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**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**

**FACULTY OF SCIENCES**

**DEPARTMENT OF PURE AND APPLIED SCIENCES**

**JULY 2018 EXAMINATIONS**

**COURSE CODE: PHY 306**

**COURSE TITLE: OPTICS II**

**CREDIT UNIT 2**

**TIME ALLOWED (2 HRS)**

**INSTRUCTION: *Answer question one (1) and any other three (3) questions***

**QUESTION 1**

a) Define simple Harmonic motion. **(2 marks)**

b) A particle is executing simple harmonic motion with a period of 5 s and amplitude of 20

cm. After one-quarter of a second the particle has passed through its equilibrium position.

What is its i) displacement **(2 marks)**

ii) velocity **(3marks)** iii) acceleration. **(2 marks)**

c) Explain Michelson interferometer. **(5 marks)**

d) What is meant by diffraction? **(3marks)**

e) State and prove Brewster’s law. **(5 marks)**

f) What is the Rayleigh criterion for the resolution of two images? **(3marks)**

**QUESTION 2**

Q2. In a Young’s two-slit experiment using light of wavelength 600 nm, the slits were 0.4 mm apart and the distance of the slits to the screen was 1.20 m

Find the separation of the fringes **(4marks)**

What is the angle in radians subtended by a central pair of bright fringes at the slits? **(4marks)**

A yellow line and blue line of the mercury arc spectrum have wavelengths of 5.79 × 10-7 m and 4.36 × 10-7m respectively. Calculate the angular separation of the two lines in the first and third-order spectrum formed by a grating of 5000 lines cm-1. **(7 marks)**

**QUESTION 3**

Q3. a) Explain one of the important and simple applications of the principle of interference in the production of coated surfaces. **(4marks)**

b) 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 **(3marks)**

ii) dark. **(3marks)**

c) White light is incident normally on a sheet of glass 500 nm thick. Which wavelength in the visible range (4 × 10-7 m to 7× 10-7 m) will be reinforced by interference between the light reflection from top and the bottom surfaces of the sheet? Assume that the glass has index of refraction 1.39. **(5 marks)**

**QUESTION 4**

Q4. a) For the human eye, with a pupil diameter of about 2 mm and using a wavelength of 500 nm,

Calculate the minimum angle separating two just resolvable points.

**(4 marks)**

Find the actual minimum distance between just resolvable points as the distance between their images on the retina (take 2 cm as the lens-retina distance). **(4 marks)**

b) i) How many Fresnel zones will be obstructed by a sphere of diameter 2 mm if the screen is 40 cm away? The wavelength is 500 nm. **(4 marks)**

ii) If the distance of the screen is 5 times, what will be the size of the sphere which will cut off 10 zones? **(3 marks)**

**QUESTION 5**

Q5. a) Three polarized filters are arranged with the axes of the second and third filters

inclined at 300 and 750 respectively with respect to the first filter randomly

polarized light is incident on the first filter.

i) Find the intensity and the state of polarization of the light after it passes each

filter. **(5 marks)**

ii) If the middle filter is removed, what is the intensity and state of polarization of the

light which comes through the last filter? **(5 marks)**

b) It is desired to coat a flat sheet of glass n = 1.5 with a layer of transparent material of n =

1.3, so that light of wavelength 5.8 × 10-7m, incident normally is not reflected. What

thickness should the layer of material be? **(5 marks)**