



Registration Number:
Date & Session

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU -27
B.Sc (PHYSICS)– III SEMESTER
SEMESTER EXAMINATION: OCTOBER 2022
(Examination conducted in December 2022)
PH 322 – Oscillations, Waves and Optics

Time: 2 Hours

Max Marks: 60

This paper contains two printed pages and three parts

PART-A

Answer any four questions:

(4 x 8 =32).

1. Define simple harmonic motion. Show that the combination of two simple harmonic motions of equal amplitude in perpendicular directions differing in phase by $\frac{\pi}{2}$ is a circular motion.
2. State the Fourier theorem and evaluate the Fourier coefficients.
3. What is a Zone plate? Show that the radii of half-period zones are proportional to the square root of natural numbers.
4. Obtain an expression for the shift in the fringe system when a transparent sheet is introduced in the path of one of the interfering beams in a biprism and explain how this can be used to determine the thickness of the sheet.
5. (a) Define the optic axis. State Huygens' theory of double refraction in uniaxial crystals.
(b) State and derive Brewster's law. (5+3)
6. (a) Distinguish between spontaneous and stimulated emission
(b) Explain the basic principle of optical fibre, also define Numerical aperture and Acceptance angle. (4+4)

Part B

Answer any four questions:

(4 x 5 = 20)

7. The wavelength of the He-Ne laser is 632.8 nm. Its output power is 3.147 mW. How many Photons are emitted each minute when it is in operation.
8. A particle executes SHM with an amplitude of 12cm and a period of 6 seconds. Find the velocity and acceleration of the particle at a distance of 5cm from the equilibrium position.

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9. The equation $y = 4 \sin 2\pi \left(\frac{t}{0.02} - \frac{x}{500} \right)$ represents a progressive wave. Find the amplitude, linear velocity, angular velocity, and maximum velocity of the wave.
10. A diffraction grating used at normal incidence gives a line (5400 \AA) in a certain order is superimposed on another line (4050 \AA) of the next higher order. If the angle of diffraction is 30° , what is the value of the grating constant?
11. Calculate the V-number for a fibre of a core diameter of $40\mu\text{m}$ and with the refractive indices of core and cladding of 1.55 and 1.50 respectively. The wavelength of propagating wave is 1400 \AA . Calculate the number of modes that the fibre can support.
12. Calculate the minimum thickness of a half-wave plate for a wavelength of 5893 \AA . If $\mu_o = 1.54$ and the ratio of the velocity of O- ray and E- ray is 1.007. Is the crystal positive or negative?

Part C

Answer any four questions:

(4 x 2 = 8)

13. (a) A sine wave is traveling in a medium, what is the minimum distance between the two particles always having the same speed?
- (b) Can a point on a rotating wheel be considered as executing SHM? Explain
- (c) Why Newton's rings are circular?
- (d) Why do thin films of oil or soap on the surface of water appear colored, when white light falls upon them?
- (e) In Fraunhofer diffraction, what is the effect on the diffraction pattern if the number of slits increases?
- (f) Population inversion is not possible in two levels pumping system. Explain