The Open University of Sri Lanka
B.Sc. Degree Programme - Level 05
Final Examination – 2008/2009
PHU 3141/ PHE 5141 – Physical Optics
Duration: Two and Half (2 1/2) hours

Date: 23rd June 2009 **Time: 1.30 pm to 4.00 pm**

ANSWER FOUR QUESTIONS ONLY

1. (a) Describe what is meant by a wave front.

   (b) State the Huygen's principle of construction of wave fronts?

   (c) Write down the principle of superposition and find the amplitude and phase angle of the resultant wave after superposition of the two waves $y_1 = a_1 \sin(\omega t - kx + \delta_1)$ and $y_1 = a_1 \sin(\omega t - kx + \delta_1)$.

   (d) If two waves moving in the same direction have amplitudes 3 and 9 units and phase angles $3\pi/4$ and π respectively, find the resultant wave after superposition.

2. (a) Explain why it is impossible to observe interference patterns without coherent sources of light.

   (b) How do you obtain two coherent sources of light in the Young's double slit experiment?

   (c) Derive an expression that gives the positions of maximum and minimum intensities from the center of the screen in the Young's double slit experiment, with the help of a diagram.

   (d) When a thin strip of glass is placed on one slit of the Young's double slits, the central bright fringe is found to shift through a distance equal to the width of two bright fringes. If the wavelength of the source of light is 590 nm, calculate the thickness of glass strip.

3. (a) Explain how you obtain *fringes of equal thickness* and *fringes of equal inclination.*

(b) How do you explain the colours seen in thin films of soap bubbles and films of oil?

(c) Light is incident on a parallel plate of refractive index μ at an angle i with the normal and gets partially reflected and partially transmitted. The transmitted light reflects back at the lower face. When the angle of refraction is r and the thickness of the plate is t, show that the path difference of the two reflected rays is given by $2\mu t \cos r$.

(d) A parallel beam of light of wavelength 6563 Å incidents normally on a thin flat glass plate of refractive index 1.59. The reflected light is found to have a zero intensity. As the angle of incident is increased, the first maximum occurred at an angle of 2°. Calculate the thickness of the glass plate.

4. (a) Mention one simple observation in nature that supports the diffraction phenomenon of light.

(b) Explain the difference between the Fresnel and Fraunhofer diffraction by drawing necessary diagrams.

(c) What are the assumptions made in the Fresnel diffraction for obtaining a diffraction pattern?

(d) A point source of monochromatic light illuminates a circular opening of adjustable radius. When the radius of the opening is 0.56 mm, the intensity of the light spot reached the maximum for the first time on a screen at a distance of 50 cm. Calculate the wavelength of the light source.

5. (a) Explain the nature of plane polarized, circularly polarized and elliptically polarized light.

   (b) Write down two methods of obtaining polarized light.

   (c) What do you understand by the terms *birefringence* or *double refraction*?

   (b) A beam of sodium light strikes on the surface of a crystal at an incident angle of 60°. The incident plane is perpendicular to the optic axis and the crystal has been cut so that its optic axis lies parallel to the surface. Find the separation of the ordinary ray and extraordinary ray at the opposite face of the crystal, if the crystal is a plane parallel slab of thickness 4 mm. Assume that the refractive indices of the crystal for the ordinary ray and extraordinary ray of sodium light are 1.3090 and 1.3104 respectively.

6. Answer any two of the following.

   (a) Describe the working principle of the Michelson interferometer and mention some of its uses.

   (b) Explain the usage of the Cornu's spiral to find out the intensity distribution after diffracting light through a single slit.

   (c) Write down the procedure to identify unpolarized, plane polarized, circularly polarized and elliptically polarized light with an analyzer.