RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES, MIHINTALE

B.Sc. (General) Degree in Applied Sciences
Second Year – Semester II Examination –April / May2016

PHY 2204 - PHYSICAL OPTICS

Answer **all four** questions — Time allowed: **2 Hours**

The use of a non-programmable electronic calculator is permitted.

1)

a. Write down the New Cartesian sign convention used in optics.

(20 marks)

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.

(30 marks)

c. Show that the first and the second focal lengths of the spherical surfaces are given by, $f_1=-\frac{Rn_1}{(n_2-n_1)}$ and $f_2=\frac{Rn_2}{(n_2-n_1)}$ respectivly.

(30 marks)

d. Obtain following relationships.

i. $\frac{f_1}{f_2}=-\frac{n_1}{n_2}$

ii. $\frac{f_1}{U}+\frac{f_2}{V}=1$

(20 marks)

2)

a. Prove that the equivalent focal length 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.

(40 marks)

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

(20 marks)

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.

(i) Calculate the equivalent focal length of the system.

(ii) Locate the principal points and focal points of the system.

(40 marks)

3)

a. Derive the conditions for dark and bright regions in young double slit experiment diffraction pattern.

i. In a double-slit experiment, a source with slit separation 0.3 mm is located 1.5 m away from the screen. The distance between successive bright fringes on the screen is 2.30 mm. Calculate the wavelength of the light.

ii. What is the color of the light?

(50 marks)

b. Light of wavelength 600 nm is used to view an object under a microscope. The diameter of the aperture of the objective is 1.00 cm.

i. What is the limiting angle of resolution?

ii. If all the colors (wavelengths from 390 to 700 nm) in the visible spectrum can be used, what is the maximum limit of resolution for the microscope?

iii. Suppose that water (n = 1.33) fills the space between the object and the objective. What effect does this have on resolving power when 600 nm light is used?

(50 marks)

4)

a. Derive equations for the distance to bright and dark fringes from central fringe of a double slit interference experiment.

(40 marks)

b. In a double-slit experiment sources with slit separation 0.3 mm is located 1.5 m away from the screen. The distance between successive bright fringes on the screen is 2.30 mm.

   i. Calculate the wavelength of the light.

   ii. What is the color of the light?

(30 marks)

c. In Young's double-slit experiment if a beam of electron is used, what are the possible changes you expect. Explain you answer.

(30 marks)