



- (f) Let  $R$  be a relation on the set of positive real numbers so that its graphical representation consists of points in the first quadrant of the cartesian plane. What can you expect if  $R$  is (i) reflexive (ii) symmetric, and (iii) transitive ?

2 Attempt any **four** parts of the following : 5×4

- (a) If for each  $a$  and  $b$  in group  $G$ ,  $(ab)^2 = a^2b^2$  show that  $G$  is abelian.
- (b) Show that the composition of two congruence relations on a set is not necessarily a congruence relation.
- (c) Show that the set  $N$  of natural numbers is a semigroup under the operation  $x * y = \max(x \cdot y)$ . Is it a monoid ?
- (d) Prove that any infinite cyclic group is isomorphic to the group  $\langle \mathbb{Z}, + \rangle$  integers.
- (e) Determine all values of  $x$  from the given field which satisfies the given equation :
- (i)  $x + 1 = -1$  over  $\mathbb{Z}_2, \mathbb{Z}_3, \mathbb{Z}_5$  and  $\mathbb{Z}_7$ .
- (ii)  $2x + 1 = 2$  over  $\mathbb{Z}_3$  and  $\mathbb{Z}_5$
- (iii)  $5x + 1 = 2$  over  $\mathbb{Z}_5$
- (f) Explain Boolean ring with suitable examples.

3 Attempt any **two** parts of the following : 10×2

- (a) Show that if  $(L, \subset, \cup, \cap)$  is a lattice then  $(L, \supseteq, \cap, \cup)$  is also a lattice. Also show that cartesian product of two lattices is a lattice.
- (b) Use K-map to find simplified form of Boolean expression :

$$f(x_1, x_2, x_3, x_4) = \bar{x}_1 \bar{x}_2 x_3 x_4 +$$

$$x_1 x_2 x_3 \bar{x}_4 + \bar{x}_1 x_2 x_3 x_4 +$$

$$\bar{x}_1 x_2 x_3 \bar{x}_4 + x_1 x_2 \bar{x}_3 \bar{x}_4 + \bar{x}_1 \bar{x}_2 x_3 x_4 +$$

$$x_1 \bar{x}_2 \bar{x}_3 x_4 + x_1 \bar{x}_2 x_3 \bar{x}_4$$

- (c) Define Tree. Describe different traversal algorithms for a binary tree.

4 Attempt any **two** of the following parts : 10×2

- (a) (i) Construct the truth table for the formulas :
- (1)  $\neg(P \wedge Q) \Leftrightarrow (\neg P \vee \neg Q)$
- (2)  $((P \rightarrow Q) \vee R) \vee (P \rightarrow Q \rightarrow R)$
- (ii) Give the recursive definition of well formed formulas. Write in symbolic form the statement.

"The crop will be destroyed if there is a flood."

