

Unit -I : Inadequacy of Classical Theories

Abstract

The goal of the first unit is to recall and briefly discuss the need for quantum theory.

Goals

For this unit the goals are have a full understanding of the following statements.

- Physical theories such as mechanics, thermodynamics, electromagnetic theory as they existed before advent of quantum mechanics turned out to be inadequate to describe many physical phenomena. Therefore, a new theory was needed. It evolved during late nineteenth century and early twentieth century.
- This new theory, called quantum theory, did not consist of small changes in the existing (classical) theories. It was a major revolution. It brought in new mathematics into Physics. several physical concepts needed major revision or complete overhaul, new concepts were brought in. The domain of validity of the old theories, the classical theories, was restricted. A new theory, Quantum Theory, emerged which explained physical phenomena in the atomic domain.
- Quantum theory, will not be presented as some kind of smooth transition from classical theories, because it was not. *It will be presented here as a complete break away theory. So what is the best way to introduce such a theory.*

A few areas where problems with classical theories surfaced are listed below.

1. Black body radiation
2. Photoelectric effect
3. Bohr model of H atom
4.(complete the list)

You may follow older books on quantum mechanics and modern physics, published before and around sixties.

Tasks for you:

1. There were several facts which pointed to inadequacy of classical theories. Some others helped in development and still others confirmed the ideas of quantum theory in early days. This list of these facts is long and one of the

first things that comes to mind is "Black Body Radiation". Compile a list of other similar milestones in development of quantum theory. Write a sentence or two about each item and include dates for each item.

2. Select an item of your choice from the above list, learn about it in detail and summarize important points in a maximum of one A4 size sheet (two sides). Be as precise as you can, include references you have consulted and used. Write in your own language. This should explain the role played by the development? For example, was it an unexplained problem for classical theory? Or was it a confirmation of new idea? or something else?

General Instructions:

Ask as many questions on the "GOALS" and try to find answers from your own sources.

Keep posting at suitable stages. Indicate when you are ready with this unit of learning. \\[1mm]

This will be followed by detailed stock taking of your efforts.

References:

1. Mani. H.S. and G.K. Mehta, " Modern Physics",
2. Aurthur Beiser, "Concepts of Modern Physics", Sixth Edition, McGraw Hill Publishers, (2003)
3. Bernstein J., Fishbane Paul M. and Gasiorowicz Stepehn" Modern Physics", Pearson Education
4. Taylor John R., Zafiratos Chris D., and Dubson Michael. A., " Modern Physics for Scientist and Engineers"
5. Pearson Education 2004.

NextToDoList :

Questions/ Discussions on important experimental and theoretical issues which

- required break from classical theories, or
- were formulated to explain experimental facts, or
- confirmed new ideas.