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 1ST SEMESTER 2016/2017 ACADEMIC YEAR

MAIN

REGULAR

COURSE CODE: SPH 103

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 1 (30 MARKS)

(a) Define the following terms as used 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 2(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 3 (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) Explain two eye defects. **(4 marks)**

QUESTION 4 (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 calculate 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)**

QUESTION 5 (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)