MANIPAL UNIVERSITY JAIPUR
(University under Section 2(f) of the UGC Act)

B.TECH SECOND YEAR

ACADEMIC YEAR: 2020-2021

COURSE NAME: ENGINEERING MATHEMATICS-III

COURSE CODE : MA 2101

LECTURE SERIES NO : 33 (THIRTY THREE)

CREDITS : 3

MODE OF DELIVERY : ONLINE (POWER POINT PRESENTATION)

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MANIPAL UNIVERSITY JAIPUR

VISION

Global Leadership in Higher Education and Human Development

MISSION

- Be the most preferred University for innovative and interdisciplinary learning
- Foster academic, research and professional excellence in all domains
- Transform young minds into competent professionals with good human values

VALUES

Integrity, Transparency, Quality,
Team Work, Execution with Passion, Humane Touch

SESSION OUTCOME

" TO UNDERSTAND THE CONCEPT OF ODE AND THEIR APPLICATIONS AND SOLVE THE PROBLEM"

ASSESSMENT CRITERIA'S

ASSIGNMENT

QUIZ

MID TERM EXAMINATION –I & II
END TERM EXAMINATION

PROGRAM OUTCOMES MAPPING WITH CO1

[PO1]

ENGINEERING KNOWLEDGE: APPLY THE KNOWLEDGE OF MATHEMATICS, SCIENCE, ENGINEERING FUNDAMENTALS, AND AN ENGINEERING SPECIALIZATION TO THE SOLUTION OF COMPLEX ENGINEERING PROBLEMS.

Algebraic Structures

- **Algebraic systems Examples and general properties**
- **Semi groups**
- **Monoids**
- Groups
- Subgroups

Algebraic systems

- $N = \{1,2,3,4,\ldots..\infty\}$ = **Set of all-natural numbers.**

  $Z = \{0, \pm 1, \pm 2, \pm 3, \pm 4, \ldots.. \infty\}$ = **Set of all integers.**

  Q = Set of all rational numbers.

  R = Set of all real numbers.

- **Binary Operation:** The binary operator * is said to be a binary operation (closed operation) on a nonempty set A, if

  $a * b \in A$ for all $a, b \in A$ (Closure property).

  Ex: The set N is closed with respect to addition and multiplication but not w.r.t subtraction and division.

- **Algebraic System:** A set 'A' with one or more binary(closed) operations defined on it is called an algebraic system.

  Ex: $(N, +)$, $(Z, +, -)$, $(R, +, \cdot, -)$ are algebraic systems.

Properties

- **Commutative:** Let $*$ be a binary operation on a set A. The operation $*$ is said to be commutative in A if

  $a * b = b * a$ for all a, b in A

- **Associativity:** Let $*$ be a binary operation on a set A. The operation $*$ is said to be associative in A if

  $(a * b) * c = a * (b * c)$ for all a, b, c in A

- **Identity:** For an algebraic system (A, *), an element 'e' in A is said to be an identity element of A if

  $$a * e = e * a = a \quad \text{for all } a \in A.$$

Properties

- **Note:** For an algebraic system (A, *), the identity element, if exists, is unique.

- **Inverse:** Let (A, *) be an algebraic system with identity ‘e’. Let a be an element in A. An element b is said to be inverse of A if

$$a * b = b * a = e$$

Semi group

- **Semi Group:** An algebraic system (A, *) is said to be a semi group if
  1. * is closed operation on A.
  2. * is an associative operation, for all a, b, c in A.
- **Ex.** (N, +) is a semi group.
- **Ex.** (N, .) is a semi group.
- **Ex.** (N, –) is not a semi group.

Monoid

- **Monoid:** An algebraic system (A, *) is said to be a **monoid** if the following conditions are satisfied.
  1) $*$ is a closed operation in A.
  2) $*$ is an associative operation in A.
  3) There is an identity in A.

Monoid

- **Ex.** Show that the set 'N' is a monoid with respect to multiplication.

- **Solution:** Here, N = {1,2,3,4,……}

1. **Closure property:** We know that product of two natural numbers is again a natural number.

i.e., $a.b = b.a \quad$ for all $a,b \in N$

$\therefore$ Multiplication is a closed operation.

Monoid

2. Associativity: Multiplication of natural numbers is associative.

i.e., $(a.b).c = a.(b.c)$ for all $a,b,c \in N$

3. Identity: We have, $1 \in N$ such that

$a.1 = 1.a = a$ for all $a \in N$.

$\therefore$ Identity element exists, and 1 is the identity element.

Hence, N is a monoid with respect to multiplication.

Subsemigroup & submonoid

Sub semigroup: Let (S, *) be a semigroup and let T be a subset of S. If T is closed under operation * , then (T, *) is called a sub semigroup of (S, *).

Ex: (N, .) is semigroup and T is set of multiples of positive integer m then (T,.) is a sub semigroup.

Sub monoid: Let (S, *) be a monoid with identity e, and let T be a non-empty subset of S. If T is closed under the operation * and $e \in T$, then (T, *) is called a sub monoid of (S, *).

THANK YOU

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