# Department of Physics

*Answer all questions.*

1. Differentiate between critical inversion and population inversion. **[3]**
2. Why is it not possible to realise population inversion in a two energy level system?**[2]**
3. Why is optical pumping effective in a solid-state laser system?**[2]**
4. Explain with the help of a diagram, regarding the selection of longitudinal mode.**[3]**
5. On the stability diagram, show the position of (a) symmetrical confocal (b)confocal/planar. Give reasons. **[3]**
6. A helium-neon laser operating at 632.8nm has mirrors with reflectivity of 0.6 placed at a separation of 0.25m. Determine the number of longitudinal modes operating within the laser cavity if the region of the spontaneous emission spectrum that exceeds the cavity losses occurs between the two frequencies at which the gain is half the maximum. The Doppler broadened full width at half maximum is given as 1.6GHz**[3]**
7. A laser cavity consists of two mirrors with reflectivities $R_1=1$ and $R_2=0.5$, while the internal loss per pass is 1%. Calculate the total logarithmic losses per pass. If the length of the active medium is l=7.5cm and the transition cross section is $2.8 \times 10^{(-19)}cm^2$, calculate the threshold inversion. **[4]**

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