Tutorial Sheet-4
[Laser Technology and Applications, 16B1NPH533, Odd Semester 2020]

1. [CO 1] An optical amplifier of length 10 cm amplifies an input power of 1 W to 1.1 W. Calculate the gain coefficient? [Ans: 0.95 m^{-1}]
2. [CO 1] Consider a laser with plane mirrors having reflectivities of 0.9 each and of length 50 cm filled with the gain medium. Neglecting scattering and other cavity losses, estimate the threshold gain coefficient (in m^{-1}) required to start laser oscillation. [Ans: 0.21 m^{-1}]
3. [CO 1] An atomic transition has a line width of $\Delta\nu = 10^8$ Hz. Estimate the approximate value of natural line shape function $g(\omega)$ at the center of the line. [Ans: 1.6 ns]
4. [CO 1] There is a 10% loss per round trip in a ruby laser resonator having a 10 cm long ruby crystal as the active medium. Calculate the cavity lifetime, assuming that the mirrors are coated on the ends of the ruby crystal. Given: Refractive index of ruby at the laser wavelength is 1.78 & reflectivities of mirrors are 96%. [Ans: 11.7 ns]
5. [CO 1] A laser resonator 1 m long is filled with a medium having a gain coefficient of 0.02 m^{-1}. If one of the mirrors is 100% reflecting, what should be the minimum reflectivity of the other mirror so that the laser may oscillate? Given: scattering and other cavity losses are zero. [Ans: ~ 96%]
6. [CO 1] Neglecting scattering and other cavity losses, estimate the cavity lifetime for a He-Ne laser having typical parameters: $n_0 \sim 1$, L = 20 cm and R1 = R2 = 0.98. [Ans: 33 ns]
7. [CO 1] An injection laser has active cavity with losses of 30 per cm and reflectivity of each cleaved laser facet is 30%. Determine the laser gain coefficient for the cavity when it has the length of 600 μm. [Ans: 50 cm^{-1}]
8. [CO 4] (a) Why steady state population inversion in two level laser system is not possible?
   (b) Differentiate between three level and four level Laser (at least four points) and give two examples of each.

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