JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE)

1ST YEAR 2ND SEMESTER 2023/2024 ACADEMIC YEAR

MAIN

SPECIAL EXAM

COURSE CODE: SPB 9106

COURSE TITLE: OPTICS

EXAM VENUE: **STREAM: EDUCATION**

DATE: **EXAM SESSION:**

TIME: 2:00 HRS

Instructions:

1. **Answer question 1 (Compulsory) and ANY other 2 questions.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

Useful constants: Speed of light in air $c = 3.0 \times 10^8\ ms^{-1}$

SECTION A

QUESTION ONE (30 MARKS)

(a) Explain the following terminologies as applied in optics

(i) Rectilinear propagation of light (1 mark)

(ii) Reflection (1 mark)

(iii) Diffraction gratings (1 mark)

(iv) Dichroism (1 mark)

(b) Distinguish between diffuse and regular reflection (2 marks)

(c) State the laws of reflection of light (2 marks)

(d) A concave mirror has a focal length of 10cm. Determine the position of the image of an object placed at a distance of 25cm from the mirror. (4 marks)

(e)Distinguish between Huygens' Principle and Fermat's principle. (2 marks)

(f) A coin at the bottom of a pool of water of depth 8m appears displaced from the bottom by 2m. Determine the velocity of light in the water. (4 marks)

(g) State three types of scattering that may occur when light is scattered by very small molecules ($d << \lambda$) (3 marks)

(h)State the principal of superposition of waves (1 mark)

(i) Show that magnification m, by a lens can be obtained from the equation

$m = \frac{v}{f} - 1$, where the symbols have their usual meanings (3 marks)

(j) State the laws of refraction (2 marks)

(k) Calculate the critical angle for zinc – selenide (n=2.5) in air. (3 marks)

SECTION B

Answer any TWO questions in this section

QUESTION TWO (20 MARKS)

(a) Show that by Fermat's principle, $\theta_i = \theta_R$ where the symbols have usual meanings.

(10 marks)

(b) An object is placed 6cm in front of a concave lens of focal length 12cm. Find the position and nature of the image. (5 marks)

(c) A telescope has an effective diameter of 10m. Determine its limiting angle of resolution for 600 nm light. (3 marks)

(d) Define optical activity; hence give an example of a material that exhibits optical activity.

(2 marks)

QUESTION THREE (20 MARKS)

(a) State two effects of rectilinear propagation of light. (2 marks)

(b) Using a labeled diagram, explain the formation of the solar eclipse (5 marks)

(c) Outline three characteristics of images formed by plane mirrors. (3 marks)

(d) Glass of unknown refractive index is shaped in the form of an isosceles prism with an apex angle of 25^o. In the laboratory, with the help of a laser beam and a prism table, the minimum angle of deviation is measured to be 15.8^o. Determine the refractive index of the glass material. (5 marks)

(e) Explain the correction of two eye defects. (5 marks)

QUESTION FOUR (20 MARKS)

(a) Derive the mirror formula (10 marks)

(b) An object is placed 12cm from a concave mirror of radius of curvature 36cm. Find the position and nature of the image . (6 marks)

(c) With aid of a diagram describe the members of electromagnetic (EM) spectrum in order of wavelength and frequency. (4 marks)

QUESTION FIVE (20 MARKS)

(a) Consider a 1550nm electromagnetic wave .What are its frequency, wavenumber and energy in vacuum. (6 marks)

(b) Consider a beam traveling from air to glass $(a^n g = 1.5)$ at an angle of incidence of 30^0. Represent the information diagrammatically, hence calculating the angle of reflection and angle of transmission. (6 marks)

(c) Name any six geometrical aberrations. (6 marks)

(d) State two properties of an image formed by a convex mirror when the object is placed beyond the centre of curvature. (2 marks)