



Date: 5<sup>th</sup> July 2011

Duration: 2 ½ Hours  
(1.30pm - 4.00pm)

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 brackets. Non-programmable calculators are permitted.

1. (i) Define the term 'potential difference' as used in resistivity method. (5 points)
  - (ii) How can you map the electric field produced when a current is passed through the ground? (5 points)
  - (iii) "The resistivity method can be successfully applied to interpret the subsurface geological formations though most of the earth materials are considered as insulators". Discuss the above statement. (15 points)
2. A Resistivity profiling was carried out using Schlumberger array at point 'P' (center point). The distance from 'P' to any current electrode ( $L/2$ ) and the distance from 'P' to any potential electrode ( $l/2$ ) is given in the Table below. Calculate
    - (i) the geometric constant (K) and resistivity values ( $\rho$ ) for each electrode separation and construct the resistivity curve. (15 points)
    - (ii) According to the results of above (i), how many subsurface layers are present in the profiling area? (10 points)

$L/2$ (m)	$l/2$ (m)	K (m)	R( $\Omega$ )	$\rho(\Omega\text{m})$
1.5	0.5		79.62	
2	0.5		39.05	
3	0.5		13.10	
4.5	0.5		1.91	
6	0.5		0.53	
8	0.5		0.17	
10	0.5		0.10	
12.5	2		0.23	
15	2		0.14	
20	2		0.08	
25	2		0.05	

(The geometric constant for the Schlumberger array is given as,  $K = \frac{\pi(l^2 - l'^2)}{4l}$ )



3. (i) List the main segments of the <sup>GPS</sup>GIS. (5 points)
- (ii) <sup>GPS</sup>GIS is considered as a real-time information system. Give the reasons. (5 points)
- (iii) List the advantages of such real-time information systems compared to the conventional information systems such as drawings, maps, aerial photographs etc. (15 points)
4. (i) Define magnetic susceptibility. (5 points)
- (ii) How can magnetic susceptibility data be used to determine bedding or foliation directions in rock samples? (5 points)
- (iii) Name the main components of the geomagnetic field. (5 points)
- (iv) "Igneous rocks can be used to interpret the changes of the Earth's magnetic field over geologic time periods". Support the above statement. (10 points)
- (5) (i) What is Newton's law of gravitation? Give the meaning of each variable or constant in its mathematical expression. (3 points)
- (ii) Given that  $G=6.672 \times 10^{-11} \text{m}^2\text{kg}^{-1}\text{s}^{-2}$ , that  $g = 9.8 \text{ m/s}^2$ , and that the radius of the earth is 6366 km, calculate the mass of the earth. (5 points)
- (iii) What is the difference in the value of gravity on top of Mountain Everest compared to that at sea level? Peak of Everest is 8850 m above sea level. (5 points)
- (iv) At birth assume that you (weight of 3kg) were delivered by a Doctor with a mass of 75 kg, and that the Doctor's center of mass was 0.5 m from yours. Also assume that at that very point in time, Mars was closest to the earth or about  $78 \times 10^6$  km from your center of mass. The mass of Mars is approximately  $6.42 \times 10^{23}$  kg. Determine the acceleration due to the gravitational field of the doctor and of Mars. (12 points)
6. (i) Describe the Snell's law in seismic method. (5 points)
- (ii) Describe the four basic modes (or "seismic rays") used in seismic investigations. (5 points)
- (iii) What is a seismograph? (5 points)
- (iv) 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)

