

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

MAPH 5237 – GEOELECTRIC AND EM METHODS

MSc PART 1: JUNE 2005

DURATION: 4 HOURS

ANSWER ALL QUESTIONS.

1. Vertical Electrical Sounding (VES) can produce an electrical resistivity section which may be very different from the geological section for the area. Explain why. (5)

2. What appears to be a green field site is to be developed. It is known that during the Second World War, anti-aircraft gun emplacements were somewhere on the site, but there is no surface evidence and records have been lost. Steel reinforced concrete would have been used in the construction of the bases of these emplacements. In addition, the site is of archaeological interest as traces of ancient walls and possible ditches have been discovered over the years.

Suggest one ideal method of geophysical site investigation that may be used to map the area, and determine the position of both the ancient and modern remains. Why is the method appropriate? Give details of the method, describing how data is collected and interpreted. (20)

3. In resistivity surveying:
 - (i) Explain why the four-electrode measurement technique is normally used. (3)
 - (ii) Given that the potential at a distance, r_1 from a point source of current on the surface of a homogeneous earth of resistivity ρ is $\phi = \frac{I\rho}{2\pi r}$, derive the equation for the apparent resistivity of the Schlumberger Array. (10)
 - (iii) Briefly discuss the factors, which influence the resistivity of rocks. (10)

4. Name 4 situations where natural potential differences occur, and describe two in detail. (20)

5. Illustrate the relationship between apparent resistivity and electrode spacing. (5)
6. IP is known to be able to function in the Time Domain and in the Frequency Domain. Explain the differences between the two techniques. (5)
7. (i) In calibration of your TDEM instruments explain how you can determine their resolution power in relation to earth model layering. (5)
- (ii) Explain the existence of a descending branch in the early stages in all apparent resistivity curves in TDEM. (2)
- How is this descending branch interpreted? (1)
8. Compare the depths of exploration of the VLF method to that of the Magnetotelluric method, explaining how depth is determined in each case. (5)
- Specify the targets of VLF and Magnetotelluric methods. (4)
- VLF is more effective in areas where the host rock is resistive and the overburden is thin. Explain. (5)

THE END