

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, MAY 2025

FIRST YEAR [BATCH 2024-28]

PHYSICS

Paper : 2PHYCOC1

Date : 28/05/2025

Time : 11 am – 1 pm

Full Marks : 50

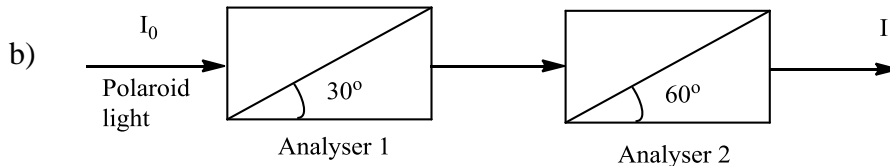
Answer **any five** questions:

[5×10]

- State whether the Newton's rings are the fringes of equal thickness or fringes of equal inclination? Explain with reason.
 - Derive the expression of nth dark ring created due to a monochromatic light of wavelength λ in presence of plane-convex lens of radius R.
 - State the nature of the central figure of Newton's ring in both theoretical and practical situation.
 - Light containing two wavelength λ_1 and λ_2 falls normally on a plano convex lens of radius of curvature R resting on a glass plate. If the nth dark ring due to λ_1 , coincides with the $(n+1)$

th dark ring due to λ_2 . Prove that the radius of nth dark ring of λ_1 is $= \sqrt{\frac{\lambda_1 \lambda_2 R}{\lambda_1 - \lambda_2}}$ [(1+2)+3+2+2]

- Explain the construction and working principle of zone plate. How does it compare its performance with a class.
 - Discuss the Fraunhofer type of diffraction produced by a single slit illuminated by monochromatic light. Obtain the position and condition for maxima and minima for intensity distribution. [(1+2+2)+(3+2)]
- What are the slow axis and fast axis in an optically active medium? Discuss about the construction of retardation plate with such medium.



What will be $I = ?$

- Find the thickness of a quarter wave plate when the wavelength of light is 5890\AA , $\mu_e = 1.533$, $\mu_o = 1.544$. [(2+2)+2+2+2]
- What is Fermat's principle? What is the modified form of this principle?
 - How do you remove chromatic aberration by using a separated doublet?
 - An achromatic cemented doublet of focal length 25 cm is to be made from a combination of an equiconvex flint glass lens ($n_b = 1.505$, $n_r = 1.498$) and a crown glass lens ($n_b = 1.662$, $n_r = 1.643$). Calculate the radii of curvature of the different surfaces and the focal length of each of the two lenses. [(2+2)+3+3]
- A point mass m is connected with a spring which supplies a restoring force proportional to displacement x from equilibrium condition with a stiffness constant s . Write down the differential equation of motion for (i) zero damping (ii) in presence of damping proportional to velocity, (iii) in presence of damping proportional to square of velocity. Proportional constant for damping can be taken as R .

- b) Construct the differential equation for case (ii) under pressure of an external force $F = F_0 e^{j\omega t}$. Solve, the equation.
- c) Consider the pulse described in terms of its displacement at $t = 0$ by $y(x, t)|_{t=0} = \frac{C}{z + x^2}$ where C is a constant. Draw the wave profile. Write an expression for the wave having speed v in the negative x direction as a function of time. If $v = 1 \text{ m/s}$ sketch the profile at $t = 2 \text{ sec}$.
[3+(1+3)+(1+1+1)]
6. a) Define phase velocity and show how group velocity forms for waves of different frequency.
b) Find a relation between phase and group velocity.
c) The phase velocity V_p of a surface wave on a liquid of density ρ and surface tension s is given by $V_p^2 = \frac{g\lambda}{2\pi} + \frac{2\pi s}{\rho\lambda}$
(i) Obtain an expression for the group velocity.
(ii) Calculate the wave length λ_0 for which V_p is maximum. [1+4+(3+2)]
7. a) Find the velocity of longitudinal waves passing through a fluid medium.
b) What is resonance in forced vibration? Explain the Q factor for resonance. Deduce its expression for a velocity resonance. [5+(1+1+3)]
8. a) Show that a uniform string of length l is plucked at $x = \frac{l}{4}$. Find the subsequent expression of vibration.
b) Draw Lissajous figure for the superposition of following vibrations,
i) $y = a \cos \omega t$
 $x = a \sin 2\omega t$ [6+4]

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