



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
- $$g = \frac{Gm_e}{r_e^2} \quad (3mks)$$
- (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
 - (i) Geothermal exploration (4mks)
 - (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)