RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES, MIHINTALE

B.Sc. (General) Degree

Second year - Semester II Examination – September 2013

PHY 2204 - PHYSICAL OPTICS

Answer **FOUR** questions only. TIME: 2 Hours

1)

a. Prove that the equivalent focal length, F of a two lens system is given by $\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{d}{f_1 f_2}$ where f_1 and f_2 are focal lengths of the 1st and 2nd lenses respectively and d is the distance between two lenses.

b. Derive Newton's relationship for the two lens combination.

c. Two thin converging lenses of focal lengths f_1 = 15.0 cm and f_2 = 20.0 cm are placed coaxially 10.0 cm apart. (a) Calculate the equivalent focal length of the system. (b) Locate the principal points and focal points of the system. (c) Locate the image of an object placed 30 cm away from the 1st lens.

2)

a. On what factors does the refractive index of a medium depend?

b. Derive equation, $n_2\frac{1}{V}-n_1\frac{1}{U}=(n_2-n_1)\frac{1}{R}$ for the refraction at a spherical surface. All the symbols have their usual meanings.

c. Obtain the thin lens formula using above equation.

d. A thin biconvex lens has faces with radii of curvature 10 cm and 30 cm. The refractive index of the glass is 1.5. What is the focal length of the lens in air?

3)

a. In a double slit experiment m^{th} bright fringe is seen at the point "P" on the screen. Show that the distance to the m^{th} bright fringe from the central bright fringe is given by, $y_m = \frac{m\lambda L}{d}$, where, λ is the wavelength of the light, L is the distance to the screen from the two slits, d is the distance between two slits and $m = 0, \pm 1, \pm 2, \ldots\ldots$

b. Show that the intensity at a point on the screen, y distance away from the central bright fringe is given by $I = 4(A\cos\frac{\pi d}{\lambda L}y)^2$ where A is the amplitude of incident waves.

4)

a. What are the proofs for the wave nature of light?

b. Are light waves longitudinal waves or transverse waves? Give evidence for your answer.

c. What are the major differences between *Fresnel* and *Fraunhofer* diffraction?

d. What are the major differences between primary and secondary rainbows?

e. What phenomenon is used in Optical fibres?

5) What do you mean by resolving power of an optical instrument?

a. Obtain an equation for the resolving power of an optical instrument having

1) a slit with width a

2) circular aperture with diameter a.

b. Light of wavelength 600 nm is used to view an object under a microscope. If the aperture of the objective lens has a diameter of 0.9 cm, what is the limiting angle of resolution?

c. If it were possible to use visible light of any wavelength, what would be the maximum limit of resolution for this microscope?

6)

Define the Brewster´s angle

a. Linearly polarized light is incident at Brewster´s angle on the surface of a medium. What can be said about the refracted and reflected beams if the incident beam is polarized, (i) parallel to the plane of incidence and (ii) perpendicular to the plane of incidence?

b. A person observes sunrays reflected on water ($n = 1.33$) are linearly polarized. What is the angle between the sun and the horizon?

c. Explain why the sky is blue, whereas during the sunset it is red.