B.Sc. Sem IV Optics Important Questions for Examination (based on previous year papers and latest Syllabus)

Short Answer Type Questions :-

1. Explain coherent sources and write the conditions to obtain sustained interference.
2. Draw a neat ray diagram of Twyman and Green interferometer and mention it's applications.
3. Differentiate between Fresnel and Fraunhofer diffraction. Give two examples of each.
4. Find expression for resolving power of grating.
5. Explain how plane polarised light can be obtained by reflection.
6. What is quarter wave plate ?
7. With the help of Young's double slit experiment, explain that the formation of the interference fringes is in accordance with the law of conservation of energy.
8. Discuss the sharpness of fringes with a Fabry-Perot interferometer.
9. Discuss the missing order spectrum in Fraunhofer diffraction by a double slit.
10. A plane transmission grating has 16,000 lines per inch over a length of 5 inches. In the wavelength region of 6000 A° and in the second order, find the resolving power of grating and smallest wavelength difference that can be resolved.
11. How will you distinguish between the circularly polarised light and (i) a mixture of plane polarized light and unpolarized light, (ii) elliptically polarized light ?
12. How will you orient the polariser and analyser so that the beam of natural light is reduced to (i) 0.5, (ii) 0.25, (iii) 0.75, (iv) 0.125 of it's original intensity ?
13. Based on Young's double slit experiment, design an arrangement for producing interference fringes 1° apart on a distant screen.
14. Show that in thin films, the interference patterns with the reflected light and transmitted light are complimentary to each other.
15. Taking the eye pupil, as a circular aperture, calculate the maximum distance at which the eye will be able to resolve the two headlights (which are 1.22 meters apart) of an approaching automobile, if the pupil diameter is 5mm and wavelength of light is 5500 A°.
16. Prove that in the Fraunhofer diffraction due to a single slit, the width of the central maximum is proportional to wavelength of light used.
17. State and explain the Brewster's law and how can it be used to design a Brewster window.
18. Explain the phenomenon of Dichroism and discuss it's applications.
19. A Fresnel's biprism arrangement is set with sodium light (λ = 5893 A.U.) and in the field of view of the eyepiece 62 fringes are observed. How many fringes shall we get in same field of view if we replace the source by mercury lamp using green filter (λ = 5461 A.U.)?
20. If the movable mirror of Michelson interferometer is moved through a distance of 0.05896 nm, a shift of 200 rings is observed in the field of view. Calculate the wavelength of light.
21. What is the radius of first zone in zone plate of length 200 cm for light of wavelength 5000 A.U.
22. Distinguish between dispersive power and resolving power of a grating. Compare the dispersive and resolving power of two gratings one having length double than that of second grating, which both have same number of rulings.
23. Explain the phenomenon of double refraction.What are ordinary and extraordinary rays in a uniaxial crystal ? Explain that they are plane polarised.

24. A tube 30 cms long filled with a solution containing 15 gm of cane sugar per 100 c.c. of water is placed in the path of plane polarised light. Find the angle of rotation of plane of polarisation. (Specific rotation of cane sugar is = 66.5°/dm/c.c.
25. Use Fresnel's biprism to determine the thickness of thin transparent glass plate.
26. Discuss the formation of Haidinger's fringes and how do they differ from fringes produced by Wedge shaped thin film.
27. How far must the movable mirror of a Michelson interferometer be displaced for 2500 fringes of red cadmium light (λ = 6438 A.U.) to cross the field of view.
28. Explain how the zone plate behaves like a convex lens. Find the first three focal lengths of a zone plate for which the radius of first zone is 0.3 mm, for light of wavelength 5000 A.U.
29. The rotation of plane of polarisation of the light, λ = 5893 A° ,in a material is 10°per cm. Calculate the difference between the refractive indices for right and left circularly polarised light in the material.
30. What is biprism ? How are coherent sources achieved in Fresnel's biprism ?
31. State advantage of concave grating over plane grating.
32. State and explain Malus law.
33. Determine the specific rotation of sugar solution if the plane of polarisation is turned through 13°. The length of tube containing 10% solution is 20 cm.
34. Two coherent sources whose intensity ratio is 81:1 produce interference fringes. Deduce the ratio of maximum to minimum intensity in fringe system.
35. Show that zone plate has multiple foci.
36. What is difference between prism and grating spectrum ?
37. Write a short note on half wave plate.
38. What is function of compensating plate in Michelson interferometer ?
39. Two coherent sources of intensity ratio α, interfere. Prove that the intensity pattern :

$$\frac{I_{max} - I_{min}}{I_{max} + I_{min}} = \frac{2\sqrt{\alpha}}{1+\alpha}$$

40. What is effect on diffraction pattern due to single slit if slit width is increased ?
41. Explain why longitudinal waves do not show polarisation of light.
42. What do you understand by rotatory polarisation ?
43. Sodium light of wavelength 5893 A° falls on a double slit of separation 2.5 mm ; distance of screen from double slit is 5 cm. Locate the position of tenth bright fringe if it is assumed that D >> 2d.
44. What is Rayleigh criterion of resolving power ?
45. Give the construction and working of Nicol Prism.
46. Explain obliquity factor in Fresnel class diffraction.
47. What is Tolansky fringes ?
48. Name two commonly used devices based on polarised light.
49. Why is concave grating better than transmission grating ?
50. When Michelson interferometer mirror is displaced 0.030 mm; 100 fringes are shifted. Calculate the wavelength of light used.

Long Answer Type Questions :-

1. Explain the Fresnel biprism and describe the experimental method to determine the wavelength of light with it's help. What happens when white light is used ?
2. Explain the construction and working of a zone plate. Show that zone plate has multiple foci. What is phase reversal zone plate ?
3. Describe the theory of Fraunhofer diffraction by N slits.
4. What is double refraction ? Describe the Huygen's theory of double refraction.
5. What is specific rotation ? Describe any one experimental method to determine specific rotation.
6. Describe the construction and working of retardation plates. Explain the limitations of retardation plates.
7. Light of wavelength 6000 A.U. falls normally on a slit of width 12×10^{-5} cm. Calculate the angular positions of first two minima on either side of central maxima.
8. Explain the formation of Newton's circular rings in reflected monochromatic light. Show that in reflected light radius of bright rings are proportional to square root of odd number.
9. Find the Fresnel reflection and transmittance coefficient, when light is incident normally on glass plate ($\mu = 3/2$).
10. Describe the construction and working of a Michelson interferometer. How will you use it to measure the difference in wavelength between D-lines of sodium light ? How will you use it to determine thickness of a thin transparent film ?
11. Find the amplitude due to plane transmission diffraction grating at point 'P' ,hence show that there are N number of minima between two maxima; where N is number of slits on grating. Obtain the condition of absent spectra in a plane transmission grating.
12. Define the optical activity and explain it with Fresnel's explaination. What is the principle of a polarimeter ?
13. Explain the principle and construction of the quarter and half-wave plate, and discuss their use in production and detection of the circularly polarised light.
14. Define and derive an expression for resolving power of plane transmission grating. The light of wavelength 6000 A.U. is incident on a plane transmission grating, which has 15000 lines. Find the smallest wavelength difference in the second order spectrum that can be resolved.
15. Describe the construction and working of Laurent's half-shade polarimeter to determine the optical rotation of cane sugar solution. Determine the specific rotation of sugar solution if the plane of polarisation is turned through 6.5°. The length of tube containing 5% solution is 0.2 m.
16. Explain the meaning of half-period zones in case of plane wavefront. Show that the area of half-period zone is constant. Also show that the amplitude due to complete wavefront is just half that due to first period zone alone.
17. In relation to plane transmission grating with 5000 lines per cm, answer the following :
    a) What is the longest wavelength of light for which spectrum can be observed.
    b) For light of wavelength 600 nm,what is highest order of spectrum may be observed ?
    c) If opaque spaces are exactly 2.0 times the transparent spaces, which order of spectra will be absent ?
18. Explain the principle of Febry Perot interferometer. Show that the intensity distribution in the fringes of Febry Perot interferometer is given by :

$$I = \frac{1}{2} I_M = \frac{I_M}{1 + F \sin^2\left(\delta/2\right)}$$

19. Give Fresnel's hypothesis of rotatory polarisation and derive a formula for rotation of quartz. The indices of refractions of quartz for right-handed and left handed circularly polarised waves of wavelength 7620 A.U. traveling in the direction of optic axis have the following values : $\mu_R = 1.53914$, $\mu_L = 1.53920$ Calculate the polarising angle in plane of polarisation by a quartz plate of 0.5 mm thick.
20. Describe how, with the help of a Nicol prism and a quarter wave plate, plane polarised and circularly polarised light are produced and detected.
21. How do you get Haidinger fringes with the Michelson interferometer and how can it be used for resolution of two spectral lines ?
22. Discuss the interference and diffraction maxima and minima with the Fraunhofer diffraction due to a double slit and describe the difference with the single slit diffraction pattern.
23. State the essential conditions for observing the phenomenon of interference of light waves and deduce the expression for fringe width in Young's double slit experiment.

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