National Exams May 2016

04-Geol-B10-1, Gravity and Magnetic fields

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.
   No 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.

4. Each question is of equal value.

5. Each question should take about half an hour.

6. 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. Use diagrams wherever appropriate.

04 – Geol – B10-1, Gravity and Magnetic fields

Examination Paper

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

1. Physical properties are important in gravity and magnetic methods. List the physical properties you think are important in these methods and explain why you think they are important. In each case, comment on the range of values and give some examples of typical values. Discuss the importance of physical property contrast in each method.
2. Gravity and magnetic methods are known as "potential field" methods, explain why this is the case. Potential fields can be dipolar and monopolar, give an example of each of these two types. Sketch the fields with solid lines and show the field strength contours with dotted lines. In each of these two cases, write an equation showing how the field strength and direction changes as a function of distance from the source?
3. Describe how you would go about planning and executing a ground magnetic survey. If you did not have a second magnetometer, describe strategies for monitoring temporal changes such as diurnal variation. In this strategy, describe the assumptions you have made and explain how the data would be reduced?
4. Describe the principles of a zero length spring and how a measurement is taken by the operator. How does the operator monitor the drift of the instrument? How are these measurements calibrated so that the absolute gravity is known at all stations in a survey?
5. (i) Describe the physical principles for one type of magnetometer capable of measuring the Earth's magnetic field. (ii) What is a magnetic gradiometer, and what are the advantages and disadvantages of gradiometry?
6. Explain why the magnetic anomaly of a body varies depending on the inclination and declination of the Earth's magnetic field. Discuss how this complicates interpretation and describe some common methods that people use to reduce or remove these complications. Specifically discuss the strengths and weaknesses of each of these methods.
7. Discuss five of the following ways of displaying and enhancing gridded geophysical data (first vertical derivative, second vertical derivative, horizontal derivative, upward continuation, downward continuation, sun angle enhancement, tilt derivative, local wavenumber, equal area colour stretch, Keating co-efficients, automatic gain control, others). In each case discuss how the particular display hinders or assists in the interpretation of the data.
8. Describe in detail the procedures you would follow to interpret a large region using gravity and magnetic data. Describe the other information you would use (if available) and where and when you might model the data.
9. What is a Fourier transform and how is it used in the processing and interpretation of gravity and magnetic data? Describe some of the pitfalls of the Fourier transform.
10. Quantitative interpretation of gravity and magnetic 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 exploration program. Provide as much detail as you can.