

UNIT 2

KINEMATICS

All the laws of nature are written in the language of mathematics– Galileo

LEARNING OBJECTIVES

In this unit, the student is exposed to

- different types of motions (linear, rotation and oscillation)
- the necessity for reference frames to explain the motion of objects
- the meaning of vectors, scalars and their properties
- the role of scalar and vector products in physics
- the basics of differentiation and integration
- the notions of displacement and distance and their variation with time
- the notions of speed, velocity, acceleration and their graphs.
- the notion of relative velocity
- kinematic equations of motion for constant acceleration
- analysis of various types of motion of objects under gravitational force
- radians and degrees
- uniform circular motion, centripetal acceleration and centripetal force.



2.1

INTRODUCTION

Physics is basically an experimental science and rests on two pillars–Experiments and mathematics. Two thousand three hundred years ago the Greek librarian Eratosthenes measured the radius of the Earth. The size of the atom was measured much later, only in the beginning of the 20th century. The central aspect in physics is motion. Motion is found at all levels–from microscopic level (within the atom) to macroscopic and galactic level (planetary system and beyond). In short the entire Universe is governed by various types of motion. The study of various types

of motion is expressed using the language of mathematics.

How do objects move? How fast or slow do they move? For example, when ten athletes run in a race, all of them do not run in the same manner. Their performance cannot be qualitatively recorded by usage of words like ‘fastest’, ‘faster’, ‘average’, ‘slower’ or ‘slowest’. It has to be quantified. Quantifying means assigning numbers to each athlete’s motion. Comparing these numbers one can analyse how fast or slow each athlete runs when compared to others. In this unit, the basic mathematics needed for analyzing motion in terms of its direction and magnitude is covered.