Indian Institute of Technology Patna

Physics Department

PH 201: Tutorial I

1. White light falls normally on a transmission grating that contains 1000 lines per centimetre. At what angle will red light (λ_0 = 650 nm) emerge in the second order spectrum?
2. Light having a frequency of 4.0×10^{14} Hz is incident on a grating formed with 10,000 lines per centimetre. What is the highest order spectrum that can be seen with this device?
3. What is the total number of lines a grating must have in order just to separate the sodium doublet (λ_1 = 5896 Å, λ_2 = 5890 Å) in the third order?
4. Consider a plane wave incident normally on a long narrow slit of width 0.02 cm. The Fraunhofer diffraction pattern is observed on the focal plane of a lens whose focal length is 20 cm. Assuming λ = 6000Å determine the positions of the first and second minima. Also determine the positions of the first and second maxima.
5. Consider a diffraction grating with 8000 lines per inch and assume that light of wavelength 5460 Å and 5460.072 Å illuminates the grating over a region of 2 inch.
    a. Calculate the number of orders in the diffracted spectrum.
    b. Calculate the dispersion in the third order.
    c. In which diffraction orders will the two wavelength components be resolved?
6. Consider a plane wave of wavelength 6×10^{-5} cm incident normally on a circular aperture of radius 0.01 cm. Calculate the positions of the brightest and the darkest points on the axis.

7. The output of a He-Ne laser (λ = 6328 Å) can be assumed to be Gaussian with plane phase front. For w_0 = 1 mm and w_0 = 0.2 mm, calculate the beam diameter at z = 20 m. [**Ans**. 2ω = 0.83 cm & 4.0 cm]
8. A Gaussian beam is coming out of a laser. Assume λ = 6000 Å and that at z = 0, the beam width is 1 mm and the phase front is plane. After traversing 10 m through vacuum, what will be (a) the beam width and (b) the radius of curvature of the phase front? [**Ans.** 2ω = 0.77 cm; R(z) = 1017 cm]