UNIT-5

5. Modern Physics

Laser (Light Amplification by Stimulated Emission of Radiation): A device that emits coherent, monochromatic, and highly directional light.

5.1.2 Absorption and Emission

Absorption: Electron absorbs energy and jumps to a higher energy level.

5.1.3 Laser Principle

Population Inversion: More electrons in excited state than ground state (achieved by pumping).

5.1.4 Characteristics of Laser Beam

Coherence: Waves are in-phase (temporal and spatial).

5.2 Applications of Laser

Cutting/Welding: Precision machining of metals.

5.2.2 Medical Applications

Surgery: Laser eye surgery (LASIK).

5.3 Optical Fibre

Total Internal Reflection (TIR): Light reflects entirely at the core-cladding interface.

5.3.2 Parts of Optical Fiber

Core: Central glass strand (high refractive index, $$ n_1 $$).

5.3.3 Types of Optical Fiber

Single-Mode Fiber: Thin core (810 m), carries one light mode (long-distance communication).

5.3.4 Applications of Optical Fibre

Telecommunications: High-speed internet (5G networks).

5.4 Introduction to Nanotechnology

Definition: Materials with at least one dimension between 1100 nm.

5.4.2 Types of Nanomaterials

0D: Nanoparticles (e.g., gold nanoparticles).

5.4.3 Properties at Nano Scale

Surface Area: $$ \text{Surface-to-Volume Ratio} \propto \frac{1}{r} $$ (increases as size decreases).

5.4.4 Applications of Nanotechnology

Electronics: Smaller, faster transistors.

Field

Healthcare

Environment