TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN ENVIRONMENTAL PHYSICS &RENEWABLE ENERGY (BTRE)

APS 4217: GEOPHYSICS

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination
-Answer Booklet, examination pass and student ID
This paper consists of **FIVE** questions.
Attempt question **ONE (COMPULSORY)** and any other **TWO** questions
Do not write on the question paper.

Question ONE (30Marks)

(a) i. Acceleration due to gravity on the earth's surface is a function of latitude. Explain this statement. (3mks)

ii. State Newton's Law of universal gravitation. (2mks)

iii. Assuming the earth to be a uniform sphere of mass M_e and radius r_e, show that the acceleration of free fall to the earth's surface is given by

$$g=\frac{Gm_e}{r_e^{\,2}} \quad \text{(3mks)}$$

(b) i. Distinguish between absolute and relative gravity measurements. (2mks)

ii. In a symmetrical free fall determination of gravity, the distance between the upper and lower levels is 1 metre. The falling mass crosses the upper and lower level after 0.80809 seconds and 0.92572 seconds respectively. Calculate the absolute gravity at the station. (4mks)

(c) I. Define the following terms as used in geomagnetism:

i. Inclination angle (1mk)

ii. Declination angle (1mk)

iii. Secular variation (1mk)

iv. Magnetic susceptibility (1mk)

II. Outline three precautions taken by an operator of a magnetometer (3mks)
III. Describe three parts of geomagnetic field and explain their sources (3mks)
IV. State three advantages of conducting an airborne magnetic survey over a ground survey (3mks)
V. Describe any three corrections that should be done on gravity data (3mks)

Question TWO (20 Marks)

(a) Define with the aid of diagrams the following elastic moduli:
   i. Bulk modulus (3mk)
   ii. Shear modulus (3mks)
(b) Outline the two types of body waves and give formulas that express their wave velocities, defining all terms used. (6mks)
(c) Describe any three sources of energy used to generate seismic waves (6mks)
(d) Distinguish between 'apparent' and 'true' resistivity. (2mks)

Question THREE (20Marks)

(a) Define the following terms:
   (i) Reference ellipsoid (1mk)
   (ii) Geoid (1mk)

(b) Explain what is inferred in qualitative and quantitative interpretation of gravity data. (4mks)
(c) With the aid of a diagram, show the paths of the following seismic rays through the earth
   i. PPP
   ii. SPP
   iii. P_cP
   iv. $P_{KIK}P$ (4mks)

(d) Explain how magneto telluric (MT) technique is used in (4mks)
   (i) Geothermal exploration
   (ii) Iron ore exploration

(e) Briefly explain what the following magnetic enhancement techniques mean (6mks)
   (i) Regionals removal
   (ii) Local anomalies removal
   (iii) Reduction to the pole.

Question FOUR (20Marks)

(a) Define the following terms in relation to seismic waves (4mks)

i. Acoustic impedance
ii. Reflection coefficient
iii. Critical refraction
iv. Diffraction

(b) A P-wave obliquely incident on an interface of acoustic impedance contrast. With the aid of a diagram, show the reflected and refracted rays (3mks)

(c) The table below shows refraction data collected to determine the depth of a sedimentary section:

Geophone Distance, X(cm).	Arrival Time(ms)
5	4.5
10	9.2
15	13.4
20	18.0
25	20.1
30	22.2
35	23.9
40	26.0
45	28.1
50	29.8

(i) Plot a travel time graph (4mks)
(ii) Determine the velocity of the seismic wave in the sedimentary layer in m/s (6mks)
(iii) Determine the depth of the sedimentary layer (3mks)

Question FIVE (20Marks)

(a) With the aid of a diagrams, describe the electrode layout for the following arrays

i. Schlumberger (2mks)
ii. Wenner (2mks)
iii. Dipole-Dipole (2mks)

(b) Outline any two advantages of Wenner sounding over Schlumberger sounding (2mks)

(c) i. Show that the apparent resistivity for Schlumberger configuration is given by: (4mks)

$$\rho_a = \frac{\Pi L^2 \Delta V}{2IX}$$

Where L and X are distances from centre of the array to the current electrode and potential electrodes respectively.

ii. The resistivity data below was obtained from Schlumberger sounding for a particular station.

$\frac{AB}{2}$ (m)	Current (mA)	P.d (mV)	MN (m)
50	73	1.95	5
100	71.5	0.10	5

Calculate the apparent resistivity for $\frac{AB}{2}$ equals to 50 and 100 metres and comment on the values. (4mks)

iii. Outline two applications for VES and CST. (4mks)