Printed Page:- **Subject Code:- BCSEH0204**
Roll. No:

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

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

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

(d) All of the above

1-g. Let P: I am in Delhi.; Q: Delhi is clean.; then $q \wedge p$ (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

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(CO2, K1)

2.c. Explain the following terms with appropriate examples: (CO3, K2) 2

i) Homomorphism

ii) Cyclic Group

iii) Group

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

<u>SECTION-B</u> 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) 6

(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.

3-b. Define the following types of relations: (CO1, K3) 6

1. Reflexive 2. Symmetric

3. Asymmetric 4. Antisymmetric

3-c. (i) Explain why the identity element in a group is always unique. (CO2, K4) 6

ii) Explain why the inverse of each element in a (G,*) is unique.

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) 6

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.

3.f. State the difference between tautology, contradiction, and contingency (CO4, K4) 6

1. Provide one example each
2. Construct truth tables to justify your examples.

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) 6

(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

<u>SECTION-C</u> 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) **10**
(a) Determine whether it forms a group.
(b) Explain addition modulo and multiplication modulo with suitable examples.

5-b. Consider the poset ({2,3,4,6,12,18,36},∣), where ∣ denotes the divisibility relation. (CO2, K4) **10**

- Draw the Hasse diagram for this poset.
- Identify all maximal and minimal elements.
- Determine if this poset is a lattice. Justify your answer.

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) **10**
(a). Is this poset a lattice? Justify your answer.
(b). Provide an example from the above hasse diagram of supremum and/or an infimum.

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) $(p \rightarrow q) \wedge (q \vee (p \wedge r))$ (b) $p \wedge (p \rightarrow q)$ (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**

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