CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN GEOPHYSICS

GPHY 316: PHYSICS OF EARTH

STREAMS: BSC Y3S2 **TIME: 2 HOURS**

DAY/DATE: MONDAY 08/04/2024 **2.30 P.M – 4.30 P.M.**

QUESTION ONE (30 MARKS)

a. Explain three main classes of magnetic behavior that can be distinguished on the basis of magnetic susceptibility (3 Marks)
b. Explain the origin of earth's magnetic fields (4 Marks)
c. Explain why there no magnetic field in the mantle (3 Marks)
d. Differentiate between the S and P Waves (3 Marks)
e. Estimate the gravitational force exerted between you and your nearest neighbor in this lecture theatre (3 Marks)
f. What will happen to the orbiting satellite if it starts to slow down? (2 Marks)
g. Explain two categories of earth crust (3 Marks)
h. On earth it looks like the sun is moving across the sky. Why is this not true (4 Marks)
i. What would happen if earth did not rotate (3 Marks)
j. Explain the two solstice (2 Marks)

QUESTION TWO (20 MARKS)

a. Explain the layers of earth clearly stating their composition and temperature ranges(6 Marks)
b. An Earth satellite of mass 200 kg lost energy slowly through atmospheric resistance and fell from an orbit of radius 8.0×10^6 m to 7.8×10^6 m. Calculate the changes in the potential, kinetic and total energies of the satellite as a result of this transition.(Given mass of Earth = 6.0×10^{24} kg)

(5 Marks)

c. What are some of advantages and disadvantages of using seismic methods (9 Marks)

QUESTION THREE (20 MARKS)

a. Show that Potential Differences Near Earth's Surface is (6 Marks)

$$\Delta V = \frac{GM_e m}{r_e}\left(\frac{\alpha}{1+\alpha}\right)$$

b. Explain how earthquakes tell us information about the structure of the earth (4 Marks)
c. Explain the Source of the Heat in Earth's Interior (4 Marks)
d. What drives earth's magnetic field (6 Marks)

QUESTION FOUR (20 MARKS)

a. Explain the working of the following magnetometers
   i. Fluxgate Magnetometers (6 Marks)
   ii. Proton Precession Magnetometer (4 Marks)

b. What drives earth's magnetic field (5 Marks)

c. A space capsule is travelling between the Earth and its Moon. Considering only the gravitational forces of the Earth and the Moon, determine the position (in terms of the distance from the center of the Earth) where the capsule experiences zero net gravitational force. (Given: Mass of the Earth, $ME = 6.0 \times 10^{24}$ kg; mass of the Moon, $MM = 7.4 \times 10^{22}$ kg; distance between the centers of the Earth and Moon, $D = 3.8 \times 10^{8}$ m) (5 Marks)

QUESTION FIVE (20 MARKS)

a. What is a geostationary satellite (1 Mark)
b. Show that for a satellite in an orbit its total energy is given by

$E_T = -\frac{GMm}{2r}$ [Note: $E_T = -E_K$ or $\frac{1}{2} E_P$] (6 Marks)

c. Give three conditions that a satellite should meet in order to move in a geostationary orbit (3 Marks)

d. A spacecraft was launched from earth into a circular orbit around earth that was maintained at an almost constant height of 189 km from the earth's surface. Assuming the gravitational field strength in this orbit is $9.4 Nkg^{-1}$, and radius of earth is 6370 km, calculate the speed of the spacecraft in this orbit (4 Marks)
e. Give the advantages and disadvantages of geostationary satellite (6 Marks)
