NATIONAL OPEN UNVERSITY OF NIGERIA
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FACULTY OF SCIENCE

SEPTEMBER-OCTOBER 2016 EXAMINATION

COURSE CODE: PHY 306
COURSE TITLE: OPTICS II
TIME: 3 Hours

INSTRUCTION: Answer question 1 and any three questions.

1. (a) Monochromatic light passes through two narrow slits 0.40 mm apart. The third-order bright fringe of the interference pattern, observed on a screen 1.0 meter from the slits, is 3.6 mm from the centre of the central maximum. What is the wavelength of the light? **8 marks**

(b) With a suitable diagram, explain Young's double-slit experiment and obtain the relevant equations for bright and dark fringes. **14 marks**

2. (a) (i) Briefly, discuss one application of thin film interference phenomenon **4 marks**
(b) Light (ª = 6000 Å) falls normally on a thin wedge-shaped film (« = 1.5).
There are ten bright and nine dark fringes over the length of the film. By how much does the film thickness change over this length? **12 marks**

3. (a) Show that the average intensity distribution for the interference fringes from two waves of the same frequency is $I_{average} = 2a^2$ where a, the amplitude is the same for the two waves.

6 marks

(b) A column of transparent material $50\ mm$ long was initially positioned in front of one of the two slits in Young experiment. The column was removed and on comparing the fringe patterns corresponding to the column with that due to argon, it was found that the entire fringe pattern on the observation screen was displaced 40 bright bands away from the side containing the column. Given that the wavelength of the light source is $5893\ Å$ for which argon has the refractive index $n_a = 1.00025$, determine the refractive index of the material of the medium. **10 marks**

4. (a) Show that for the Fresnel's biprism, the minimum angle of deviation is

$\delta_m = n - 1\ \alpha$ **6 marks**

where α angle of prism and n the refractive index.

(b) In a Fresnel's biprism experiment, the eyepiece is at a distance of 100 cm from the slit. A convex lens inserted between the biprism and the eyepiece gives two images of the slit in two positions. In one case, the two images of the slit are 4.05 mm apart, and in the other case 2.10 mm apart. If sodium light of wavelength 5893 Å is used, find the thickness of the interference fringes. **10 marks**

5. (a) Explain the origin of colours seen in thin films such as the soap bubbles. **6 marks**

(b) White light is reflected normally from a uniform oil film (« = 1.33). An interference maximum for 6000 Å and a minimum for 4500 Å, with no minimum in between, are observed. Calculate the thickness of the film. **10 marks**

6. (a) What is diffraction of waves? Briefly distinguish between Fresnel and Fraunhofer diffraction. **6 marks**

(b) Show that for a single slit diffraction, the intensity distribution is

$I = I_0 \frac{sin^2\beta}{\beta^2}$

The symbols have their usual meaning. **10 marks**