UNIT-I QUANTUM PHYSICS & SOLIDS

QUANTUM PHYSICS

1.Introduction to quantum physics

2.Blackbody radiation

3.Laws of Blackbody Radiation

(i)Stefan-Boltzmann la

(ii)Wien's law

(iii)Rayleigh-Jeans law

(iv)Planck's radiation law

4.Photoelectric effect

5.Davisson & Germer experiment

6.Heisenberg uncertainty principle

7.Born interpretation of the wave function

8.Time independent Schrödinger's wave equation

9.Particle in 1-D box

SOLIDS

10.Symmetry in solids

11.Free electron theory (Drude-Lorentz, Sommerfeld)

12.Fermi-Dirac distribution

13.Bloch’s theorem

14.Kronig Penney model

15.E-K diagram

16.Effective mass of electron

17.Origin of energy bands

18.Classification of solids

QUANTUM PHYSICS

1.1.INTRODUCTION TO QUANTUM PHYSICS

- The basic aim of physics is to understand the natural phenomena around us.

Classical Physics:

The 19th century witnessed a rapid growth in physics. Newtonian mechanics, Maxwell's EM theory, and thermodynamics came to be known as classical physics.

- Classical physics deals with the motion of macroscopic particles. The three laws of conservation, namely conservation of linear momentum, angular momentum, and energy, formed the basis for classical physics.
- Classical physics/mechanics failed to explain the motion of microscopic particles.

Quantum Physics:

In the 20th century, several fundamental discoveries were reported which could not be explained by classical physics.

- The limitations of classical physics became apparent when it failed to explain the phenomenon of blackbody radiation.
- To explain blackbody radiation, Max Planck put forward a revolutionary hypothesis that the molecules in a source emit energy not continuously but in small discrete packets called quanta.

- Quantum physics, a new framework based on Planck's work, successfully describes the behavior of matter and radiation at the atomic level.
- Einstein utilized Planck's concept of quantized radiation energy (hv) to provide a successful explanation for the photoelectric effect.
- In 1926, Max Born introduced the probability interpretation of the wave function. The wave nature of microparticles was experimentally confirmed in 1927 through electron diffraction experiments conducted in multiple laboratories simultaneously. Also in 1927, Heisenberg formulated the uncertainty principle.
- Experimental evidence demonstrated the inadequacy of classical concepts in the microscopic realm, where quantum concepts offered accurate explanations for atoms and subatomic particles.
- The particle nature of radiation can be observed in photoelectric effect and Compton effect.
- The wave nature of radiation can be observed in the Davisson & Germer experiment and G.P.Thomson experiment.