



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**  
**FACULTY OF SCIENCES**

**DEPARTMENT OF PURE AND APPLIED SCIENCE**

**2022\_2 EXAMINATIONS**

**COURSE CODE:** PHY306  
**COURSE TITLE:** OPTICS II  
**CREDIT UNIT:** 2  
**TIME ALLOWED:** (2 HRS)

**INSTRUCTION:** *Answer question 1 and any other three questions*

**QUESTION 1**

- (A) Explain the term: Simple Harmonic Motion (SHM) (3 marks)
- (B). Define amplitude of SHM (2 marks)
- (C). Explain the Phase of a vibrating particle (2 marks)
- (D). List two (2) conditions for interference of waves from two sources to occur. (2 marks)
- (E). Define interference of waves (3 marks)
- (F). Write three differences between the biprism and Lloyd's mirror fringes. (6 marks)
- (G).What are coherent waves? (2 marks)
- (H). Highlight the salient features of the resultant double slit diffraction pattern. (5 marks)

**QUESTION 2**

- (A).A ball rotates counter-clockwise in a circle of radius 3.00 m with a constant angular speed of 8.00 rad/s. At  $t = 0$ , its shadow has an  $x$  coordinate of 2.00 m and is moving to the right.
- (i) Determine the position of the shadow as a function of time in SI units. (6 marks),
  - (ii) Find the shadow's velocity and acceleration at any time  $t$  (6 marks),
- (B). State the principle of superposition of waves (3 marks)

**QUESTION 3**

- (A). If the displacement of a moving particle measured in m at any time is given by  
 $x = a \cos \omega t + b \sin \omega t$ . Show that the motion is simple harmonic. (5 marks)

(B) If  $a = 3$ ,  $b = 4$ ,  $\omega = 2$ , find (i) the amplitude (3 marks), (ii) the period (3 marks), (iii) maximum velocity (2 marks), and (iv) maximum acceleration (2 marks).

#### QUESTION 4

Two electromagnetic waves with identical frequencies have individual intensities  $I_1 = 4.00 \text{ W/m}^2$  and  $I_2 = 2.00 \text{ W/m}^2$ .

(A) What phase difference results in a maximum resultant intensity and what is that intensity? (5 marks)

(B) What phase difference results in minimum resultant intensity and what is that intensity? (5 marks)

(C) If we want a resultant wave with an intensity of  $I = 7.00 \text{ W/m}^2$ , what must the phase difference between  $I_1$  and  $I_2$  be? (5 marks)

#### QUESTION 5

(A). A viewing screen is separated from a double-slit source by 1.2 m. The distance between the two slits is 0.030 mm. The second-order bright fringe ( $m = 2$ ) is 4.5 cm from the center line.

(i) Determine the wavelength of the light. (3 marks)

(ii) Calculate the distance between adjacent bright fringes. (5 marks)

(B). Red light ( $\lambda = 664 \text{ nm}$  in vacuum) is used in Young's experiment with the slits separated by a distance  $d = 1.20 \times 10^{-4} \text{ m}$ . The screen is located at a distance of  $L = 2.75 \text{ m}$  from the slits as seen in the figure below. Find the distance  $y$  on the screen between the central bright fringe and the third order bright fringe.

