OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2019 /2020 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

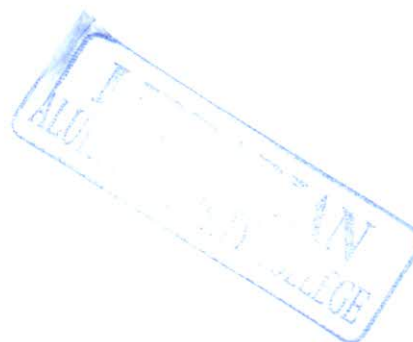COURSE CODE: PHY 121

COURSE TITLE: GEOMETRIC OPTICS

DATE: 15TH OCTOBER, 2020   TIME: 0900 – 1200 HRS

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

THIS PAPER CONSISTS OF 4 PRINTED PAGES   PLEASE TURN OVER

REGULAR – MAIN EXAM

PHY 121: GEOMETRIC OPTICS

STREAM: Bed Sc.   **DURATION: 3 Hours**

INSTRUCTIONS TO CANDIDATES

   i.   *Answer Question **ONE** and **TWO** in **SECTION A** and any other **THREE** questions in*
       SECTION B.

  ii. *Where necessary the following constants maybe used:*

Refractive index of air=1
Refractive index of water = 1.33
Refractive index of glass = 1.5
Velocity of light in vacuum/air=$3 \times 10^8 m/s$

SECTION A (28 MARKS)

Section A (28 marks)

Question one (14 marks)

   a)   With relevant examples distinguish between geometric and quantum optics.(4 marks)

   b) State two characteristics of images formed by plane mirrors.   (2marks)

   c) With appropriate illustration show that for curved mirrors $r = 2f$.   (4 marks)

   d) A certain prism is found to produce a deviation of 51°, while it produces a deviation
       of 62.8° for two values of the angle of incidence namely 40.1° and 82.7°
       respectively. Determine the refracting angle of the prism, the angle of incidence at
       minimum deviation and the refractive index of the material of the prism.
       (4 Marks)

Question two (14 marks)

   a) Deduce the expression $n_1 \sin i = n_2 \sin r$.   (4 marks)

   b) A ray of light of wavelength 500 nm is incident on a transparent surface from air. If
       the incident ray makes an angle of 55° with the normal and the refracted ray makes an
       angle of 40° with the normal. Calculate the refractive index of the material. (4 marks)

   c) State the Huygens principle.   (2 marks)

   d) One end of a cylindrical glass rod of refractive index 1.5 is a hemispherical surface of
       radius of curvature 20 mm. An object is placed on the axis of the rod at 80 mm to the
       left of the vertex of the surface. Determine the position of the image.   (4 marks)

SECTION B (42 MARKS)

Question three (14 marks)

    a) State any two types of convex lenses   (2 marks)

    b) Define the following terms as relating to thin lenses   (2 marks)

        i.   Optical Centre

       ii.   Focal point

    c) With appropriate illustrations derive the lens's marker's equation:

    $1/f = (\eta-1)(1/R_1 - 1/R_2)$, where the symbols have their usual meaning   (6 marks)

    d) An object is placed 30.0 cm from a converging lens of focal length 10.0cm. By construction of ray diagrams determine the image distance and describe the image.
        (4 marks)

Question four (14 marks)

    a) Give three advantages of using a reflector telescope in astronomy   (3 marks)

    b) Using appropriate diagrams/illustrations explain the functioning of a terrestrial microscope   (7 marks)

    c) An object is located 20.0 cm to the left of a diverging lens of focal length $-32.0cm$. Determine:

        i.   The location of the image   (2 marks)

       ii.   Magnification of the image.   (2 Marks)

Question five   (14 marks)

    a) Draw a well labeled ray diagram explaining short sightedness and how it can be corrected.   (6 Marks)

    b) A near sighted person cannot see objects clearly that are beyond 50cm from his eye. Determine the focal length and powers of the glasses that will enable him see distant objects clearly.   (2 Marks)

    c) Differentiate between chromatic and spherical aberration   (4 Marks)

    d) Explain why a mirror cannot give rise to chromatic aberration.   (2 Marks)

Question six (14 marks)

    a) Distinguish between fiber optics and optical fiber   (2 marks)

    b) Explain the relevance of total internal reflection in fiber optics   (3 marks)

    c) State any five advantages optical fiber over copper wire   (5 marks)

d) A ray of light traveling in water is incident on an interface with a flat piece of glass. The wavelength of the light in the water is 726 nm and its wavelength in the glass is 544 nm. If the ray in water makes an angle of 42°with respect to the normal to the interface, what angle does the refracted ray in the glass make with respect to the normal   (4 Marks)

Question seven (14 marks)

a) i. Show that the deviation by a small angle prism is given as:

$d= (\mu-1) A$ (5 marks)

ii. Briefly explain the interpretations of the formula in (i) above   (2 marks)

b) The refracting angle of a prism is 62° and the refractive index of the glass for yellow light is 1.65. What is the smallest possible angle of incidence of a ray of this yellow light which is transmitted without total reflection?   (4 marks)

c) Give three applications of concave mirrors   (3 marks)

****