LECTURE - 10 : Laser physics

Components of laser device.

- We obtain amplification of light using principle of stimulated emission.
- stimulated emission produces completely coherent source of light. On superimposition, in turn produces highly intense beam.
- The components of laser are:

(a) The pump - an external source that supplies energy, helps in obtaining population inversion.
  - Excitations may occur directly or by atom - atom collision
  - Life time of metastable state should be a lot higher than the usual life-time of an excited state.

(b) The laser medium - It is the material where the laser action is made to take place.
  - Can be solid, liquid or gas.
  - eg - ruby, He-Ne, CO_2, Nd-YAG.
  - Wavelength may extend from UV to infrared.
  - Most important requirement for material is that we should be able to achieve population inversion.

- According to Boltzmann cond^n, N_1 — E_1
N_2 — E_2

$$\frac{N_2}{N_1} = e^{-h\nu/k_BT}$$

where $h\nu = E_2 - E_1$. Usually $N_2 < N_1$ so, pumping is required.

- So only certain pairs of energy levels with appropiate lifetimes can be inverteted.

(c) The resonator - consists of a pair of plane or spherical mirros having the same principle axis.

- Reflection coefficient of one mirror is 1 (one), while that of the other is less than one. It enables a part of internally reflected beam to escape out as a laser beam.

- It is basically a feedback device that directs photons back and fourth through the medium. In the process, the number of photons is multiplied due to stimulated emission.

- Brewsters window is used in front of the mirror to minimize unwanted reflection. It also provides plane-polarized light.