University School of Automation and Robotics
Physics Assignment

Unit III

Assignment 1

1. (a)What are the conditions for observing interference fringes?

   (b) What are coherent sources? How they are realized in practice? Explain why two independent sources can never be coherent sources. Describe two methods for the production of coherent sources.

2. In an experiment using sodium light of wavelength 5890 Å, an interference pattern was obtained in which 20 equally spaced fringes occupied 2.30 cm on the screen. On replacing sodium lamp with another monochromatic source of a different wavelength with no other changes, 30 fringes were found to occupy 2.80 cm on the screen. Calculate the wavelength of light from this source.

3. In a Young's double slit experiment, the angular width of a fringe formed on a distant screen is 0.1^0. The wavelength of light used is 6000 Å. What is the spacing between the slits.

4. In an interference experiment, the distance between the slits is 1 mm and the width of the fringe is 0.6 mm. If the distance between the screen and the slits is 1.2 m, calculate the wavelength, λ of the light.

5. At a given point P, three different waves are meeting in phase. Those waves are given by $Y_1 = A_1 \sin(\omega t)$, $Y_2 = A_2 \sin(\omega t)$ and $Y_3 = A_3 \sin(\omega t)$. What is the resultant amplitude at P due to those three waves.

6. Two coherent sources whose intensity ratio is 81:1 produce interference fringes. Deduce the ratio of maximum intensity to minimum intensity in fringe system.

7. White light falls normally upon a soap film whose thickness is 5×10^{-5} cm and whose index of refraction is 1.33. Which wavelength in the visible region will be reflected most strongly?

8. Two plane glass plates are placed on top of one another and on one side a paper is introduced to form a thin wedge of air. Assuming that a beam of wavelength 600 nm is incident normally, and that there are 100 interference fringes per cm, calculate the wedge angle.
9. In Newton's ring experiment the diameters of 4^{th} and 12^{th} dark rings are 0.4 and 0.7 cm respectively. Calculate the diameter of 20^{th} dark ring.
10. In a Newton's ring experiment, the diameters of 5^{th} and 25^{th} rings are 0.3 cm and 0.8 cm respectively. Find the wavelength of light used. Take Radius of curved surface of lens R = 100 cm.
11. Newton's rings formed by monochromatic light between a flat glass plate and a plano-convex lens are viewed normally. Calculate the order of the dark ring which will have double the diameter of that of 40^{th} dark ring.
12. In a Newton's ring arrangement, light consisting of wavelengths λ_1 and λ_2 incidents normally on a plane convex lens of radius of curvature *R* resting on a glass plate. If the nth dark ring due to λ_1 coincides with (n+1)th dark ring due to λ_2, then show that the radius of the nth dark ring of λ_1 is given by $\sqrt{\frac{\lambda_1\lambda_2 R}{(\lambda_1-\lambda_2)}}$.

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Assignment 2

1. (a)Differentiate between interference and diffraction phenomena in light.

   (b)Explain the difference between Fresnel and Fraunhofer type of diffraction.

2. Show that, for Fraunhofer diffraction at a single slit, the relative intensities of the successive maxima are approximately $1 : 4/9\pi^2 : 4/25\pi^2 : 4/49\pi^2$ ……..

3. Light of wavelength 5000 Å is incident normally on a plane transmission grating of width 3 cm and 15000 lines. Calculate the angle of diffraction in first order.

4. What is grating element? Show that only first order is possible if the width of the grating element is less than twice the wavelength of light.

5. A diffraction grating is just able to resolve two line of λ=5140 Å and λ=5140.85 Å in the first order. Will it resolve the line λ = 8037.20 Å and λ = 8037.50 Å in the second order?

6. The limits of visible spectrum are approximately 400nm and 700nm. Find the angular width of the first order visible spectrum produced by a plane diffraction grating having 15000 lines per inches when the light is incident normally on the grating.

7. What is the ratio of resolving powers of two gratings having 15000 lines in 2 cm and 10,000 lines in 1 cm in first order? Each grating has lines in its 2.5 cm width.

8. How many orders will be visible if the wavelength of incident radiation is 4800 Å and the number of lines on the grating is 25000 lines per inch.

9. Light is incident normally on a grating of total ruled width 5×10^{-3} m with 2500 lines in all. Calculate the angular separation of two sodium lines in the first order spectrum. Can they be seen distinctly?

10. The wavelengths of sodium D lines are 589.6nm and 589nm. What is the minimum number of lines that a grating must have in order to resolve these lines in the first order spectrum?
11. (a) What do you understand by the term resolving power of a grating? Explain Rayleigh criterion for the limit of resolution.

    (b) Two plane diffraction gratings A and B have the same width of ruled surface but A has greater number of lines than B. Which has greater intensity of fringes?

Assignment 3

1. Explain the following terms:

   a. Plain of polarization

   b. Optic axis of a crystal

   c. Double refraction

   d. Quarter and Half wave plates

   e. Ordinary and Extra ordinary ray

2. Using two Nicol prisms, how would you find whether the given plate is a quarter wave plate or a half wave plate or a simple glass plate?
2. If the plane of vibration of the incident beam makes an angle of 30° with the optic axis, compare the intensities of extraordinary and ordinary rays.
3. Light reflected from a glass plate ($n_g = 1.65$) immersed in ethyl alcohol ($n_e = 1.36$) is found to be completely linearly polarized. At what angle will the partially polarized beam be transmitted into the plate?
4. A right circularly polarized beam is incident on a calcite half-wave plate. Show that the emergent beam will be left-circularly polarized.

5. Calculate the thickness of a quarter wave plate of quartz for sodium light of wavelength 5893 Å. The refractive indices of quartz for E-ray and O-ray are equal to 1.5533 and 1.5442 respectively.
6. A beam of linearly polarized light is changed into circularly polarized light by passing it through a sliced crystal of thickness 0.005 cm. Calculate the difference in refractive indices of the two rays in the crystal assuming this to be of minimum thickness that will produce the effect. The wavelength of light used is $5000\,\overset{0}{A}$.
7. A plate of thickness 0.020 mm is cut from calcite with optic axis parallel to the face. Given, μ_o = 1.648 and μ_e = 1.481 (ignoring variations with wavelength), find out those wavelengths in the range 4000 Å to 7800 Å for which the plate behaves as a half wave plate and also those for which the plate behaves as a quarter wave plate.
8. A beam of light is passed through a polarizer. If the polarizer is rotated with the beam as an axis, the intensity *I* of the emergent beam does not vary. What are the possible polarization states and how to ascertain the state of the light beam with an additional quarter wave plate?
9. A $\lambda/4$ plate is rotated between two crossed Polaroids. If an unpolarized beam is incident of the 1st Polaroid, discuss the variation of intensity of the emergent beam as the quarter wave plate in rotated. What will happen if have a $\lambda/2$ plate instead of a $\lambda/4$ plate.
10. A 20 cm long tube containing 60 cc of sugar solution produces an optical rotation of 11^0 when placed in a polarimeter. Calculate the quantity of sugar contained in the tube. The specific rotation of sugar is 66^0.