PRANVEER SINGH INSTITUTE OF TECHNOLOGY, KANPUR

Odd Semester Session 2022-23 CT - II

B. Tech. III Semester

## Discrete Structures & Theory of Logic (KCS-303)

| CO Number | Course Outcome (Please include all COs of your Course here) |
|---|---|
| CO1 | Define[1.Remember] various discrete structures, basic properties of lattices, modern algebra, graphs & trees, can count using advanced counting computing techniques like generating functions and recurrence relation so that they can study the problems |
| CO2 | Discuss [2.Understand] the basic concepts of sets, various relations & functions, modern algebra and express the arrangements of basic elements of circuits using Boolean algebra. |
| CO3 | Employ [3.Apply] their logical ability such as reasoning, logical deduction and examine the correctness of algorithms, setup mathematical model real life problem by applying advanced counting/computing techniques like generating functions and recurrence relations which in turn will increase their problem solving approach as well as their programming skills. |

Time: 1.5 Hrs. M. M. 15

### Section A

**Q1. Attempt all questions:** **(1X3 = 3 Marks)**

a) Define domain and co-domain with example. CO1

b) Define modular lattice with example. CO1

c) Write short note on growth of functions. CO1

### Section B

**Q2. Attempt all questions:** **(2X4 = 8 Marks)**

a i) Prove that $n^3 + 2n$ is divisible by 3 using principle of mathematical induction, where n is natural number. CO2

**Or**

ii) Define a Boolean function of degree n. Simplify the following Boolean expression using Karnaugh maps $xyz + xy'z + x'y'z + x'yz + x'y'z'$. CO2

b i) The following relation on A = {1, 2, 3, 4}. Determine whether the following: CO2

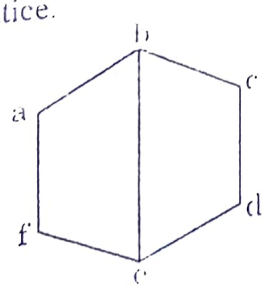
a. R = {(1, 3), (3, 1), (1, 1), (1, 2), (3, 3), (4, 4)}

b. R = A × A

Is a Partial Order Relation or not?

**Or**

ii) Calculate the complement of 'c' and prove that the given lattice is bounded complemented lattice. CO2



c i) If $f : A \rightarrow B$, $g : B \rightarrow C$ are invertible functions, then show that $g \circ f : A \rightarrow C$ is invertible and $(g \circ f)^{-1} = (f)^{-1} o (g)^{-1}$. CO2

**Or**

ii) Discuss that in any lattice the following distributive inequality holds CO2

a. $a \wedge (b \vee c) \geq (a \wedge b) \vee (a \wedge c)$

b. $a \vee (b \wedge c) \leq (a \vee b) \wedge (a \vee c)$

d i) For any positive integer $D_{36}$, then examine whether $(D_{36}, '|')$ is lattice or not? CO3

**Or**

ii) Prove that $\forall$ a, b $\in$ B CO3

a. $(a + b)(a + b)' = a'.b'$ b. $(a.b)' = a' + b'$

## Section C

**(4X1 = 4 Marks)**

Q3

i) Determine whether each of these functions is a bijective from R to R. CO3

a. $f(x) = x^2 + 9$ b. $f(x) = (x^2 + 1)/(x^2 + 2)$

**Or**

ii) Construct the Hasse diagram of [P (a, b, c), $\supset$] (Note: '$\supset$' stands for super set). Find greatest element, least element, minimal element and maximal element. CO3