JaganNath Gupta Institute of Engineering & Technology

Department of Physics

(2011-2012)

UNIT- I: INTERFERENCE OF LIGHT

ASSIGNMENT NO – 2

CATEGORY B

Students are advised to give the answers in explicit form of the following questions.

1. Prove that for thin films, the interference patterns in reflected rays and transmitted rays are complimentary. Extend the relation for the case of thin wedge shape film.
2. With the help of experimental arrangement of Newton's ring, prove that the diameters of dark rings are proportional to the square root of natural numbers and diameters of bright rings are proportional to the square root of the odd natural numbers.
3. Show that the diameter D_n of n^{th} Newton's ring, when two surfaces of radii R_1 and R_2 are placed in contact, is given by $\frac{1}{R_1} \pm \frac{1}{R_2} = \frac{4n\lambda}{D_n}$.
4. Describe the construction with diagram and outline the theory of Michelson Interferometer. How would you obtain (i) circular fringes, (ii) straight fringes?
5. How will you determine the wavelength difference of two components of a line by Michelson's Interferometer? Also calculate the thickness / refractive index of unknown thin film.
6. Show that the necessity of opposite phase and equal amplitudes of reflected rays leads to desired conditions for Anti Reflecting Coatings.
7. Describe the uses of Interference in Optical Technology.
8. Explain the construction and working of Interference filters. How do we overcome with the problem of limitation of thickness of the film?
9. White light falls normally upon a film of soap water whose thickness is $5 \times 10^{-5}\ cm$ and refractive index is 1.33. What wavelength of which color will be seen (reflected) strongly in the visible region.
10. Thin film soap is illuminated by white light at an angle of incidence $i = \sin^{-1}\left(\frac{4}{5}\right)$. In reflected light, two dark consecutive overlapped fringes are seen corresponding to the wavelength $6.1 \times 10^{-7} m$ and $6 \times 10^{-7} m$. Calculate the thickness $\left(\mu = \frac{4}{5}\right)$.
11. Interference fringes are produced by monochromatic light falling normally on wedge shaped film of cellophane whose refractive index is 1.4. The angle of wedge is 40 second and distance between successive fringes is 1.25 mm. Calculate wavelength of the light used.
12. Light containing two wavelengths λ_1 and λ_2 falls normally on a plano-convex lens of radius of curvature R resting on a glass plate. If the n^{th} dark ring due to λ_1 coincides with the $(n+1)^{th}$ due to λ_2, prove that the radius of the n^{th} dark ring of λ_1 is $\sqrt{\frac{\lambda_1 \lambda_2 R}{\lambda_1 - \lambda_2}}$.
13. Newton's rings are observed between the spherical surface of radius of curvature 120 cm and on a plate. The diameters of 5th and 16th bright rings are 0.314 cm and 0.584 cm. Calculate the diameter of 25th and 37th bright rings and also the wavelength of the light used.
14. Michleson's Interferometer experiment is performed with a source which consists of two wavelengths $4882A^0$ and $4886A^0$. Through what distance does the mirror have to be moved between two positions of disappearance of finges.
15. Find the minimum thickness required of a layer of cryolite $\mu = 1.35$ in a interference filter design to isolate light of wavelength $5400A^0$. I the thickness of the cryolite is is changed by 1% then how much does the wavelength change?