Birla Institute of Technology and Science - Pilani, K.K.Birla Goa Campus, Zuarinagar, Goa -403726

Assignment - I

First Sem.' 2017-18 Course No :- PHY F213,

Course Title:- OPTICS

MM = 50, Assignment date = 29/08/17, Due date 09/09/17

Instructions Attempt all questions.

Q1. Consider a concave mirror of radius R whose center is at (0,0,-R). A point object O is placed at $z = u = -d_u$ on the principal axis (which is the $z-$ axis). The image is formed at a point I on the principal axis given by $z = v = -d_v$. Determine the relation between u, v and R using the Fermat's Principle.

10

Q2. Consider a coordinate system in which the Horizontal direction is labelled as the $z-$ axis, and the vertical axis is labelled the $x-$ axis. This is consistent with the principal axis being regarded as the $z-$ axis and distances perpendicular to the Principal axis being measured by the variable x. If the refractive index of a medium is given by

$$n^2(x) = \begin{cases} 1 + \dfrac{x}{L} & \text{if } x > 0, \\ 1 & \text{if } x < 0, \end{cases}$$

Write down the equation of a ray (in the $z - x$ plane) that passses through the origin at an angle of 45^o w.r.t the x-axis

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Q3. The angle of a Prism is 90^o and the refractive index of the prism is $n = \sqrt{3/2}$.

a) Calculate the angle of minimum deviation, and the incident angle at which the minimum deviation takes place.

b) Calculate the angle of incidence for which an emergent ray will still barely exist.

10+5 = 15

Q4. Use the Matrix method for Paraxial optics to determine i) the System Matrix ii) the equation for image formation and iii) the magnification for the following systems. (Ensure that you use the correct sign convention) Note the object is always in region I.

a) Consider a spherical surface of radius R with its center to the left of the vertex, with the object also to the left of the vertex. Let the region to the left of the surface have a refractive index n_1 and that to the right have a refractive index n_2.

b) A thick double convex lens of radii R_{12} and R_{23}, with the distance between the two vertices $= t$, which is not negligible. Note $R_{12} > 0$ and $R_{23} < 0$. Assume that the refractive indices in the three regions are $n_1 = n_3 = 1$ and $n_2 > 1$. Note the distance d_u is measured from the left vertex V_1 and d_v is measured form the right vertex V_2. Note distances are no longer measured from the center of the lens. Further one cannot ignore the translation within the lens through a distance of t.

5+10 = 15