NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

MAPH 5237 – GEOELECTRIC AND EM METHODS

MSc PART 1: JUNE 2004 DURATION: 4 HOURS

ANSWER **ALL** QUESTIONS. **SECTION A** CARRIES **40 MARKS** & EACH QUESTION IN **SECTION B** CARRIES **20 MARKS**.

SECTION A

1. (a) Describe briefly two of the field techniques for the measurement of spontaneous potentials. State the advantages and disadvantages of each technique. [6]

(b) (i) What does the depth of investigation with four electrode collinear array depend on? Explain your answer. [4]

(ii) Explain why porous pot electrodes are used in standard electric resistivity surveying [3]

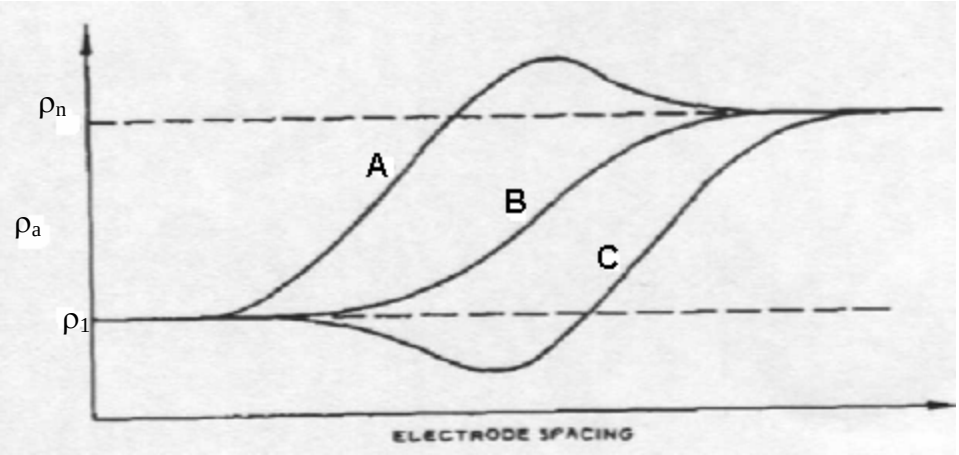
(c) In a conventional horizontal loop EM (HLEM) survey, measurements are taken at two frequencies f_1 = 222 Hz and f_2 = 3555 Hz. What is the depth of penetration of the electromagnetic waves in:

(i) Resistive environment (ρ_1 = 10 000 Ωm) and

(ii) Conductive environment (ρ_2 = 30 Ωm) [5]

(d) With the aid of a diagram, describe the Wenner electrode configuration used in electrical investigations and show how the value of ground resistance is converted to ground resistivity [6]

(e) Consider the following three (A, B, C) hypothetical apparent resistivity curves.



Explain the three apparent resistivity curves by giving the corresponding earth models [6]

(f) Explain the origins of the telluric currents [3]

(g) Explain the physical difference between IP in the 'time domain' and IP in the 'time domain'. [4]

(h) Give and explain at least 4 questions that must be considered in preparation for a GPR survey. [6]

(i) Discuss the restrictions placed on the VLF method of geophysical exploration because of the source direction. [5]

(j) In FDEM, what is the response parameter and how is it used to discriminate between good and bad conductors? [3]

SECTION B

2. (a) Name and discuss in detail two proposed mechanisms for producing spontaneous potentials in the ground. [10]

(b) Describe an environmental issue to which the SP survey method is applied, illustrating your answer with a case history. [10]

3. (a) Derive the expression for the potential due to a point source on a homogeneous earth and hence show that for the Wenner array, the geometric factor is given by:

$$K = 2\pi a$$

Where *a*, is the spacing between any adjacent electrodes. [6]

(b) Explain the importance of the following ratio in the field procedures of a Wenner array.

$$\frac{a_i}{a_{i-1}} = 10^{\frac{1}{n}}$$ [5]

(c) Briefly discuss the factors, which influence the resistivities of rocks. [3]

(d) Describe the mechanisms of induced polarisation and specify at least 2 examples targeted in IP exploration [6]

4. (a) Explain what you understand by signal to noise ratio in TDEM soundings. [2]

(b) List four sources of noise in TDEM soundings and give a brief explanation of two of them. [6]

(c) List and explain three significant differences between terrain conductivity meters and the traditional HLEM method. [12]

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