



ST JOSEPH'S UNIVERSITY, BENGALURU -27
B.Sc. (PHYSICS)– III SEMESTER
SEMESTER EXAMINATION: OCTOBER 2023
 (Examination conducted in November /December 2023)
PH 322 - Oscillations, Waves and Optics

(For current batch students only)

Time: 2 Hours

Max Marks: 60

This paper contains 2 printed pages and 3 parts

PART-A

Answer any four of the following:

4 x 8 = 32

1. What are Lissajous's figure? Obtain the resultant of two simple harmonic motions acting on a particle in perpendicular directions. Arrive at the condition to get a circle as their resultant. (6+2)
- 2.a) State and explain Fourier theorem.
 b) Distinguish between phase velocity and group velocity of waves.
 Show that $V_g = V_p - \lambda \frac{dV_p}{d\lambda}$, with usual notation. (3+5)
3. a) Distinguish between interference and diffraction fringes.
 b) Give the theory of interference at an air wedge. (2+6)
4. a) Give any three differences between Fresnel and Fraunhofer diffraction.
 b) What is quarter wave plate? Derive an expression for the thickness of a quarter wave plate. (3+5)
5. What is a zone plate? Derive an expression for the focal length of a zone plate. (2+6)
6. Describe the principle, construction and working of ruby laser with energy level diagram. (8)

PART- B

Solve any four of the following

4 x 5 = 20

7. A plane transmission of grating having 5000 lines per cm is used to obtain a spectrum light from a sodium lamp in the second order. Calculate the angular separation between the two sodium lines whose wavelengths are 5890 Å and 5896 Å.
8. A ray is travelling from air to an optical fibre of core and cladding of refractive indices 1.48 and 1.46 respectively. Calculate the critical angle, acceptance angle and numerical aperture.
9. A 0.2m long polarimeter tube containing a certain solution of concentration 20% produces an optical rotation of 24°. Find the specific rotation of the solution.

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10. A simple harmonic wave train travelling in the positive X- direction has an amplitude of 2 cm, frequency 75 Hz and velocity 45 m/s. Calculate the propagation constant, the displacement of the particle, and the particle velocity, at $x = 1.35$ m from the origin at $t = 3$ seconds.
11. In a biprism experiment, fringes of width 0.023 cm, is obtained on the screen kept at a distance of 1.2 m from the slit. When a convex lens is introduced at 0.3 m from the slit, two images of the slit are seen 0.72 cm apart for the same position of the eye piece. Calculate the wavelength of the light used.
12. A particle with a mass of 0.5 kg has a velocity of 0.3 m/s after 1 second of its starting from the mean position. Calculate its K.E. and total energy, if its time period is 6 s.

PART - C

Answer any four of the following:

4 x 2 = 8

13. Population inversion is not possible in two-level pumping scheme. Explain.
14. What are the advantages of optical fibres in communication?
15. It is easy to observe diffraction effect in sound than in light. Explain.
16. How does the Newton's ring pattern change when a monochromatic source is replaced by a white light?
17. Find the phase difference between two points which are 1.5 cm apart in a wave of length three metre.
18. Estimate the height of the building, if the time period of oscillation of a long pendulum suspended from the ceiling of a tall building is 8 s.