00230

The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme

Department	: Physics
Level	: 04
Name of the Examination	: Final Examination
Course Code and Title	**: PHU 4302/PYU2164-OPTICS**
Academic Year	: 2019/2020
Date	: 21st December, 2019
Time	: 9.30 am- 11.30 am
Duration	: 2 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **06** questions in **04** pages.
3. Answer any **04** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Draw fully labelled diagrams where necessary
5. Relevant log tables are provided where necessary.
6. Having any unauthorized documents/ mobile phones in your possession is a punishable offense
7. Use blue or black ink to answer the questions.
8. Circle the number of the questions you answered in the front cover of your answer script.
9. Clearly state your index number in your answer script

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THE OPEN UNIVERSITY OF SRI LANKA

BACHELOR OF SCIENCE DEGREE PROGRAMME–LEVEL 04

FINAL EXAMINATION 2019/2020

OPTICS–PYU 2164/PHU4302

Duration: TWO HOURS (2 hrs)

Date: 21st December 2019 **Time 9.30 am -11.30 am**

Answer Four (4) questions only

1. (a). Two monochromatic waves originating from two coherent sources have the displacements represented by $y_1 = a \cos \omega t$ and $y_2 = a \cos (\omega t + \phi)$, where ϕ is the phase differences between the two displacements. Show that the resultant intensity at a point due to their superposition is given by $I = 4I_o \cos^2 \phi/2$, where $I_o = a^2$. **(25 marks)**

(b).Two sources of intensities 4I and I are used in an interference experiment. Obtain the intensity at the points where the waves from these two sources superimpose with a phase difference of zero. **(25 marks)**

(c). In a double slit experiment with monochromatic light, fringes are obtained on a screen placed at some distance from the slits. If the screen is moved by 5×10^{-2} m towards the slits, then fringe width is changed to 3×10^{-5} m. If the distance between slits is 1×10^{-3} m, find the wavelength of the light used? **(25 marks)**

(d). Light waves of wavelength 650 nm and 500 nm produce interference fringes on a screen at a distance of 1 m from a double slit of separation 0.5 mm. Find the least distance of a point from the central maximum where bright fringe due to both coincide. **(25 marks)**

2. (a) A soap bubble of 250 nm thick is illuminated by white light at normal incidence. The index of refraction of the soap film is 1.36. What colours appear strong in the reflected light? **(25 marks)**

(b). Two thin glass plates enclose a wedge shaped air film, touching at one edge and separated by a wire of 0.05 mm diameter at a distance 15 cm from that edge. Calculate the spacing between dark fringes due to the monochromatic light of wavelength $\lambda = 6000$ Å from a broad source falls normally on the film. **(25 marks)**

(c). With relevant theory explain how radius of curvature of a convex lens be determined by Newton's rings. **(25 marks)**

(d). In a Newton's ring experiment the diameters of the 5^{th} and 25^{th} dark rings are found to be 0.3 cm and 0.8 cm. If the radius of the curvature of the plano-convex lens is 100 cm, calculate the wavelength of the light used. **(25 marks)**

3. (a). Describe two differences between interference and diffraction of light. **(25 marks)**

(b). Show that the radii of half period zones of a zone plate are proportional to the square root of natural numbers. **(25 marks)**

(c). Calculate the radius of the 10^{th} zone in a zone plate of focal length 20 cm for light of wavelength 5000Å ? **(25 marks)**

(d). Prove that the area of each half period zone is approximately equal and is independent of the order of the zone. **(25 marks)**

4. (a). Explain the differences between the Fresnel and Fraunhofer classes of diffraction. **(25 marks)**

(b). A single slit diffraction pattern is formed using white light. For what wavelength of light does the second minimum coincides with the third minimum relevant to the wavelength 400 nm. **(25 marks)**

(c). In Fraunhofer double slit diffraction, the slit width is 0.06 cm and the separation between the slit is 0.30 cm. The diffraction pattern is observed on the screen at a distance of 100 cm from the slits. If the fringe separation is 0.10 cm, find the wavelength of light? Deduce the missing order of fringes. **(25 marks)**

(d). Light of wavelength 5000 Å is incident normally on a plane transmission grating. Find the difference in the angles of deviation in the first and third order spectra. The number of lines per centimeter on the grating surface is 6000. **(25 marks)**

5. (a). List four (4) methods of producing plane polarized light. **(25 marks)**

(b). State Malus's Law. A plane polarized light beam with an intensity of 500 W m^{-2} is passing through a polarizer and an analyzer. The polarizer is oriented at an angle of 60° to the vertical. The analyzer axis is at an angle 30° to the polarizer axis. Calculate the intensity of the transmitted light through the analyzer. **(25 marks)**

(c). State and explain Brewster's Law. Find the refractive index of a glass plate having the Brewster's angle of 60° 25'. **(25 marks)**

(d). Giving two examples of each, explain uniaxial and bi-axial crystals.

(25 marks)

6. (a). Discuss the construction of a Nicol Prism. **(25 marks)**

(b). Calcite has refractive indices $\mu_o = 1.658$ and $\mu_e = 1.486$. Calculate the thickness of the half-wave plate for sodium light of wavelength 589 nm. **(25 marks)**

(c). Calculate the minimum thickness of a quarter-wave plate for a monochromatic light of wavelength 600 nm, if the refractive indices of ordinary and extraordinary rays in the medium are 1.5533 and 1.5442 respectively. **(25 marks)**

(d). A tube 20 cm long with a solution of 15 *g* of sugar in 100 cc of water is placed in the path of polarized light. Find the angle of rotation of the plane of polarization if the specific rotation of cane sugar is 66° ? **(25 marks)**

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