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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Second Year Semester II Examination –September / October 2020

PHY 2204 –PHYSICAL OPTICS

Time: Two (02) hours

- **Answer Only four (04) questions**
- A non-programmable calculator is permitted.
- All undefined symbols or terms appear below have their usual meaning.

01. a) Prove that in the case of a thin convex lens,

$$\frac{\mu_1}{u} + \frac{\mu_2}{v} = \frac{(\mu_2 - \mu_1)}{r}$$ (5 marks)

b) A biconvex lens has a thickness of 2 cm along its axis, and spherical surfaces of 10 cm radius each. The refractive index, μ of the glass is 1.5. Obtain the position and magnification of an image formed by an object on the axis, 30 cm from the nearest surface. Take refractive index of air to be μ =1.

(9 marks)

c) Find the power of the above lens if the thickness of it is assumed to be negligibly small. Prove any formula you may use. (11 marks)

02. a) What do you mean by interference of light waves?

What are the conditions necessary to observe interference fringes? (7 marks)

b) Prove the formula for the amplitude of the n^{th} fringe of the constructive interference pattern using Young's double slit experiment. (8 marks)

c) A light source emits visible light with two wavelengths, $\lambda = 430$ nm and λ =510 nm. The source is used in a double-slit experiment in which L = 1.5 m and d = 0.025 mm. Find the distance between the second order fringes. (10 marks)

03. a) What are Newton rings? (05 marks)

b) Describe an experiment to determine the radius of curvature, R of a plano convex lens using Newton rings. (10 marks)

c) Newton's rings are observed in reflected light of $\lambda = 5.9 \times 10^{-5}$cm. The diameter of the 10^{th} dark ring is 0.5 cm. Find the radius of curvature of the lens and the thickness of the air film. (10 marks)

04. a) Draw a well labelled diagram of the Michelson Interferometer. (05 marks)

b) Explain the formation of circular fringes in Michelson Interferometer. (07 marks)

c) State the condition for obtaining white light fringes. (03 marks)

d) Define Haidinger's fringes. (03 marks)

e) In an experiment for determining the refractive index of gas using Michelson Interferometer, a shift of 140 fringes is observed when all the gas is removed from the tube. If the wavelength of light used is 5460 $\dot{A}$ and the length of the tube is 20 cm, calculate the refractive index of the gas. Derive the formula used. (07 marks)

05. a) Describe the Fraunhofer diffraction pattern obtained with a narrow slit and illuminated by a parallel beam of monochromatic light using a suitable diagram. (15 marks)

b) In a diffraction pattern of a single slit, the separation between the first minimum on both sides is 5.2 mm. The distance of the screen from the slit is 80 cm and the wavelength of the light used is 546 nm. Calculate the width of the slit? (10 marks)

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