NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCES
SEPTEMBER, 2020_1 EXAMINATION

COURSE CODE: **PHY 306**
COURSE TITLE: **OPTICS II**
CREDIT UNIT **2**
TIME ALLOWED **(2 HRS)**
INSTRUCTION: ***Answer question 1 and any other three questions***

1. (a)(i) Define simple harmonic motion. 2 marks
(ii) Define the following terms: Period, Wavelength, and Amplitude 6 marks
(iii) A body vibrates in simple harmonic motion with a frequency of 50Hz and amplitude of 0.04m. Find: (a) the period (b) the acceleration at the middle and at the end of the path of oscillation. (c) the velocities at the middle and at the end of the oscillation 6 marks

(b) Explain (i) Mechanical wave (ii) Electromagnetic wave 4 marks
(ii) A traveling wave in a string is given by:
$Y = 0.03\sin(2.2x - 3.5t)$, where Y and x are in meters, and t is in seconds. Find Frequency, period, wavelength and speed of the wave. 7 marks
Total: 25 marks

2. (a)(i) Explain superposition principle 2marks
(ii) What is aromatic fringes? 2marks
(iii) State the differences between Biprism and Lloyd's mirror fringes 4marks
(b) A particle is executing simple harmonic motion, with a period of 3s and amplitude of 6cm. One – half second after the particle had passed through its equilibrium position, what is its (a) displacement (b) velocity (c) acceleration 7marks
Total: 15 marks

3. (a)(i) Given that the path difference between the interference rays in reflected light is expressed as: $2\mu t\cos r - \frac{\lambda}{2}$, state whether the following statement is true or false. Give reasons. "An excessively thin film seen in reflected light appears perfectly black". 4marks

   (ii) A thin film of 4×10^{-5}cm thickness is illuminated by white light normal to its surface($r = 0^o$). Its refractive index is 1.5. Of what colour will the thin film appear in reflected light? 5marks

   (b) State the applications of the principle of interference in thin film. 6marks

   Total: 15 marks

4. (a) Given that in a Newton's ring experiment, the air in the interspace is replaced by a liquid of refractive index 1.33, in what proportion would the diameters of the ring change. 5marks

   (b) White light is reflected normally from a uniform oil film (μ = 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. 5marks

   (c) Newton's rings are formed in reflected light of wavelength 5895×10^{-8}cm with a liquid between the plane and curved surfaces. The diameter of the fifth ring is 0.3 cm and the radius of curvature of the curved surface is 100 cm. Calculate the refractive index of the liquid, when the ring is (i) bright, (ii) dark. 5marks

   Total: 15 marks

5. (a) When one leg of a Michelson interferometer is lengthened slightly, 150 dark fringes sweep through the field of view. If the light used has λ = 480 mm, how far was the mirror in that leg moved. 5marks

   (b) In Michelson's interferometer, the readings for a pair of maximum indistinctness were found to be 0.6939 mm and 0.9884 mm. If the mean wavelength of the two components of light be 5893Å, deduce the difference between the wavelengths of the components. 5marks

   (c) When the movable mirror of Michelson's interferometer is shifted through 0.0589 mm, a shift of200 fringes is observed. What is the wavelength of light used? Give the answer in Angstrom units. 5marks

   Total: 15 marks

6. (a) Circular fringes are observed in a Michelson interferometer illuminated with light of wavelength 5896 Å. When the path difference between the mirrors M_1 and M2 is 0.3cm, the central fringe is bright. Calculate the angular diameter of the 7th bright fringe. 9marks

(b) Explain: (i) Constructive interference (ii) Destructive interference

6marks

Total: 15 marks