TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTHY SCIENCES

DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATION FOR THE DEGREE OF
BACHELOR OF TECHNOLOGY IN RENEWABLE ENERGY(BTRE)
BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS (BTAP)

APS 4203: PHYSICAL OPTICS

SPECIAL/ SUPPLIMENTARY EXAMINATIONS

SERIES: September 2018

TIME: 2 HOURS

DATE: September 2018

INSTRUCTION TO CANDIDATES

You should have the following for this examination.
-Answer Booklet, examination pass and student ID.
This paper consists of FIVE questions.
Answer question ONE (COMPULSORY) and ANY other TWO questions.
The maximum marks for each question is shown.
Do not write on the question paper.
Mathematical tables and scientific calculators may be used.

Question one (30 marks)

a) Define interference and diffraction of waves and explain how they are interrelated (5marks)

b) Explain the two types of wave propagation (4marks)

c) Describe how plane polarization can be used to confirm propagation of a wave (4marks)

d) Light from a blue laser of wavelength 440nm passed through a diffraction grating and then produces 7 bright spots on screen (a central spot and three spots on each side). The two bright spots furthest from the central spot occur at $\theta = \pm 72^0$. How far are the lines in the diffraction grating? If a red laser light of wavelength 680nm is passed through the same grating, how many spots will be formed? (9marks)

e) Explain the following terms as applies to optics

i) Interference (2marks)

ii) Polarization (2marks)

iii) Diffraction (2marks)

iv) Coherence (2marks)

Question Two (20 marks)

a) Given two waves $y_1 = Sinx$ and $y_2 = 2Sin(x + \frac{\pi}{4})$

(i) Find the result wave resulting from the superposition of the two (2mark)

(ii) What is the phase difference between the waves (2mark)

(iii) Determine the values of x for which there is constructive and distructive interferences (4marks)

b) (i) Differentiate between coherent light source and incoherent light source (3marks)

(ii) Show that for constructive interference, the intensity of the resulting wave is greater than the sum of the individual wave intensities (3marks)

(iii) In a double-slit experiment, intensity at a point P on the screen, where interference of light of wavelength 560nm takes place, is 60% of maximum value. Find the minimum phase difference (in radians) between the sources and the corresponding path difference between the waves interfering at the screen (6marks)

Question Three (20 marks)

a) Figure 1 below shows interference of double slit with P as the position of m^{th} bright band. Show that for very small θ, stating any assumption or condition,

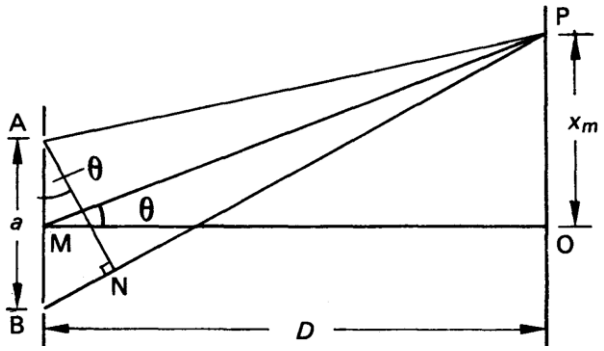

Figure 1

i) $aSin\theta = m\lambda$ (6marks)

ii) $ay = D\lambda$ where y is separation between successive bands (7marks)

b) The angle between the two first order spectra on either side of the normal is 27.7^0. Assuming that the wavelength of light is $5893x10^{-8}$cm, find the number of rulings per cm on the grating. (7marks)

Question four (20 marks)

a) Explain what plane polarization is. Give conditions under which it takes place (5marks)

b) With illustrations describe how plane polarization can be demonstrated using a rope and two open slits made in boards (7marks)

c) Describe how ordinary light can be plane polarized by reflection (8marks)

Question five (20 marks)

a) State the principle of linear superposition of waves and criteria for interference of transverse waves (3marks)

b) The width of the central maximum in the diffraction pattern is often of particular interest. Suppose that a slit $3x10^{-4}$m wide is illuminated by a yellow-green light (λ=500nm). Find the total width of the central maximum on a screen 2m from the slit. (8marks)

c) Explain two conditions upon which diffraction grating depends (6marks)

d) State conditions which must be observed for Fresnel diffraction to occur (3marks)