

UNIT 6

GRAVITATION

“The most remarkable discovery in all of astronomy is that the stars are made up of atoms of same kind as those in the Earth” – Richard Feynman



LEARNING OBJECTIVES

In this unit, the student is exposed to

- Kepler’s laws for planetary motion
- Newton’s law of gravitation
- connection between Kepler’s laws and law of gravitation
- calculation of gravitational field and potential
- calculation of variation of acceleration due to gravity
- calculation of escape speed and energy of satellites
- concept of weightlessness
- advantage of heliocentric system over geocentric system
- measurement of the radius of Earth using Eratosthenes method
- recent developments in gravitation and astrophysics



6.1

INTRODUCTION

We are amazed looking at the glittering sky; we wonder how the Sun rises in the East and sets in the West, why there are comets or why stars twinkle. The sky has been an object of curiosity for human beings from time immemorial. We have always wondered about the motion of stars, the Moon, and the planets. From Aristotle to Stephen Hawking, great minds have tried to understand the movement of celestial objects in space and what causes their motion.

The ‘Theory of Gravitation’ was developed by Newton in the late 17th century to explain the motion of celestial

objects and terrestrial objects and answer most of the queries raised. In spite of the study of gravitation and its effect on celestial objects, spanning last three centuries, “gravitation” is still one of the active areas of research in physics today. In 2017, the Nobel Prize in Physics was given for the detection of ‘Gravitational waves’ which was theoretically predicted by Albert Einstein in the year 1915. Understanding planetary motion, the formation of stars and galaxies, and recently massive objects like black holes and their life cycle have remained the focus of study for the past few centuries in physics.

Geocentric Model of Solar System

In the second century, Claudius Ptolemy, a famous Greco-Roman astronomer,