



MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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UNIVERSITY EXAMINATIONS 2023/2024

FOURTH YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN PHYSICS, BACHELOR OF SCIENCE (MATHEMATICS
AND PHYSICS) AND BACHELOR OF SCIENCE (PHYSICS)

SPH 3456: APPLIED GEOPHYSICS

DATE: APRIL 2024

TIME: 2 HOURS

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

- State and distinguish between the two main categories of geophysical exploration methods (4 Marks)
- Describe magnetic permeability of rocks and give example of geological materials with high permeability (4 Marks)
- In exploration what can we use to infer that rocks or materials are porous (4 Marks)
- Explain frequency domain electromagnetics (5 Marks)
- Calculate the maximum gravity anomaly at ground level over a buried anticlinal structure, modelled by a horizontal cylinder with radius 1000 m and density contrast 200 kg m^{-3} , when the depth of the cylinder axis is 1500 m (3 Marks)
- A plane seismic wave, travelling vertically downwards in a rock of density 2200 kg m^{-3} with seismic velocity 2000 m s^{-1} incident on the horizontal top surface of a rock layer of density 2400 kg m^{-3} and seismic velocity 3300 m s^{-1} .



MUST is ISO 9001:2015 and



ISO/IEC 27001:2013 CERTIFIED

- i. What are the amplitude ratios of the reflected and the transmitted waves. (3Marks)
 - ii. What fraction of energy of the incident wave is transmitted into the lower medium. (3 Marks)
- g) The p-wave from an earthquake arrives at a seismograph station at 10:20 a.m. and the S wave arrives at 10:25 a.m. Assuming that the P-wave velocity is 5 kms _____ and that Poisson's ratio is 0.25, compute the time at which the earthquake occurred (4 Marks)

QUESTION TWO (20 MARKS)

- a) A plane seismic wave travels vertically downwards at a velocity of 4800 ms^{-1} through a salt layer with density 2100 kg m^{-3} . The wave is incident upon the top surface of a sandstone layer with density 2400 kg m^{-3} . The phase of the reflected wave is changed by 180° and the reflected amplitude is 2% of the incident amplitude. What is the seismic velocity of the sandstone? (10 Marks)
- b) A strong earthquake off the coast of Japan sets off a tsunami that propagates across the Pacific Ocean (average depth $d=6.4 \text{ km}$).
- c) Calculate the velocity of the wave in km/hr (5 Marks)
- d) The corresponding wavelength, when the wave has a dominant period of 24 min (5 Marks)

QUESTION THREE (20 MARKS)

- a) Explain The gradient method of self-potential surveying clearly outlining its working principles, sources of errors and how they can be minimized (12 Marks)
- b) Describe the sources of time variations in the Earth magnetic field? (8 Marks)

QUESTION FOUR (20 MARKS)

- a) Describe the three main sources of magnetic field on the earth (10 Marks)
- b) Prove that the total magnetic field (F) at north pole is twice as at the equator? (10 Marks)

