RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Second Year - Semester II Examination – Oct. /Nov. 2017

PHY 2204 - PHYSICAL OPTICS

Time: Two (2) hours

Answer **all four** questions
The use of a non-programmable electronic calculator is permitted.

1.

a. 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)

b. Show that the first and the second focal lengths of the spherical surfaces are given by,

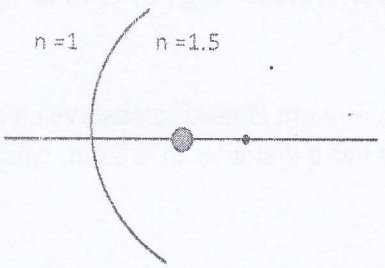
$f_1=-\frac{Rn_1}{(n_2-n_1)}$ and $f_2=\frac{Rn_2}{(n_2-n_1)}$ respectivly.

(30 marks)

c. A small air bubble is in a glass sphere of radius 5 cm. It appears to be 1.25 cm away from the surface nearer the eye as shown in the Figure.

i. What is the actual position of the bubble?

ii. What is the true diameter of the bubble if the diameter of the image is 1 cm?



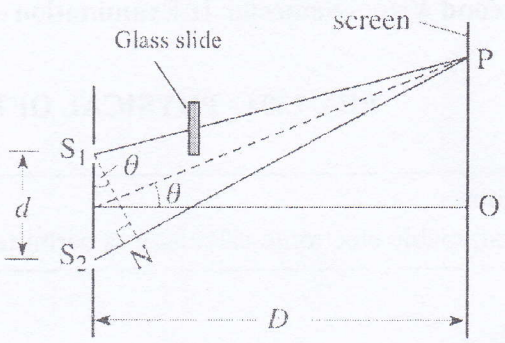
(40 marks)

2.

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

(50 marks)

b. In a double-slit experiment sodium light of 5890 Å is used. A very thin film of glass with refractive index 1.4 for sodium light is inserted normally in the path of one of the interfering waves as shown in the Figure. The central bright fringe shifts to the position of 6^{th} bright fringe. Calculate thickness of the glass slide.



(50 marks)

3.

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

(30 marks)

b. Monochromatic blue light (wavelength = 450 nm) has been used to obtain the diffraction pattern from a narrow slit on to a screen. Keeping the experimental set up unchanged if blue light is replaced by red monochromatic light (wavelength = 650 nm), what will happen to the diffraction pattern?

(20 marks)

c. Obtain an equation for the resolving power of an optical instrument having a slit width *a*.

(25 marks)

d. Light of wavelength 600 nm is used to observe an object under a microscope. If the aperture of the objective lens has a diameter of 0.8 cm, what is the limiting angle of resolution?

(25 marks)

4.

a. Two thin lenses of focal lengths f_1 and f_2 are separated in air by a distance d. Prove that the equivalent focal length F of the two lens system is given by $F = \frac{f_1 f_2}{f_1 + f_2 - d}$.

(40 marks)

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

(20 marks)

c. Briefly explain the formation of primary rainbow using relevant ray diagrams.

(40 marks)

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