



KIBABII UNIVERSITY

SUPPLEMENTARY/SPECIAL UNIVERSITY EXAMINATIONS

ACADEMIC YEAR 2021/2022

SECOND YEAR SECOND SEMESTER EXAMINATIONS

BACHELOR OF SCIENCE

COURSE CODE: SPC 221

COURSE TITLE: PHYSICAL OPTICS

DATE: 28/07/2022

TIME: 8:00AM-10:00AM

INSTRUCTIONS TO CANDIDATES

Answer question ONE and any TWO of the remaining.

Time: 2 hours

KIBU observes ZERO tolerance to examination cheating

QUESTION ONE (30 MARKS)

- a) Define Physical optics (2 marks)
- b) Differentiate between a transverse wave and a longitudinal wave (2 marks)
- c) What is a wave equation? (1 mark)
- d) Differentiate between coherent and incoherent sources of light (2 marks)
- e) What is interference? (1 mark)
- f) State any two uses of infrared radiation (2 marks)
- g) State the full name of the word LASER as used in optics (1 mark)
- h) Write a 1-D wave equation for light waves and define the terms (3 marks)
- i) State Fermat's principle (2 marks)
- j) Draw a sketch of an optical fibre showing its basic parts (2 marks)
- k) Define the term optical path (2 marks)
- l) State any two methods of polarization (2 mark)
- m) What is an electromagnetic spectrum (3 marks)
- n) Name any three types of optical disks (2 marks)
- o) Give any two Maxwell's equations in Gaussian units (2 marks)

QUESTION TWO (20 MARKS)

- a) Write notes on the Young's Double-slit experiment (12 marks)
- b) Consider a double-slit arrangement with separation, $d = 0.150\text{mm}$, a viewing screen at a perpendicular distance, $D = 120\text{cm}$ from the slits and a monochromatic light source with a wavelength, $\lambda = 833\text{nm}$.
- i) What is the path difference Δ for the rays from the two slits arriving at M located a distance $y = 2.00\text{cm}$? (3 marks)
- ii) Express this path difference in terms of λ (3 marks)
- iii) Does point M correspond to a maximum, minimum or intermediate condition? (2 marks)

QUESTION THREE (20 MARKS)

- a) State what is meant by a thin film and give an example (2 marks)
- b) White light falls on a soap film with a refractive index of 1.33 at an angle of 45° . What must be the minimum thickness of the film for the reflected rays to be yellow and a wavelength of $6.0 \times 10^{-7}\text{m}$. (5 marks)
- c) Discuss how microwaves are produced, their uses and their dangers (13 marks)

QUESTION FOUR (20 MARKS)

- a) What is total internal reflection? (2 marks)
- b) Losses occurring in optical fibres are attributed to three mechanisms. Discuss the three mechanisms that the losses are attributed to. (12 marks)
- c) A step index has a numerical aperture of 0.16, a core refractive index is 1.45 and a core diameter of 90 mm, Calculate:
- i) The acceptance angle θ_c . (4 marks)
- ii) The refractive index of the cladding. (2 marks)

QUESTION FIVE (20 MARKS)

Discuss the Maxwell's wave equations and show that in a source-free region of space each Cartesian component of electric field \mathbf{E} and magnetic field \mathbf{H} satisfies the scalar wave equation with phase velocity, $V = \frac{C}{\sqrt{\epsilon\mu}}$ (20 marks)