Class 11 Mathematics – Chapter: Mathematical Reasoning

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1. Introduction

- Mathematical reasoning is the process of using logic and facts to arrive at conclusions.
- It forms the foundation for all mathematical proofs and problem solving.

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2. Statements

- A statement is a sentence that is either true or false, but not both.
- Example:
  - "2 + 3 = 5" (True)
  - "7 is an even number" (False)

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3. Types of Statements

- **Atomic statement:** Simple statement, cannot be broken further.

- **Compound statement:** Formed by combining two or more statements using connectives.

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4. Logical Connectives

- **Negation (¬p\neg p¬p):** Opposite of the statement ppp.
- **Conjunction (p qp\wedge qpq):** True if both ppp and qqq are true.
- **Disjunction (p qp\vee qpq):** True if at least one of ppp or qqq is true.
- **Implication (p qp\to qpq):** If ppp then qqq. False only if ppp true and qqq false.
- **Biconditional (p qp\leftrightarrow qpq):** True if ppp and qqq have same truth value.

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5. Truth Tables

- Used to determine the truth value of compound statements.
- Lists all possible truth values of components and the resulting truth value.

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6. Tautology and Contradiction

- **Tautology:** Always true statement regardless of truth values of components.
- **Contradiction:** Always false statement.

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7. Implications and Equivalences

- p→qp\to qp→q is equivalent to ¬p∨q\neg p \vee q¬p∨q.
- Two statements are **logically equivalent** if they have the same truth table.

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8. Quantifiers (Basic Introduction)

- **Universal Quantifier (∀\forall∀)**: “For all”
- **Existential Quantifier (∃\exists∃)**: “There exists”

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9. Applications

- Used in proofs, algorithms, computer science, and logic puzzles.

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10. Exam Tips

- Practice constructing truth tables.
- Understand the meaning of connectives and implications.
- Know how to write and negate statements.
- Familiarize yourself with logical equivalences.