Potential Field Methods in Applied Geophysics

Wednesday 6 - 9pm

Professor: Kristina Keating
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Office Hours: TBA
Office Location: Smith Hall Room 139

Course Description:

This graduate course will examine the theory and practice of potential field methods in geophysics. Potential field methods include gravity and magnetic surveys; these methods rely on gravitational and magnetic fields and are used to image the subsurface. The focus of this class will be the application of potential field methods in environmental geophysics and hydrogeophysics; however, the material of the class will be relevant to many areas of applied geophysics.

Course Objectives:

By the end of this class you will have:

- Comprehension of the theory and application of magnetic surveys in environmental studies
- Understanding of the link between geophysical properties controlling magnetic surveys and subsurface environmental parameters
- Knowledge of field procedures for magnetic surveys
- Informed interpretation of magnetic survey datasets
- Comprehension of the theory and application of gravity surveys in environmental studies
- Understanding of the link between geophysical properties controlling gravity surveys and subsurface environmental parameters
- Knowledge of field procedures for gravity surveys
- Informed interpretation of gravity survey datasets

Course Expectations:

The class consists of one three-hour lecture a week. Attendance during class is strongly recommended. Although there is a required text for this course, the material covered will draw from multiple sources and will be difficult to obtain from outside the class. **Out of consideration for your classmates, please arrive on time and turn off your cell phone.**

There will be one quiz each class that will address the material covered in the pervious lecture. Each quiz will be worth 5 points and you will either get 5 points for answering every question or 0 points for an incomplete quiz.

There will be a biweekly assignment that will address theory learned in class. These assignments are to assess your understanding and you are encouraged to work with peers and ask the instructor to help improve your understanding. Although two weeks is allotted for each assignment, students are encouraged to start working on the assignment right away and not leave them until the last minute.

Students taking the course for graduate credit will be expected to present a journal article and lead a discussion on this article. The articles will be chosen from a list provided by the professor. The presenting student will submit five discussion questions one week prior to the discussion of the paper; these questions will be given to all students prior to the article presentation. During the class, the student will present the paper (including relevant background information) and lead the discussion. All students are expected to hand their answers to the discussion questions prior to class and participate in the class discussion.

Students taking the course for undergraduate credit are expected to read the journal articles, answer the discussion questions and participate in the discussion but are not expected to present a paper.

There will be one in class midterm and one take home final exam for this class.

Late Assignment Policy:

Students will be allowed one “free” late assignments during the quarter; a late assignment is an assignment that is handed in after the end of class. For the second late assignment 10% will be docked for each day late. These assignments must be handed in no later then the Friday after the assignment due date, assignments handed in later than the Friday following class will not be accepted.

Undergraduate Grading Basis:

The grading for the undergraduate class will be distributed as follows

Biweekly Assignments	25%
Participation	10%
Weekly Quiz	15%
Midterm	25%
Final	25%
Total	100

Graduate Grading Basis:

The grade for the graduate class will be distributed as follows

Biweekly Assignments	25%
Paper Presentation	20%
Weekly Quiz	10%
Midterm	20%
Final	25%
Total	100

Reference Material:

Required Text: Potential Theory in Gravity and Magnetic Applications by *Richard J. Blakely*

Recommended Texts and Resources:

Applied Geophysics by *W. M. Telford, L. P. Geldart, and R. E. Sheriff*

A multivariable calculus textbook e.g. Multivariable Calculus by *J. Stewart*

or Vector Calculus by *J. E. Marsden and A. J. Tromba*

MATLAB

Americans with Disabilities Act Statement:

If you need accommodations because of a documented disability, contact the Disabled Student Services Office on a campus phone at 5300.

Academic Honesty Policy:

Cheating in any form will not be tolerated. The first occurrence of any of this behavior will result in a grade of "F". For more information see the university academic integrity policy http://academicintegrity.rutgers.edu/.

Course Schedule (subject to change):

Date	Class Topic	Reading	Assignment
	• Syllabus. • Introduction to Fields. • Math Review: vectors, scalars, vector multiplication and properties, spherical and cylindrical coordinates.	Chapter 1 Appendix A	Assignment 1 handed out
	No Class		
	• Math Review: partial derivatives, gradients, laplacian, curl, differential equations.	Appendix A	
	• Math Review: Volume Integrals, Surface integrals, line integrals, divergence theorem.	Appendix A	Assignment 1 due Assignment 2 handed out
	• Introduction to gravitational potential and gravitational acceleration. • Density of materials. • Gravitational acceleration due to simple shapes.	Chapter 3	Gravity Paper 1 Presented
	• Gravity measurements. • Earth's Gravitational Field • Gravity anomalies and corrections.	Chapter 7	Assignment 2 due Assignment 3 handed out
	• Introduction to forward modeling and inverse theory • Forward modeling and inversion of gravity data.	Chapter 9 Chapter 10	Gravity Paper 2 presented
	• Review. • Examples.		Assignment 3 due Gravity Paper 3 presented
	Midterm Exam		**Midterm**
	• Introduction to magnetic potential. • Magnetic susceptibility • Magnetic susceptibility of materials.	Chapter 4 Chapter 5	Assignment 4 handed out Magnetics Paper 1 Presented
	• Magnetic potential due to simple shapes. • Magnetic measurements. • Earth's magnetic field	Chapter 5	Magnetics Paper 2 Presented
	• Forward modeling and inversion of magnetic data.	Chapter 8	Assignment 4 due Assignment 5 handed out Magnetics Paper 3 Presented
	• Introduction to Nuclear magnetic resonance (NMR) • NMR Theory and material properties.	Chapter 9 Chapter 10	Magnetics Paper 4 Presented
	• NMR measurements. • Basic inversion of NMR data.		Assignment 5 due Assignment 6 handed out NMR Paper 1 Presented
	• Review. • Examples.		Assignment 6 due NMR paper 2 presented
	Final Exam Due		