National Exams May 2018

04-Geol-A7, Applied Geophysics

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is a CLOSED BOOK EXAM.
   Approved Casio or sharp calculator is permitted.

3. Six (6) questions constitute a complete exam paper.
   The first six questions as they appear in the answer book will be marked. If you decide you do not want an answer marked, put a single diagonal line through your answer

4. Each question is of equal value.

5. Each question should take about half an hour.

5. All questions require an answer in essay format. Clarity and organization of the answer are important. Please write legibly, as we can only grade what we can understand. Drawing diagrams is strongly encouraged, as long as the diagram is explained.

Marking Scheme

Each of the six questions selected is worth 16.66 percent of the total mark.

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Examination Paper

Choose six (6) of the following ten (10) questions:

1. Magnetic susceptibility is an important physical property in geophysics. Define this quantity and give some typical values for rocks, minerals or materials of interest to geotechnical/engineering studies. What is the magnetic remanence and how is this physical property measured and quantified in comparison to the magnetic susceptibility?
2. Explain the layout of sources and sensors when a seismic reflection profile is acquired. Then explain the steps necessary to generate a zero offset sections. What are some of the artifacts evident on these sections and how are they removed? Use diagrams where appropriate.
3. Describe exploration or engineering applications (problems) for which gamma-ray spectrometry surveys might be an appropriate geophysical tool. In each case discuss the survey specifications (acquisition platform, survey spacing, etc) that you would use and how you would go about processing and interpreting the data.
4. Give two examples of arrays or configurations used for downhole resistivity surveying. In each case, describe the geometric configuration and how the different elements of the array are moved throughout the survey. What are the strengths and weaknesses of each array. Describe a case history of a survey, with specifics (or rough estimates if you forget or did not know) of the survey parameters. Also describe how the geophysicist would go about processing, displaying and interpreting the data.
5. Describe the difference between time-and frequency-domain geophysical measurements (electromagnetic or induced polarization) and discuss their advantages and disadvantages, citing examples where appropriate.
6. Describe the similarities and differences between the electrical and the electromagnetic method and discuss the advantages and disadvantages of each method, citing examples where appropriate.
7. Describe the difference between high- and low-pass filtering. Give examples of specific filters for each case. Discuss why the filters would be used in the process of interpreting geophysical data. Give artifacts or pitfalls of each of these types of filter.
8. Select three tools or methods used for geophysical well logging surveys and describe what they measure, how they measure it, and what physical property contrasts they are sensitive to. Give an example of a situation where each tool would be applied to solve a problem.
9. Give specific examples of i) one airborne, ii) one ground and iii) one borehole electromagnetic system. In each case provide details of the system name, the transmitter waveform, the receiver operation, the geometric configurations used and other relevant details like normalization and reduction if appropriate. In each case, list some advantages and disadvantages of the system and give an example of when it is most appropriate to use each system.
10. Quantitative interpretation of geophysical data involves forward and inverse modelling. Explain the difference between these two types of modelling approaches. Discuss the strengths and weaknesses of each approach and give some example algorithms or programs for each approach. Describe how these modelling approaches might be used in a geophysical study. Describe an example if possible.