2 Introduction to Automata Theory, Formal Languages and Computation

- **Substring:** A substring of a string is defined as a string formed by taking any number of symbols of the string.

  Example: For the string $w = 012$, the substrings are $\lambda, 0, 1, 2, 01, 12,$ and 012

1.2 Basics of Set Theory

A set is a well-defined collection of objects. The objects used for constructing a set are called elements or the members of the set.
A set has some features as follows:

- A set is a collection of objects. This collection is regarded as a single entity.
- A set is comprised of distinct elements. If an clement, say "a',is in set S, then it is denoted as a $\in$ S.
- A set has a well-defined boundary. If S is a set and 'a' is any element, then depending on the properties of 'a',it can be said whether a € S ora¢ S.
- A sct is characterized by its property. In general, if p is the defined property for the elements of S,then Sis denoted as S = {a : a has the property p}

Example:

- The set of all integers is denoted as S = fa: a is an integer Here, 7 $\in$ S but 1/7 $\notin$ S
- The set of all odd numbers denoted as S = {a; a is not divisible by 23 Here, 7 $\in$ S but 8 $\notin$ S
- The set of prime numbers less than 100 is denoted as S = { a: a is prime and less than 100 ? Here, 23 $\in$ S but 98 or 101 $\notin$ S

1.2.1 Subset Let there be two sets S and S_1 S_1 is said to be a subset of S if every element S, is an element of S.Symbolically,it is denoted as $S_i \subset S$
The reverse of a subset is the superset.In the previous example,S is the superset of S_1
Example:

- Let Z be the set of all integers.E is the set of all even numbers. All even numbers are natural numbers.So,it can be denoted as $E \subset Z$.
- Let S be the set of the numbers divisible by 6, where T is the set of numbers divisible by 2.Property says that if a number is divisible by 6, it must be divisible by 2 and 3. So,it can be denoted as S $\subset$ T.

1.2.2 Finite and Infinite Set A set is said to be finite if it contains no element or a finite number of elements.Otherwise,it is an infinite set.
Example:

- Let S be the set of one digit integers greater than 1, S is finite as its number of elements is 8.
- Let P be the set of all prime numbers.T is infinite,as the number of prime numbers is infinite.