CL41_Q1. What is the role of Helium atoms in He-Ne laser?

Ans:

The role of helium atoms in the laser is to excite neon atoms and to cause population inversion. The excited states of helium atoms are metastable states and this helps in achieving population inversion in neon atoms by resonant transfer of energy. The probability of energy transfer from helium atoms to Ne atoms is more and the probability of reverse transfer of energy from neon to helium atom is negligible as the ratio of helium atoms is more than Ne in the gas mixture.

CL41_Q2. Explain how population inversion takes place in He-Ne laser.

Ans:

Helium atoms are excited with an electrical discharge and the two excited states of helium atoms, the 2^3S and 2^1S which are Meta stable. These excited Helium atoms transfer their energy to Ne atoms by collisions and excites the Neon atoms to the 2s and 3s levels as the energy levels of these states are close to the He excited states. This process is referred to as resonant energy of transfer. A large number of Ne atoms due to collision with Helium atoms get to the excited state create a population inversion with 2p and3p states.

CL41_Q3. Why narrow tube is used in He-Ne Laser? What happens if its diameter is increased?

Ans:

Narrow tube enables the collisions of Ne atoms in the 1s state with the sides of the walls of the tube and de-populates the 1s state. If the diameter is increased then Ne atoms will get accumulated at the 1s level as it the meta-stable state.

CL41_Q4. How can we eliminate unwanted IR radiation that accompanies with the visible radiation in He-Ne laser?

Ans:

The path length within the resonant cavity consisting of reflecting mirrors is adjusted for the visible radiation at 632.8 nm ($L = n\lambda/2$, with λ=632.8 nm), which suppress the IR radiations. Additionally, some gases like methane and other IR absorbing materials which have absorption in the Infra red are added in small quantities in the cavity to suppress the IR radiations.