Module 1 Unit 1

THIN FILM INTERFERENCE – NUMERICAL PROBLEMS

1. A parallel beam of light of wavelength 6000 Å is incident on a plain transparent film of R. I. 1.5. If the angle of refraction is 28°. Find thickness of the film if it appears bright in the reflected light. Assume n = 1.
2. A soap film of R. I. 1.33 and thickness 1.5×10^{-5} cm is illuminated by light incident at 30°. Light reflected from it shows a dark band in the 2nd order. Calculate wavelength corresponding the dark band.
3. A parallel beam of light falls normally on an oil film of R. I. 1.25. Complete destructive interference is observed for wavelengths 5000 Å and 6000 Å and for no wavelength in-between. Find the thickness of the oil.
4. White light falls normally on a soap film (μ = 1.33) of thickness 3800 Å. Which wavelength/s within the visible spectrum (4000 – 7000 Å) will be intensified in the reflected light?
5. A parallel beam light falls normally on an oil film of R. I. 1.2 having uniform thickness which is spread on water (R. I. 1.33). Brightness is obtained for wavelengths 5000 Å and 7500 Å and for no wavelength in-between. Find thickness of the oil film.
6. White light is incident on a soap film of R. I. 1.25 at 50°. Find minimum thickness of the film required if it appears bright yellow (λ = 5893 A) in the transmitted light.
7. A soap film of R. I. 1.33 and thickness 0.11 μm is illuminated by light incident at 30°. The reflected light shows a bright band corresponding to a wavelength of 5×10^{-5} cm. Calculate order of interference of the band.
8. A parallel beam of light is incident at an angle of 30° on a film of refractive index 1.5. Find the colours from the visible spectrum (4000 – 7000 Å) which will be intensified in transmitted light? Thickness of the film is 5×10^{-5} cm.
9. A soap film is illuminated by monochromatic light of wavelength 7000 Å incident at certain angle. The film appears bright in reflected light. If its thickness is 1.5×10^{-5} cm and refractive index is 1.33, find the angle of incidence for minimum thickness. At what angle would it exhibit destructive interference?
10. White light is incident on a thin film of oil of R. I. 1.4 and thickness 0.0045 cm deposited on a glass plate of R. I. 1.52. The reflected light shows red colour of a particular wavelength at an angle of incidence of 9.8° in a certain order and again at 5.74° in the next higher order. Determine wavelength of the red colour getting reflected.
11. Calculate the wavelength which would be cut-off from reflection due to a film of thickness 1 micron and refractive index 1.28.
12. Can a thin film of MgF_2 of R. I. 1.22 act as an antireflection film if deposited on glass of R. I.1.52? If yes, determine the minimum thickness required to cut-off reflection due to wavelength 5500 Å.
13. Determine the thickness of thin coating required for which, it will act as anti-transmitting film for the wavelength of 5000 Å. Given R. I. of the film = 1.28.
14. In above example, calculate the wavelength which will be highly transmitted by the same film.
15. A binocular has two-layer antireflection coating. The outer coating is MgF_2 (μ = 1.38) and the inner coating is ZrO_2 (μ = 2.10) to reduce reflections due to 6600 Å and 5700 Å respectively. Determine thickness of each coating required.

Homework:

16. 2. White light falls at an angle of 45° on a parallel soap film of refractive index 1.33. At what thickness (minimum) of the film will it appear bright yellow of wavelength 5896 Å in the reflected light?

17. An oil drop of volume 2 cc is dropped on the surface of a tank of water of area 1 sq. m. the film spreads uniformly over the surface and white light which is incident normally is observed through a spectrometer. The spectrum is seen to contain one dark band whose centre has wavelength 5.5×10^{-6} m in air, find the R. I. of oil
18. A plane wave of monochromatic light falls normally on a uniform thin film of oil which covers a glass plate. The wavelength of the source can be varied continuously. Complete destructive interference is obtained only for wavelengths 5000 Å and 7000 Å find the thickness of oil layer. Given: R. I. of oil = 1.3.
19. A drop of oil of R. I. 1.20 floats on a water surface and it is observed that the thickness of oil drop at the edge is very smallest and gradually increases towards the middle of the oil drop then (i) how will the thinner outer region appear - dark or bright and why? (ii) what will be the thickness of oil layer where the wavelength of 4800 Å is intensified in reflected light for third order.
20. Light falls normally on a soap film of thickness 5×10^{-6} m and of R. I. 1.33. Which wavelength/s in the visible region will be reflected most strongly?
21. White light is incident on a soap film at an angle $\sin^{-1}(4/5)$ and a reflected light is observed with a spectroscope. It is found that two consecutive dark bands are formed correspond to wavelengths 6100 Å and 6000 Å. If the refractive index of the film is 4/3, calculate its thickness.
22. A film of magnesium fluoride of thickness 0.1 micron and R.I 1.22 is deposited on a glass plate. Calculate the wavelength which would be cut-off on reflection.
23. It is desired to make a non-reflecting lens for an infrared radiation detector. If the coating material has a R.I. 1.20, what should be the film thickness for radiation with frequency of 3.75×10^{14} Hz?
24. A film coated on a lens is 100 nm thick and is illuminated with white light. The R.I. of film is 1.4. For what wavelength of light will the lens be non-reflecting?
25. A glass of R. I. 1.5 is to be coated with a transparent material of refractive index 1.2 so that the reflection of light of wavelength 6000 Å is eliminated by interference. What is the required thickness of the coating?
