

# UNIT 3

## LAWS OF MOTION

*“In the beginning there was a mechanics” – Von Laue*



### LEARNING OBJECTIVES

**In this unit, the student is exposed to**

- Newton's laws
- logical connection between laws of Newton
- free body diagram and related problems
- law of conservation of momentum
- role of frictional forces
- centripetal and centrifugal forces
- origin of centrifugal force



### 3.1

#### INTRODUCTION

Each and every object in the universe interacts with every other object. The cool breeze interacts with the tree. The tree interacts with the Earth. In fact, all species interact with nature. But, what is the difference between a human's interaction with nature and that of an animal's. Human's interaction has one extra quality. We not only interact with nature but also try to understand and explain natural phenomena scientifically.

In the history of mankind, the most curiosity driven scientific question asked was about motion of objects–‘How things move?’ and ‘Why things move?’ Surprisingly, these simple questions have paved the way for development from early civilization to the modern technological era of the 21<sup>st</sup> century.

Objects move because something pushes or pulls them. For example, if a book is at rest, it will not move unless a force is applied on it. In other words, to move an object a force must be applied on it. About 2500 years ago, the famous philosopher, Aristotle, said that ‘*Force causes motion*’. This statement is based on common sense. But any scientific answer cannot be based on common sense. It must be endorsed with quantitative experimental proof.

In the 15<sup>th</sup> century, Galileo challenged Aristotle's idea by doing a series of experiments. He said force is not required to maintain motion.

Galileo demonstrated his own idea using the following simple experiment. When a ball rolls from the top of an inclined plane to its bottom, after reaching the ground it moves some distance and continues