NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: II - THEORY EXAMINATION (20..... - 20.....)
Subject: Discrete Structures

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   20

1. Attempt all parts:-

1-a.   A _____ is an ordered collection of objects. (CO1,K1)   1

    (a)   Relation

    (b)   Function

    (c)   Set

    (d)   Proposition

1-b.   A relation R from a set A to a set B is a: (CO1,K2)   1

    (a)   Subset of $A \cup B$

    (b)   Subset of $A \cap B$

    (c)   Subset of $A \times B$

    (d)   Subset of $B \times A$

1-c.   A semigroup is an algebraic structure $(S, *)$ where $*$ is a binary operation that is: (CO2, K2)   1

    (a)   Closed

    (b)   Associative

    (c)   Both closed and associative

    (d)   Closed, associative, and has an identity element

1-d.   In a Boolean algebra, which of the following is the identity element for the $\wedge$ operation? (CO2, K1)   1

    (a)   0

(b)   1

(c)   a

(d)   a′

1-e.   A partially ordered set (poset) is a set with a binary relation that is: (CO3,K2)   1

    (a)   Reflexive and symmetric

    (b)   Reflexive and transitive

    (c)   Reflexive, antisymmetric, and transitive

    (d)   Symmetric and transitive

1-f.   In a lattice, which of the following is always true? (CO3, K4)   1

    (a) $a \lor a = a$ (Idempotent Law for join)

    (b) $a \land a = a$ (Idempotent Law for meet)

    (c) $a \lor b = b \lor a$ (Commutative Law for join)

    (d)   All of the above

1-g.   Let P: I am in Delhi.; Q: Delhi is clean.; then $q \land p$ (q and p) is? (CO4, K3)   1

    (a)   Delhi is clean and I am in Delhi

    (b)   Delhi is not clean or I am in Delhi

    (c)   I am in Delhi and Delhi is not clean

    (d)   Delhi is clean but I am in Mumbai

1-h.   Which of the following is NOT a valid propositional operator? (CO4, K2)   1

    (a)   AND

    (b)   OR

    (c)   NOT

    (d)   SOMETIMES

1-i.   Which matrix is used to represent adjacency between vertices? (CO5, K1)   1

    (a)   Adjacency matrix

    (b)   Incidence matrix

    (c)   Path matrix

    (d)   Distance matrix

1-j.   If a graph has a chromatic number of 1, it must be: (CO5, K4)   1

    (a)   Null graph

    (b)   Complete

    (c)   Empty (no edges)

    (d)   Tree

2. Attempt all parts:-

2.a.   Explain the difference between ordered and unordered pairs. Why is the order important in the Cartesian product of sets? (CO1, K2)   2

2.b.   State the defining property of a commutative binary operation $*$ on a set S.   2

(CO2, K1)

2.c.	Explain the following terms with appropriate examples: (CO3, K2) i) Homomorphism ii) Cyclic Group iii) Group	2
2.d.	Differentiate between *Modus Ponens* and *Modus Tollens*? Provide an example to distinguish between the two. (CO4, K4)	2
2.e.	How is the number of edges calculated in a complete graph and a regular graph? (CO5, K3)	2

SECTION-B 30

3. Answer any <u>five</u> of the following:-

3-a.	Consider the sets A={1,2,3} and B={a,b}. (CO1, K3) (a) Find the Cartesian product A×B. (b) Determine the power set of A, denoted by P(A). (c) Define a relation R from A to B such that R={(x,y)│x∈A,y∈B,and x+1 corresponds to the position of y in the alphabet} List the elements of R.	6
3-b.	Define the following types of relations: (CO1, K3) 1. Reflexive 2. Symmetric 3. Asymmetric 4. Antisymmetric	6
3-c.	(i) Explain why the identity element in a group is always unique. (CO2, K4) ii) Explain why the inverse of each element in a (G,*) is unique.	6
3-d.	Consider the group ({0,1,2,3}, +₄) under addition modulo 4. Find whether it satisfies the Commutative property or not. (CO2, K3)	6
3.e.	Given a set A={2,3,4,5,6,10,12,24} with the 'divides' relation (│): (CO3, K3) 1. Draw the Hasse diagram of the poset (A,│). 2. Identify all minimal and maximal elements, 3. Determine if there is a greatest and a least element in this poset.	6
3.f.	State the difference between tautology, contradiction, and contingency (CO4, K4) 1. Provide one example each 2. Construct truth tables to justify your examples.	6
3.g.	Let G=(V,E) be an undirected, simple graph with │V│=6 and the degree sequence (3,3,2,2,2,2). (CO5, K4) (a)Draw a graph corresponding to this degree sequence (b) Is the graph complete graph or not? Justify your answer (c) Is the graph Eulerian? Explain why or why not	6

SECTION-C 50

4. Answer any <u>one</u> of the following:-

4-a.	Given a set A and a relation R on A. Discuss the properties that R must satisfy for	10

its transitive closure R+ to be equal to its reflexive transitive closure R∗. Provide an example of a relation where R+=R∗ and an example where R+=R∗. (CO1, K3)

4-b.	What is a Venn Diagram? Explain set operations using Venn Diagrams. Draw a Venn Diagram for a group of 65 people includes 40 who like cricket, and 10 who like both tennis and cricket. (CO1, K3)	10

5. Answer any <u>one</u> of the following:-

5-a.	Consider the group ({1,2,3,4,5,6} +7), of addition modulo 7. (CO2, K3) (a) Determine whether it forms a group. (b) Explain addition modulo and multiplication modulo with suitable examples.	10
5-b.	Consider the poset ({2,3,4,6,12,18,36},|), where | denotes the divisibility relation. (CO2, K4) • Draw the Hasse diagram for this poset. • Identify all maximal and minimal elements. • Determine if this poset is a lattice. Justify your answer.	10

6. Answer any <u>one</u> of the following:-

6-a.	Draw the Hasse diagram of power set P=(P({a,b,c}),⊆). (CO3, K4) (a). Is this poset a lattice? Justify your answer. (b). Provide an example from the above hasse diagram of supremum and/or an infimum.	10
6-b.	Prove Idempotent law and Associative law in lattice , including the join (∨) and meet (∧) operations with a help of an example. Also describe Distributive lattice and Bounded lattice with a help of an example. (CO3, K4)	10

7. Answer any <u>one</u> of the following:-

7-a.	Convert the following compound propositions into CNF: (a) (p → q) ∧ (q ∨ (p ∧ r)) (b) p ∧ (p → q) (CO4, K4)	10
7-b.	Define all laws in propositional logic algebra and prove any four using truth tables. (CO4, K4)	10

8. Answer any <u>one</u> of the following:-

8-a.	Illustrate Graph coloring and chromatic number with a help of an example. Give an example of a graph with chromatic number 2 and one with chromatic number 3. Also prove that every complete graph is a regular graph but every regular graph is not complete graph. (CO5, K4)	10
8-b.	What are planar and non-planar graph. Explain with a help of an example. Determine whether 5 vertices graph is planer or not. Illustrate with a help of an example. (CO5, K3)	10