

Q-1 (a) Attempt any two.

10

- (1) Draw truth table of $(R \rightarrow Q) \wedge (\neg P \leftrightarrow (Q \vee (R \rightarrow P)))$.
- (2) Using theory of inference show the following:
$$x(p(x) \vee q(x)) \Rightarrow xp(x) \vee (\exists x)q(x).$$
- (3) Draw truth table of $r \rightarrow \{(q \rightarrow p) \wedge (\neg p \vee \neg q)\}$.

(b) Attempt any four.

04

- (1) Construct truth table of $p \vee q$.
- (2) Write contrapositive of the statement "If you work hard then you get good marks."
- (3) Write negation of the statement "Vrushabh likes everyone and Pritesh likes everyone therefore none likes Pritesh and Vrushabh."
- (4) Write in a symbolic form: Every differentiable function is continuous.
- (5) Define: predicate logic.

Q-2 (a) Attempt any two.

10

- (1) Prove that converse of a partially ordered relation is also a partially ordered relation.
- (2) For any sets A, B and C with $A \cup B = A \cup C$ and $A \cap B = A \cap C$, prove that $B = C$.
- (3) If A and B are any sets then prove that $B - A = B \cap A'$.

(b) Attempt any four.

04

- (1) Define: Upper bound.
- (2) Define: Maximal bound.
- (3) Define: Least element.
- (4) Define: Poset.

(5) Define: Totally ordered set.

Q-3 (a) Attempt any one.

10

- (1) Prove that $(P(X), \leq)$ is a lattice. Where $P(X)$ is the set of all subsets of any set X and \leq means set inclusion relation.
- (2) Prove that intersection of two equivalence relations is also an equivalence relation.

(b) Attempt all.

04

- (1) consider (S_{30}, \leq) , where S_{30} is the set of all positive divisors of 30 And \leq means divisibility relation. Is $A = \{1, 2, 4, 6\}$ a sublattice of S_{30} ?
- (2) Draw Hasse diagram of S_{90} and S_{45} .

Q-4 (a) Attempt any two.

10

(1) Use K-map to minimize the following Boolean function

$$f(x, y, z, w) = \sum m(0, 1, 2, 3, 7, 9, 11, 12, 13, 14)$$

- (2) Show that there does not exist a Boolean algebra of order 3.
- (3) In a complemented distributive lattice, prove that if $a * b = a * c$ And $a \oplus b = a \oplus c$, then $b = c$.

(b) Attempt any four.

04

- (1) Define Boolean algebra.
- (2) Define associative property of lattice.
- (3) Find complement of each element in (D_{45}, \leq) . Where D_{45} is the Set of all positive divisors of 45 and \leq means divisibility relation.
- (4) Define complement of an element.
- (5) Write both De' Morgan laws for lattice.

Q-5 (a) Attempt any one.

10

- (1) Prove that $(Z_5, +_5)$ is a group.
- (2) Prove that (S_3, \circ) is a group.

(b) Attempt any two.

04

- (1) Calculate the order of each element in $(Z_3, +_3)$.
- (2) Define subgroup.
- (3) Define Lagrange's theorem for group.