RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Second Year - Semester II Examination – November/December 2016

PHY 2204 - PHYSICAL OPTICS

Time: Two (2) hours

Answer **all four** questions

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 $f_2=\frac{Rn_2}{(n_2-n_1)}$ respectively.

(30 marks)

d. Prove the equation $Vf_1+Uf_2=UV$ for refraction at spherical surfaces

i.

(20 marks)

2)

a. Prove that the equivalent focal length of two lenses are in contact is given by $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$ where f_1 and f_2 are focal lengths of the 1st and 2nd lenses respectively.

(40 marks)

b. Derive an equation for equivalent focal length for a thin lens combination with n numbers of lenses which are in contact. The focal lengths of the lenses are $f_1, f_2, f_3, \ldots, f_n$ respectively and the thickness of lenses are negligible compared to focal lengths.

(30 marks)

c. Two thin lenses are in contact. One of the lenses has a focal length of +10.0 cm when used alone. When the two are in combination, an object 20.0 cm away from the lenses forms a real image 40.0 cm away from the lenses. What is the focal length of the second lens?

(30 marks)

3)

a. Prove that the radius of m^{th} bright ring of Newton's rings is given by $r_m = \sqrt{(m+\frac{1}{2})\lambda R}$, where λ and R are wavelength of light and radius of curvature of the convex side of the plano-convex lens.

(30 marks)

b. Obtain an equation for the radius of m^{th} dark ring.

(20 marks)

c. In a Newton's rings arrangement, the radius of curvature of the curved surface is 50 cm. The radii of the 9^{th} and 16^{th} bright rings are 0.18 cm and 0.2235 cm respectively. Calculate the wavelength of light.

(30 marks)

d. What is the color of central ring of the Newton's ring experiment? Explain.

(20 marks)

4)

a. Drive the conditions for dark and bright regions in single slit *Fraunhofer* diffraction pattern.

(40 marks)

b. Blue light is used to obtain a diffraction pattern on a screen using a narrow slit. Without changing the experimental arrangement, blue light is replaced by red light. What will happen to the diffraction pattern?

(30 marks)

c. 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?

(30 marks)

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