Tutorial Sheet-2

[Laser Technology and Applications, 16B1NPH533, Odd Semester 2020]

1. [CO 1] Calculate the frequency in Hz and wave numbers (cm^{-1}) and the energy in electron volts of a photon of wavelength λ =600 nm in vacuum.

   [Ans: 5×10^{14}Hz, 1.66×10^4cm^{-1}, 2.07eV]

2. [CO 1] Show that the Brightness of a diffraction-limited beam is given by $B = P(2/\pi\lambda)^2$.

3. [CO 1] The Brightness of probably the brightest lamp so far available (PEK Labs type 107/109, excited by 100W of electrical power) is about 95W/cm^2 sr in its most intense green line λ = 546 nm. Compare this brightness with that of a 1W Argon laser λ= 514.5 nm, which can be assumed to be diffraction limited.

   [Ans: 1.53×10^8 W/cm^{2}Sr, 10^6 times]

4. [CO 1] What is the temporal coherence length l_c of the following (a) a mercury vapour lamp with emission bandwidth of $\Delta v = 9 \times 10^8$ Hz? and (b) He-Ne Laser with $\Delta v = 10^6$ Hz?   [Ans: (a) 0.33m, (b) 300nm]

5. [CO 1] Laser produced plasma consisting of 50μm diameter ball radiates very strongly a wavelength of 100nm. Determine spatial coherence at a distance of 1 m from the source.

   [Ans: 2 mm]

6. [CO 1] A He-Ne laser (633 nm, 20mW) light with beam diameter 2 mm passes through a lens of focal length 5mm and diameter 2.5 mm. Determine Intensity of laser beam at the focus point.

   [Ans: 0.1 MW/cm^2]

7. [CO 1] (a) Explain the role of factor hv/kT in Spontaneous emission and stimulated emission.

   (b) Why Maser was first discovered instead of Laser, is there any technical role of frequency in the development of these devices?

   (c) Is two level Laser possible? Explain your answer.

   (d) Briefly describe the properties of laser. What is the difference between intensity and brightness of a Laser?

   (e) What is population inversion? Is this necessary for Laser action.