Laser generation refers to the process of producing coherent light through stimulated emission. It involves several key components and principles:

1.1 Basic Principles of Laser Generation

- **Stimulated Emission**: When an excited electron in an atom or molecule drops to a lower energy level, it emits a photon. If this photon stimulates another excited electron, it results in the emission of another identical photon.
- **Population Inversion**: More electrons must be in the excited state than in the lower energy state to allow amplification of light.
- **Optical Cavity**: Mirrors at both ends of the gain medium reflect light back and forth, amplifying it before it exits through a partially transparent mirror.

1.2 Components of a Laser System

- **Gain Medium**: The material that amplifies the light (e.g., gases, semiconductors, crystals).
- **Energy Source (Pump Source)**: Provides energy to excite atoms in the gain medium (e.g., electrical discharge, flash lamps, diodes).
- **Optical Resonator**: Two mirrors (one fully reflective and one partially reflective) that help amplify and direct the light.

1.3 Laser Generation Applications

- **Industrial**: Cutting, welding, engraving.
- **Medical**: Laser surgery, skin treatments.
- **Military**: Laser weapons, targeting systems.
- **Communication**: Optical fiber communication.
- **Scientific Research**: Spectroscopy, particle acceleration.

2. How Lasers Work – Step-by-Step Process

(A) Energy Absorption (Pumping)

- External energy (electrical, optical, or chemical) excites electrons in the gain medium.
- Electrons move to a higher energy level.

(B) Spontaneous Emission

- Excited electrons naturally return to a lower energy state, emitting photons.
- These photons have random phases and directions.

(C) Stimulated Emission

- If an emitted photon interacts with another excited electron, it stimulates the emission of an identical photon (same wavelength, phase, and direction).
- This results in **coherent light**.

(D) Optical Resonator & Amplification

- The gain medium is placed between two mirrors:
  - **High Reflector** (fully reflective)
  - **Output Coupler** (partially reflective)
- Light bounces back and forth, amplifying through stimulated emission.
- A portion of the light escapes through the output coupler, forming the laser beam.