



B.Sc. Degree Programme (Level – 05)

Final Examination – Fundamentals of Geophysics

PHU 3159/PHE 5159

Date: 21st June 2008

Duration: 2 ½ Hours

From 13.30 hrs - 16.00hrs

Answer **FOUR (04)** questions. **SHORT ANSWERS ARE PREFERRED.** Answers should be illustrated with sketch maps and diagrams where appropriate. Each question is allocated 25 points, and the marking scheme is given in *italics*

1. (a) What is the lithosphere? How are its boundaries defined? On what evidence is its existence based? (5 points)
- (b) Briefly explain how you would locate an earthquake using travel times of S and P waves. (5 points)
- (c) What are the processes that seismic waves undergo when they interact with subsurface geological strata? Explain how these are used to investigate the interior of the earth. (5 points)
- (d) Define focus and epicenter of an earthquake. How deep are (i) shallow focus earthquakes (ii) intermediate focus earthquakes (iii) deep focus earthquakes? (10 points)
2. (a) What is Newton's law of gravitation? What is the meaning of each variable or constant? (5 points)
- (b) Explain how we can measure gravity or gravity differences using free-falling masses, pendulums and gravity meters (10 points)
- (c) Give the reasons why the values of g measured at poles are different from the equator. (5 points)
- (d) State the discoveries of some geologically important bodies/structures using the method of Gravity anomaly (5 points)
3. (a) Define: conductivity, resistivity, apparent resistivity (5 points)
- (b) What are the units for resistivity and resistance? (5 points)
- (c) Write down the expression used to calculate apparent resistivity from field electrical measurements using the Wenner electrode array. Include a sketch to define all terms (5 points)
- (d) Describe how you would carry out a resistivity sounding test to determine the depth to the water table. Explain how the method of images can be used to derive model data as part of the interpretation process (10 points)



4. (a) Describe the Snell's law in seismic method. (5 points)
- (b) Describe the four basic modes (or "seismic rays") used in seismic investigations. (5 points)
- (c) What is a seismograph? (5 points)
- (d) Derive travel-time equation of reflected seismic wave arrivals (two layer case, horizontal interface): $T(x) = \sqrt{\left(\frac{x}{V_1}\right)^2 + \left(\frac{2d}{V_1}\right)^2}$ (10 points)
5. (a) How is the earth's magnetic field generated? Explain the elements of the earth's magnetic field with illustrated diagrams. (5 points)
- (b) What happens to the strength of the Earth's magnetic field during a magnetic reversal? (5 points)
- (c) Define magnetic susceptibility. How can magnetic susceptibility data be used to determine bedding or foliation directions in rock samples? (5 points)
- (d) Why are magnetic prospecting methods more complicated than gravity prospecting methods? (5 points)
- (e) What are magnetic prospecting methods most commonly used for? (5 points)
6. (a) What is geochronology? (5 points)
- (b) What is radioactivity? What changes take place during radioactive decay? Define half life, parent element, daughter element. (10 points)
- (c) How can natural radioactivity be used in geophysical exploration? (10 points)
7. (a) What is ground penetrating radar? (5 points)
- (b) Discuss the basic principles behind the ground penetrating radar (10 points)
- (c) What are the advantages and limitations of ground penetrating radar? (10 points)
8. (a) Briefly explain the mechanism of a proton precession magnetometer. (5 points)
- (b) Magnetic substances fall into several classes depending on their behaviour when placed in an external magnetic field. Briefly explain the properties of different types of magnetism. (10 points)
- (c) A magnetizable body placed in an external magnetic field becomes magnetized by induction. Using the hysteresis loop describe the behaviour of the total magnetic field during a complete cycle of magnetization of a ferromagnetic material (10 points)

