NATIONAL OPEN UNIVERSITY OF NIGERIA
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FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

2021_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). Define period of SHM **(2 marks)**

(B). Define frequency of SHM **(2 marks)**

(C). What are the three conditions necessary for body to perform simple harmonic motion? **(6 marks)**

(D). The motion of a particle executing simple harmonic motion is represented by $y = a \sin(\omega t + \theta)$. What is the phase constant and phase of this motion?**(2 marks)**

(E). State the conditions for constructive and destructive interference in Young's double-slit experiment to occur? **(4 marks)**

(F). What are the conditions for constructive and destructive interference when a thin film is illuminated by monochromatic light, and seen in reflected light?**(4 marks)**

(G). List the three prerequisites for diffraction of light to occur **(3 marks)**

(I). Explain optical interferometer **(2 marks)**

QUESTION 2

(A). A light source emits visible light of two wavelengths: $\lambda_1 = 430$ nm and $\lambda_2 = 510$ nm. The source is used in a double-slit interference experiment in which L = 1.5 m and d = 0.025 mm. find the separation distance between the third-order bright fringes. **(9 marks)**

(B). Consider two simple harmonic waves: $y_1 = a_1 \sin \omega t$ and $y_2 = a_2 \sin (\omega t + \delta)$ of same frequency but having constant phase difference, δ. Show, by the principle of superposition that their resultant displacement is simple harmonic and of amplitude *A* **(6 marks)**

QUESTION 3

(A).A body on the end of spring oscillates with an amplitude of 5 cm at a frequency of 1 Hz. At t = 0 the body is at its equilibrium position x = 0.

(i). Write the equation describing the position of the body given the numerical values of A, ω and α in the form x = A cos (ωt + θ). **(5 marks)**,

(ii) What will be its velocity at t = 8/3 sec? **(4 marks)**,

(B). A 0.500-kg cube connected to a light spring for which the force constant is 20.0 N/m oscillates on a horizontal, frictionless track.

(i) Calculate the total energy of the system **(2 marks)**

(ii) What is the maximum speed of the cube if the amplitude of the motion is 3.00 cm? **(4 marks)**

QUESTION 4

(A) (i). Calculate the minimum thickness of a soap-bubble film (n = 1.33) that results in constructive interference in the reflected light if the film is illuminated with light whose wavelength in free space is λ = 600 nm. **(5 marks)**

(ii). Differentiate between Fraunhofer and Fresnel class of diffraction **(2 marks)**

(B) (i). Monochromatic light from a helium-neon laser (λ = 632.8 nm) is incident normally on a diffraction grating containing 6 000 lines per centimeter. Find the angles at which the first-order and second-order maxima are observed. **(6 marks)**

(ii). Define the resolving power of a diffraction grating **(2 marks)**

QUESTION 5

(A). When a narrow beam of white light shines almost perpendicular to the surface of a soap bubble, the bubble appears blue (480 nm in air) in reflected light. The index of refraction of the soapy water is approximately 1.33. What are three possible thicknesses for the wall of the soap bubble? **(9 marks)**

(B). Two strong components in the atomic spectrum of sodium have wavelengths of 589.00 nm and 589.59 nm.

(i) What must be the resolving power of a grating if these wavelengths are to be distinguished? **(3 marks)**

(ii) To resolve these lines in the second-order spectrum, how many lines of the grating must be illuminated? **(3 marks)**