**TUTORIAL – UNIT 2**

**INTERFERENCE**

1. Explain how Newton's rings are formed and derive the condition for dark rings and show that the radii of dark rings are proportional to the square root of natural numbers.
2. Describe the method for determination of 1) wavelength of light 2) radius of curvature of lens and 3) refractive index of liquid using Newton's rings.
3. What is interference of light?
4. State the necessary conditions for producing sustained interference pattern.
5. What are coherent sources? Describe the methods used to obtain coherent sources.
6. Define spatial and temporal coherence?
7. Two independent non-coherent sources of light cannot produce an interference pattern. Why?
8. Describe Fresnel’s biprism. Deduce the conditions for observing bright and dark fringes on the screen.

**NUMERICALS**

1. Newton’s rings are formed using light of wavelength 5896A in reflected light with a liquid placed between plane and curved surfaces. The diameter of 7th dark fringe is 0.4 cm and the radius of curvature is 1.0 m. Evaluate the refractive index of liquid.

Formula:  **[Ans: refractive index of liquid, µ = 1.03]**

1. Newton’s rings are formed by light reflected normally from convex lens of radius of curvature of 90 cm and a glass plate with liquid in between them. The diameter of nth dark ring is 2.25 mm and that of (n + 9)th dark ring is 4.5 mm. Calculate the refractive index of the liquid. Given λ = 6000 Å.

**Formula: R = [Ans: µ = 0.781]**

1. In a Newton’s ring experiment, the diameter of 10th dark ring due to wavelength 6000 Å in air is 0.5 cm. Find the radius of curvature of the lens.

**Formula: R = [Ans: R = 104 cm]**

1. A biprism is placed at a distance of 5 cm in front of a narrow slit, illuminated by a sodium light (λ =5890 Å) and the distance between the virtual sources is found to be 0.05 cm. Find the width of the fringes observed in eyepiece placed at a distance of 75 cm from the biprism.

**Hint:**β   = λ D/ d **[Ans : 9.424 cm]**

1. In a Fresnel’s biprism experiment, the fringe width observed is 0.130 cm. If the slit separation is reduced by ½ of its original value, what will be the fringe width?

**[Ans:** **0.26 cm]**

1. If the distance between the slit and biprism is 0.2 m and it is illustrated by sodium light, the fringe width obtained on a screen 1.10 m away from the biprism is 3.5 × 10-4 m. Calculate the distance between the coherent sources. **[Ans:2.19 mm]**

**DIFFRACTION**

1. Define diffraction and mention the necessary condition to observe a clear diffraction pattern.
2. What is diffraction and explain Fresnel’s and Fraunhofer diffraction?
3. Differentiate between interference and diffraction.
4. Discuss the Fraunhoffers’ diffraction from a single slit. Give the conditions for maxima and minima. Also give the expression for intensity at a point on the screen, giving the intensity distribution curve
5. What is diffraction grating? How are gratings manufactured? What is grating Spectrum?
6. Define dispersive power of a grating and resolving power of a grating.

**NUMERICALS**

1. In a single slit Fraunhofer diffraction experiment using monochromatic light of 589.3 nm wavelength and a slit width of 6 µm, calculate the angular separation between first order minima on either side of central maximum.

**Formula: dsinθ = nλ [Ans: angular separation θ = 5.63deg]**

1. A light of 500 nm wavelength is incident normally on a single slit. The first minimum of   
   Fraunhofer diffraction pattern is observed to lie at a distance o f 5 x 10(-3) m from the central maximum on a screen placed at a distance of 2 m away from the slit. What is the width of the slit?

**Formula: dsinθ = nλ**

1. In Fraunhofer diffraction due to narrow slit, a screen is placed 1 m away from the lens to obtain the pattern. If the slit width is 0.1 x 10(-3) and the first minimum lies 5.0 x 10(-3) m on either side of the central maximum, find the wavelength of light. If the source is replaced by another light for which the first minimum lies at 5.89 x 10(-3) m, find the wavelength of light.

**Formula: dsinθ = nλ , sinθ = x/D [Ans: λ1 =500nm and λ2 = 589nm]**

1. A parallel beam of monochromatic light is allowed to be incident on a plane grating having 6000 lines/cm and second order spectral line is found to be diffracted through 460. Calculate the wavelength of light used.

**Formula: dsinθ = nλ , d=1/N, N= no. of lines/cm ruled on the grating [Ans: λ =599.4nm]**

1. Monochromatic light of λ = 6560 Å falls normally on the grating 2 cm wide. The first order spectrum is produced at an angle 19º from the normal. What is the total number of lines on the grating?

**Formula: dsinθ = nλ , d=1/N, N= no. of lines/cm ruled on the grating**

**[Ans.: Number of lines on grating, N = 9925.85 per 2 cm]**

1. A plane grating has 15000 lines per inch. Find the angle of separation of the 5048 Å and 5016 Å lines of helium in second order spectrum.

**Formula: dsinθ = nλ , d=1/N, N= no. of lines/cm ruled on the grating**

1. A grating has 15 cm of the surface ruled with 6000 lines / cm. what is the resolving power of the grating in the first order?

**Formula: R.P = R = mN** **[ Ans: 9 × 104]**

1. A diffraction grating which has 4000 lines per cm is used at normal incidence. Calculate the dispersive power of the grating in the third order spectrum in the wavelength region 5000 Å **[ Ans: 15,000]**