RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Second Year – Semester II Examination – February/March 2019

PHY 2204 – PHYSICAL OPTICS

Time: Two (**02**) hours

Answer all the Questions.
The use of a nonprogrammable calculator is permitted.

1) a) A double slit experiment produces fringes on a distant screen. Obtain the expression for the fringe separation. (8 Marks)

b) A beam of light consisting of two wavelengths 6500 Å and 5200 Å is used to obtain interference fringes in a Young's double slit experiment.

I. Find the distance of the third bright fringe on the screen from the central maximum, for the wavelength of 6500 Å. (4 Marks)

II. What is the least distance from the central maximum to the point where the bright fringes of both wavelengths coincide? (8 Marks)

The distance between the slits is 2 mm and the distance between the plane of the slits and screen is 120 cm.

2) a) To obtain a stationary interference pattern, certain conditions are needed to be satisfied. State the conditions and standard techniques (with examples) for obtaining a stationary interference pattern. (6 Marks)

b) Derive the Brewster's law $n = tan\,\Phi$, where Φ is the polarization angle of light, the angle between polarized ray and refracted ray is 90°. n is the refractive index of the medium. (6 Marks)

c) A parallel beam of unpolarized light is incident at an angle of 58° on a plane glass surface. The reflected beam is completely polarized. What is;

I. the refractive index of glass. (4 Marks)

II. the angle of refraction of the transmitted beam. (4 Marks)

Contd.

3) a) For the Frounhofer single slit diffraction pattern, the resultant field is given by,

$$E = \frac{A \sin \beta}{\beta} \cos(\omega t - \beta)$$

I. Explain the meaning of all the symbols that used in the above equation.

(2 Marks)

II. Using this equation derive an expression for the intensity distribution.

(3 Marks)

III. Helium-Neon laser light of wavelength 633 nm passes through a single slit of width 0.1 mm. The diffraction pattern is observed on a screen 3 m away. What is the distance between the first two diffraction minima on either side of the central maxima?

(6 Marks)

b) Draw the intensity distribution produced by a two slit interference setup taking into consideration the diffraction caused at each slit.

Assume that $d = 3b$

where, d – slit separation
b – slit width

(6 Marks)

c) A double slit pattern contains exactly 9 bright interference fringes within a central diffraction peak. What is the slit separation, if slit width is 0.3 mm? (3 Marks)

4) a) Newton's rings are formed by reflection in an air film between a plane surface and a spherical surface of radius R.

Show that $\lambda = \frac{D_{n+p}^2 - D_n^2}{4pR}$, Where λ is the wavelength and D_n and D_{n+p} are the diameters of the n^{th} and $(n+p)^{th}$ rings.

(10 Marks)

b) Newton's ring arrangement is used with a monochromatic source of light of wavelength 5460 Å. With the thin film of air formed between the lens and the plate, distance between two dark rings of order 5 and 15 is found to be 2.30 mm. When the space between the lens and the plate is filled with liquid, the distance between rings of the same order becomes 1.76 mm. Determine the refractive index of the liquid.

(10 Marks)

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