following:-

4-a. Use Karnaugh map to simplify the followings:  $X=A'B'C'+A'B'C+A'BC+A'BC'+AB'C+ABC$ . (CO1, K3) 10

4-b. Simplify the expression using K-maps:  $F(A,B,C) = \pi(0,2,4,5,7)$ . (CO1, K3) 10

5. Answer any one of the following:-

5-a. Give an example of a set which is closed under certain binary operation but a subset of it may not be closed under the same operation. (CO2, K3) 10

5-b. Show that  $G=\{1,\omega,\omega^2\}$  is a group under multiplication,  $\omega$  being the cube root of unity. (CO2, K3) 10

6. Answer any one of the following:-

6-a. Solve the following recurrence relation:  $a_{n+2} - 4a_{n+1} + 4a_n = n \cdot 2^n$ . (CO3, K3) 10

6-b. In how many ways 5 boys and 4 girls can be seated at a round table if (CO3, K3) 10

- a) there is no restriction
- b) all the four girls sit together
- c) all the four girls do not sit together
- d) no two girls sit together.

7. Answer any one of the following:-

- 7-a. Construct a binary tree from the given two Travels (CO4, K3) 10  
 In order 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11  
 Post order 1, 4, 3, 2, 6, 8, 9, 11, 10, 7, 5
- 7-b. What is DFS with respect to graph theory? What is the application of DFS? (CO4, K3) 10

8. Answer any one of the following:-

- 8-a. Show that  $p \leftrightarrow q \equiv p \vee q \Rightarrow p \wedge q$ , using (CO5, K3) 10  
 a) Truth table  
 b) algebra of propositions.
- 8-b. Prove that the following propositions are tautology (CO5, K3) 10  
 a)  $p \vee \sim p$   
 b)  $\sim(p \wedge q) \vee q$   
 c)  $p \Rightarrow (p \vee q)$

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