

2. Answer any eight from the following questions

2×8 = 16

- (a) Give definition of equal sets with examples.
- (b) Prove that $A \cap (A' \cup B) = A \cap B$.
- (c) Write different properties of relation in a set.
- (d) Let $A = \{-2, -1, 1, 2\}$.
A function $f : A \rightarrow R$ is defined as $f(x) = x^2$. Find the range of f .
- (e) Write two possible negation of the statement "All Scientists are men".
- (f) Distinguish between conjunction and disjunction.
- (g) Verify whether $P \vee (\sim P)$ is a tautology.
- (h) Examine validity of the arguments
 $P \rightarrow Q, Q \rightarrow R \vdash P \rightarrow R$
- (i) Write all the properties of a ring.
- (j) Show that Z is not a group under the operation $*$ defined by
 $a * b = a - b \forall a, b \in G$.

3. Answer any five from the following questions:

4×5 = 20

- (a) Out of 120 students, 70 play cricket, 60 play football, 25 play hockey, 30 play both cricket and football, 22 play both cricket and hockey, 17 play both football and hockey and 12 play all the three games. How many students donot play any one of the three games?
- (b) Prove that if R be an equivalence relation in a set A , then R^{-1} is also an equivalence relation in A .
- (c) Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be given by $f(x) = x^2 + 1$ and $g : \mathbb{R} \rightarrow \mathbb{R}$ be given by $g(x) = x + 3$. Calculate $(f \circ g)(2)$ and $(g \circ f)(2)$.
- (d) What do you mean by a conditional statement $A \rightarrow B$. Write down the converse and the inverse of the statement "If a number is divisible by 9, then it is divisible by 3".
- (e) Construct the truth table for $P \rightarrow (Q \rightarrow R)$.
- (f) If a student is getting admission in 5 different Engineering colleges and 4 different Medical colleges, find the number of ways of choosing one of the above colleges?
- (g) Prove that a commutative ring with unity is an integral domain if and only if cancellation laws hold in it.

4. Answer any two from the following questions

- (a) A bag contains 5 black and 6 white balls. Determine the number of ways in which 2 black and 3 white balls can be selected.
- (b) Find inverse matrix using elementary row operations of the following.

$$\begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}$$

(c) Write down the converse and the contrapositive of the following implications :

- (i) "If x is prime number, then x is odd"
 "If two lines are parallel,
 then they do not intersect in the same plane".

- (ii) Let P : she is tall
 Q : she is beautiful

Write the following statements in sentences :

$$P \wedge Q$$

$$\sim P \wedge \sim Q$$

$$P \wedge (\sim Q)$$

$$\sim(\sim P \vee \sim Q)$$

5. Answer any two from the following questions:

10×2 = 20

- (a) What do you mean by transpose of a matrix? Write all the important properties of transpose of matrices.

$$\text{If } A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}, B = \begin{pmatrix} 5 & 6 & -1 \\ 7 & 8 & 1 \end{pmatrix}$$

Then find out $B' A'$.

- (b) Prove that the system of equations $AX = B$ has a unique solution if $|A| \neq 0$, i.e.; A is a non-singular matrix.

Solve by Cramer's rule :

$$2x - y + 3z = 9$$

$$2x + 2y + 2z = 12$$

$$x - y + z = 2$$

- (c) In how many ways players for a cricket team can be selected from a group of 25 players containing 10 batsmen, 8 bowlers, 5 all-rounders and 2 wicket-keepers? Assume that the team require 5 batsmen, 3 all-rounders, 2 bowlers and 1 wicket keeper.