CL38_Q1. State the basic requirements to be satisfied for laser action.

Ans:

Active medium – The active medium consists of the medium which possess the appropriate energy levels which are meta stable states. The presence of the meta stable states increases the probability of population inversion which is a prime condition for laser action. The active medium could be solids, liquids or gases depending on the type of lasers.

Energy pump – external energy source used to excite atoms to high energy state. The external energy sources could be optical, thermal, electrical or chemical depending on the type of lasers. In the case of gas lasers, generally an electrical discharge is a sufficient source for exciting the medium.

Resonating Cavity –The design of the optical cavity is an important aspect of the laser system. In general the optical cavity has to be a narrow region whose length in the direction of propagation is a multiple of the desired wavelength. This also helps in eliminating undesired wavelengths which may be present in the lasing process and increase the mono-chromaticity of the system.

CL38_Q2. What is meant by active medium in a Laser? What is the role of metastable states in the operation of the laser?

Ans:

The active laser medium (also called gain medium or lasing medium) is the source of optical gain within a laser. The gain results from the stimulated emission of electronic or molecular transitions to a lower energy state from a higher energy state previously populated by a pump source.

The metastable state allows accumulation of a large number of excited atoms at that level. The metastable state population can exceed the population at a lower level and establish the condition of population inversion in the lasing medium. It would be impossible to create the state of population inversion without a metastable state. Population inversion readily takes place as the lifetimes of these levels are large, and secondly, there is no competition in filling these levels, as they are localized levels. There could be no population inversion and hence no laser action, if metastable states do not exist.

CL38_Q3. Mention the role of resonant cavity in laser device?

Ans:

Once the lasing action is initiated it is essential that the stimulated emission in the desired wavelength is amplified to get a sustainable laser action of sufficient intensity. The design of the optical cavity is an important aspect of the laser system. In general the optical cavity has to be a narrow region whose length in the direction of propagation is a multiple of the desired wavelength. This also helps in eliminating undesired wavelengths which may be present in the lasing process and increase the monochromaticity of the system