CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATIONS

FOURTH YEAR EXAMINATIONS FOR THE AWARD OF DEGEE IN BACHELOR OF SCIECE AND BACHELOR OF EDUCATION SCIENCE

PHYS 416: APPLIED GEOPHYSICS

STREAMS: B.Sc & BED (SC) **TIME: 2 HOURS**

DAY/DATE: FRIDAY 14/12/2018 **11.30 A.M - 1.30 P.M.**

INSTRUCTIONS

- **Answer Question ONE and any other TWO Questions.**

QUESTION ONE: [30 MARKS]

1) a) Define the following [3 Marks]

i) Young's modulus
ii) Bulk modulus
iii) Acoustic impedance

b) State and explain two types of surface waves [4 Marks]

c) Explain how acoustic impedance affects transmission of seismic waves in rock layers [2 Marks]

d) Compression ray travels with a velocity of 2.1×10^3 m/s in a rock material of density 267 kg/m^3 and at a velocity 1.6×10^3 in a rock layer of density 295 kg/m^3, calculate its reflection coefficient [5 Marks]

e) State two types of seismic survey [2 Marks]

f) Explain briefly the principle behind electrical methods in geophysical survey [4 Marks]

g) With the aid of a diagram explain the Wenner configuration [3 Marks]

h) State the limitations of the resistivity method [3 Marks]

i) Explain the factors affecting wave amplitude at detection station [2 Marks]

j) Describe the occurrence of critical refraction [2 Marks]

QUESTION TWO: [20 MARKS]

2 a) An incident P-wave strikes an interface between two different rock types. The upper layer has a compression wave velocity of 1200 m/s. The lower layer has a compression wave velocity of 3800 m/s and a shear wave velocity of 1900 m/s. The incident angle is 18^0. Calculate the angle of refraction for the P and S waves. [7 Marks]

b) What is the crossover distance for direct andcritically refracted rays in the case of a horizontalinterface at a depth of 200m separating a toplayer of velocity 3.0kms-1 from a lower layer ofvelocity 5.0kms^{-1}? [6 Marks]

c) With the aid of a diagram show that the travel time for reflected ray is given [7Marks]

$$t = \frac{(x^2 + 4z^2)^{\frac{1}{2}}}{v_1}$$

QUESTION THREE: [20 MARKS]

3 a) What is a hidden layer [2 Marks]

b) The following dataset was obtained from a reversed seismic refraction line 275 m long. The survey was carried out in a level area of alluvial cover to determine depths to the underlying bedrock surface.

Offset (m)	**Travel time (ms)**
Forward direction	
12.5	6.0
25	12.5
37.5	19.0
50.0	25.0
75.0	37.0
100.0	42.5
125.0	48.5
150.0	53.0
175.0	57.0
200.0	61.5
225.0	66.0
250.0	71.0
275.0	76.5
Reverse direction	
12.5	6.0
25.0	12.5
37.5	17.0
50.0	19.5
75.0	25.0
100.0	30.5

125.0	37.5
150.0	45.5
175.0	52.0
200.0	59.0
225.0	65.5
250.0	71.0
275.0	76.5

Carry out a plus–minus interpretation of the dataand comment briefly on the resultant bedrockprofile. [15 Marks]

c) Is the bed rock characterized by dipping interface, explain. [3 Marks]

QUESTION FOUR: [20 MARKS]

4 a) Using the method of electrical images, derivethe relationship between apparent resistivity,electrode spacing, layer thicknesses and resistivitiesfor a VES performed with a Schlumbergerspread over a single horizontal interfacebetween media with resistivities r_1 and r_2. [7 Marks]

b) Calculate the variation in apparent resistivityalong a CST profile at right angles to a verticallyfaulted contact between sandstone and limestone,with apparent resistivities of 50ohmm and600ohmm, respectively, for a Wenner configuration.What would be the effect on the profiles ifthe contact dipped at a shallower angle? [7 Marks]

c) If a CST were to be performed along theprofile, select, giving reasons, a suitable electrodespacing to map the basement. Sketch theexpected form of the CST for both longitudinaland transverse traverses. [6 Marks]

QUESTION FIVE: [20 MARKS]

5 a) What physical property is studied in seismic survey [2 Marks]

b) To find the depth to bed rock in a damp site survey travelling times are measured from the shot point to 12 geophones laid out at 15 m interval in a straight line through the shot point. The offset x range from 15 m to 180 m, determine the depth of overburden from the data.

X (m)	T (ms)	X (m)	T (ms)
15	19	120	68
30	29	135	72
45	39	150	76
60	50	165	78
75	59	180	83
90	62	195	87
105	65	210	91

[12 Marks]

c) A single-ended refraction profile designed to determine the depth to an underlying horizontal refractor reveals a top layer velocity of 3.0kms^{-1} and a refractor velocity of 5.0kms^{-1}. The crossover distance is found to be 500 m. What is the refractor depth? [6 Marks]

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