MECHANICS - Why?

Mechanics has been an integral part of human civilization. Ever since lighting fire, hunting tools, and start of cultivation, evolutions of mechanics took place intuitively and has grown with human observation and experience. It is starting point of learning of Physics, meaning 'Knowledge of nature'; a word coined from Greek language and involves study of matter, energy and their interaction. In depth study of mechanics is essential for every student, irrespective of discipline. Laws of mechanics find manifestation right from physiology of plants, animals, human, sociology and extends into advanced physics from atomic to cosmic scale. Correlation of mechanics with the other branches shall also be made appropriately, to establish the relevance of mechanics.

As one proceeds with application of concepts of physics, it may be considered as an extensive subject. But, with the grooming of ability to integrate these concepts it becomes so intuitive that one can feel a set of laws, with different combinations, coming into play in any physical observation or problem. This is precisely the reason to integrate complete mechanics into one chapter. Nevertheless, understanding of individual principles of mechanics shall have to be done with assumptions to exclude principles extraneous to it. However, as the journey into mechanics proceeds, integration of concepts studied earlier is done and it is intrinsic to the philosophy of this manual. Proficiency in physics depends upon one's ability to visualize given problems with the known laws of physics, and to correctly translate them into a mathematical statement or a set of such statements.

This chapter would start with understanding of dimensions, units, measurements, time and motion, force, work and energy, circular and rotational motion, gravitation, fluid behaviour, mechanical properties of matter, and Simple Harmonic Motion (SHM). The SHM forms a foundation to the study of energy and its propagation.

Readers are advised not to limit joy of learning of the subject to the study of this manual only. The joy should find extension in solving problems, of different types, so as to gain proficiency, accuracy and speed, essential, both for mentoring and success in competition.

Accordingly, illustration of each topic is made along with typical problems from selected and world class books viz. Concepts of Physics, Part-I by H.C. Verma; S.L. Loney's books – a) Elements of Statics & Dynamics, Part I& II, b) c) An Elementary Treatise on Statics, An Elementary Treatise of Dynamics of Particles and Rigid Bodies; Physics Part I, by Robert Resnick and David Helliday and Problems in Physics by I.E. Irodov. and other sources.

History of Mechanics: A brief historical account is considered to be essential so that students and mentors of science are able to appreciate contemporary knowledge of mathematics and science is a gift to us out of tireless and gruesome quest of human race and researchers. It is believed that this would incite a sense of Personal Social Responsibility (PSR) among students to continue with the quest for making living on this planet sustainable.

In Indian mythology, during the **Vedic era**, competence in astronomy viz-a-viz astrology, Fire arms, Air/Space aviation etc. is available in scriptures. However, in recorded history of science, **Socrates, Plato and Aristotle**, Greek philosophers during 4th to 5th Century BC, are considered to be first set of scientific philosophers. Later, **Nicolaus Copernicus**, an astronomer from Poland, in early sixteenth century, was first to propound the concept of a heliocentric solar system, in which the sun, rather than the earth, is the centre of the solar system. A century after him, **Galileo**, an Italian astronomer, physicist, engineer, philosopher, developed telescope to make observations to establish validity of the proposition that earth revolves around the Sun and not the vice-versa. His contributions have earned him titles of "father of observational astronomy", "father of modern physics", and the "father of science". In early Seventeenth century **Johannes Kepler**, a German mathematician and astronomer, propounded three Laws of Planetary Motion which formed basis of Laws of Gravitation discovered by **Sir Isaac Newton**. The latter was an English Physicist and Mathematician and in his book "Mathematical Principles of Natural Philosophy", first published in 1687, he laid foundation of classical mechanics through Laws of Motion. Later, Albert Einstein through his Theory of Relativity in 1905 revolutionized dimension of understanding matter and energy. There have been numerous contributions by various scientists to mature the understanding of mechanics but, the quest is still on for a unified theory to address laws of nature.

The journey of mechanics, which grows into Physics in particular and Science in general, can be rationalized into - a) observation of facts, b) measurement of variables, c) visualization of interdependencies of variables, d) mathematical formulation of problem and e) verification results through its reproducibility. ***In case results of any analysis do not conform to the observations, there are only Two possibilities; either known laws have not been applied correctly, or the problem is in a domain beyond boundaries of known laws. It is a cross road to think beyond the existing knowledge.***

Dimensions in physics form independent variables without having any projection on other variables; it is different from the dimensions referred to in Coordinate Geometry. Accordingly, Dimensional analysis forms is taken as starting point of learning of physics, which would take course through measurement of primary dimensions, accuracy, mechanics to other topics of the subject in separate chapters.

Conclusions: This Mentor's Manual being developed by SUBODH FOUNDATION is a free web resource and is available at our website, which is aimed at enhancing the learning of mathematics and science. Your valuable suggestions on this prologue to make this upcoming chapter more purposeful, to Contact Us, are welcomed in tune with the sense of Personal Social Responsibility (PSR) of elite readers.