120

KIBABII UNIVERSITY

2017/2018 ACADEMIC YEAR

SEOND YEARSECOND SEMESTER

MAINEXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN B.ED AND BSC(PHYSICS)

COURSE CODE: SPH 214

COURSE TITLE: PHYSICAL OPTICS

DATE: 08/8/2018TIME: 2-4PM

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWOof the remaining.

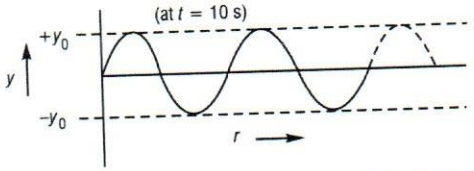
Symbols used bear the usual meaning.

QUESTION ONE (30MARKS)

a) Briefly describe the following
   i) Wave theory of light (3marks)
   ii) Newton's corpuscular theory (3marks)

b) Show that Huygens principle is in good agreement with the Snell's law of refraction (3marks)

c)



The figure shows a wave profile making a complete cycle in a second. Use it to answer the following

I. Write down the equation for such a sinusoidal varying travelling wave (1mark)
II. Determine the phase angle ϕ for a wave front at position $r = 102.5cm$ and $r = 107.5cm$ at $t = 10s$. (3marks)
III. Wave displacement y on the wave front at $r = 102.5cm$ and $r = 107.5cm$ (3marks)

d) Identify three categories of lasers (3marks)
e) Discuss the criteria for far-field and near-field diffraction (4marks)

a) Ochola a physicist wants to know how widely the red light and blue light fringes are separated on a screen one metre from a grating. The transmission grating is illuminated at normal incidence with red light at λ=632.8mm and blue light at λ=420mm. If there are 5000 slits (lines) per centimeter on the grating

I. Determine the distance between the slit centers (1mark)
II. Determine the angular deviation in 2nd order for both the red and blue lights (4marks)
III. The separation distance on the screen between the red and blue fringes (2marks)

QUESTION TWO (20 MARKS)

a) Differentiate between Fraunhoffer and Fresnel diffraction (2marks)
b) Differentiate between the various types of diffraction gratings (2marks)
c) A particular color of light is passed through a double slit. The distance between the slits is 1.4×10^{-4}m and the length from the slits to the screen is 2.50m. The second order bright fringe is measured to be 2.07×10^{-2}m from the bright central antinode. The wavelength of several colors of light are listed below

Color	Red	Orange	Yellow	Green
λ (nm)	664	622	580	520

I. Show that the color of light passed through the slits was yellow (5marks)
II. Find the distance to the 3rd order bright fringe for this color (3marks)

d) State and verify Malus law (5marks)
e) State the conditions to be satisfied for two light sources to be coherent. (3marks)

QUESTION THREE (20 MARKS)

a) Briefly explain how thin film interference occurs (4marks)

b) A light wave is incident on a thin soap bubble. Given the optical path difference due to the film is Δp and the optical path difference upon reflection is Δr,

i) Write down the expression for the condition for constructive interference to occur (1mark)

ii) If the thin film has a thickness t and refractive index $n_f$located in air, derive the expression for

I. Constructive interference at normal incidence (2marks)

II. Destructive interference at normal incidence (2marks)

c) A light wave with amplitude E_i is travelling in optical material with refractive index $n_o$strikes at normal incidence an interface with another optical material with refractive index n_f

I. Write down the expression for the amplitude of reflected wave in terms of the incident wave. (1mark)

II. Explain the physical interpretation of three cases that may arise when the case in (I) above is considered. (6marks)

d) Determine the minimum thickness of an anti-reflection coat of MgFe deposited on a glass substrate ($n_s = 1.52$) if the coating is to be highly anti-reflective for the center of the white light spectrum i.e. at $\lambda_{air} = 550nm$.(Refractive index of MgFe=1.38) (4marks)

QUESTION FOUR (20MARKS)

a) Explain why no interference pattern is observed when two coherent sources are

I. too close (2marks)

II. very far apart (2marks)

b) Highlight the differences between interference and diffraction (6marks)

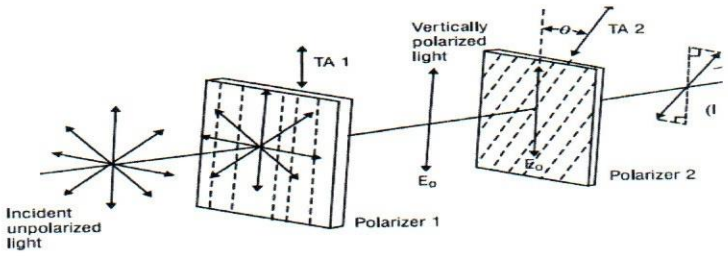
c) State and verify Brewster's law for the polarizing angle (5marks)

d) In one instance, unpolarized light in air is to be reflected off a glass ($n = 1.5$). In another instance, internal unpolarized light in a glass prism is to be reflected at the glass-air interface, where n for the prism is also 1.5. Determine the Brewster angle for each instance. (5marks)

QUESTION FIVE (20 MARKS)

a) Discuss the properties of laser light (8marks)

b) Unpolarised light is incident on a pair of polarizer's as shown



I. Determine the angle θ required between the transmission axes of polarizer 1 and 2 that will reduce the intensity of light I_o incident on polarizer 2 by 50%. (3marks)

II. For the same reduction, determine by how much the field E_o incident on polarizer 2 has been reduced. (2marks)

c) In a Young's double slit experiment, two light waves arrive on a screen placed at a distance S from slits. If the two waves interfere in the region of the space of their transmission, derive

i) the expression for their phase difference (2marks)

ii) the distance between any

1. Two consecutive bight fringes formed on the screen (3marks)

II. Two consecutive dark fringes formed on the screen (2marks)