SAMPLE QUESTION FOR SECOND SEMESTER PHYSICS HONOURS
UNIT: OPTICS

Refraction at a Spherical Surface

1. State & explain Fermat's principle of stationary time and using this derive laws of reflection and laws of refraction.
2. Discuss the refraction at a convex surface when the image formed is real.
3. Derive the relation $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$ where symbols have their usual meanings.
4. Explain the terms: *first principal focus* and *second principal focus* and show that $f_1 v + f_2 u = uv$.
5. Define lateral magnification & longitudinal magnification. What is the relation between them?
6. Define angular magnification.
7. Establish Lagrange's law and Abbe's Sine condition.
8. Establish Lens makers' formula.
9. Establish Newton's lens equation.
10. Define the term power of a refracting surface.
11. Derive an expression for the equivalent focal length of two thin co-axial lenses separated by a distance apart.
12. What is meant by optical interval?
13. What are cardinal points of a thick lens or a co-axial combination of lenses? Define them, state their characteristics and show them diagrammatically for a lens system.
14. Define cardinal points of a system of coaxial lenses. Show that the principal planes are conjugate planes of +1 magnification.

Defects in Lens

15. What are the common defects in the images produced by a single lens? How can these defects be removed?
16. What is meant by *spherical aberration* of a lens? What are the causes of spherical aberration? How can these be minimized?
17. Show that the condition for minimum spherical aberration is that the distance between two lenses is equal to the difference in their focal lengths.
18. What is chromatic aberration? Define axial and lateral chromatic aberration.
19. Show that a single lens cannot form an image free from chromatic aberration.
20. Derive an expression for longitudinal chromatic aberration in a lens for an object at infinity.
21. Derive an expression for longitudinal chromatic aberration in a lens for an object at finite distance.
22. What is achromatic doublet?
23. Derive an expression for achromatism of two thin lenses placed in contact.
24. Derive an expression for achromatism of two thin lenses separated by a finite distance.

Interference of Light

25. What is interference?
26. State the conditions necessary for sustained interference.
27. Discuss the formation of interference pattern produced in (i) Fresnel's Biprism (ii) Llyod's mirror.
28. How can one determine the wavelength of a monochromatic radiation using Fresnel's bi-prism?
29. What is coherence?

30. Discuss the formation of interference pattern in a thin film due to (i) reflected light & (ii) transmitted light. Hence establish the condition for bright and dark fringe.
31. Discuss the formation of interference pattern in Newton's rings experiment. Establish the expression for radius of nth order dark fringe. Comment on the nature of the central fringe in Newton's ring experiment.
32. How can you measure the refractive index of a liquid using Newton's ring experiment.
33. Discuss qualitatively how you can measure the wavelength of a monochromatic radiation using Newton's ring.
34. Interpret the phenomenon of interference of light. Also discuss the various conditions to be fulfilled for the production of sustained interference.
35. Find an expression for resultant intensity at any point due to the superposition of two light sources of same wave length. Show that resultant intensity is the sum of individual intensities. Also discuss the term constructive and destructive interference.
36. Show the conservation of energy is not violated in the interference phenomena.
37. Why it is necessary to use narrow sources for observation of interference phenomena.
38. Why it is difficult to observe the phenomenon of interference for two extended sources (for example two candles).
39. Find an expression for fringe width produce by two narrow sources. Also show the shape of the fringes is parabola. What are non-localised fringes in this case?
40. How the interference fringes are classified in terms of sources that are used?
41. Describe with necessary ray diagram the method of determination of wavelength of a monochromatic light can be measured with Fresnel's Bi-prism. Why base angle of the prism made very small? How this angle has been measured?
42. Why base angle of the prism made very small? How this angle has been measured?
43. Describe how the thickness of a transparent sheet be measured by using bi-prism experiment.
44. Describe with necessary ray diagram the method of determination of wavelength of a monochromatic light by using Lloyd's mirror. Why central fringe becomes dark?
45. Distinguish between Fresnel's Bi-prism experiment and Lloyd's mirror experiment.
46. Consider a wedge shape thin film of oil. Find an expression for maxima and minima. What happen if the film is (a) extremely thin. (b) surfaces are parallel.
47. What happen if the thin film is illuminated by white light?
48. Why broad source is being used in thin film experiment?
49. What are Newton's rings? How they are constructed?
50. Give the theory of Newton's rings and show that fringe width is decreases with increase in the diameter of the ring.
51. Why central fringe is dark in Newton's rings?
52. How we determine the wave length of the light by using Newton's rings experiment?
53. How we determine the refractive index of liquid by using Newton's rings experiment?

Diffraction of Light

54. What do understand by diffraction of light?
55. Distinguish between Fraunhofer and Fresnel class of diffraction.
56. What is Fresnel half period zone? How these zones are arranged? Show the area of the zone is proportional to the perpendicular distance from the wavefront. Show that the resultant amplitude produce by a wavefront is proportional to the wave from the first half period zone. What are factors on which the amplitude of light waves from a half-period zone at the point of observation depends?

57. Explain the rectilinear propagation of light.
58. What is zone plate? Find an expression for focal length of zone plate. How it is constructed? State the difference between zone plate and convex lens.
59. Find the expression for the intensity of Fraunhofer diffraction pattern due to a single slit. Discus the conditions of maxima and minima. Draw the intensity pattern due to single slit.
60. Obtain the expression for the intensity of Fraunhofer diffraction pattern due to double slit. Discus the conditions of maxima and minima. What is missing order? Draw the intensity pattern due to double slits.
61. Find the resultant intensity of the diffracted beams when rays fall normally on a plane diffraction grating.
62. From the expression of resultant intensity, deduce the condition for principal maxima and secondary maxima and minima.
63. What is the difference between a grating spectrum and a prism spectrum?
64. Explain the term absent spectra, ghost line and normal spectrum.
65. State Rayleigh criterion of resolution. Show graphically the how two spectrums become just resolved.
66. Find an expression for resolving power of gratings.
67. Discus the resolving power of telescope.
68. Discus the resolving power of microscope.