











Introduction to Geophysics

Geow-B402-V2




Instructor Info —

-  Reinhard Drews
-  Office Hrs: on demand.
-  GUZ 3U37
-  [Website](#)
-  reinhard.drews@uni-tuebingen.de

Course Info —

-  Prereq: None
-  Tues & Thurs
-  16:15-18.00
-  Online

Field Exercises —

-  In sub-groups of 6
-  Three exercises with individual timing for groups. It will be one afternoon of field work per exercise.
-  Outside.

Add. Instructors -

-  Prof. P. Dietrich
-  Office Hrs: On demand
-  UFZ, Leipzig
-  R. Ershadi
-  GUZ Level 3

Overview

This 6 ECTS course provides a broad overview in applied geophysics with a focus on the most common sub-surface imaging techniques: gravimetry, magnetics, geoelectrics, electromagnetic induction, ground-penetrating radar and seismics. We will discuss applications in industry as well as for general scientific questions in the geo- and environmental sciences. The lecture is accompanied with three mandatory, hands-on field exercises that will be conducted in small groups. The field exercises are planned to be in-person, the lecture is largely done online. Everything is subject to change considering updated regulations regarding the pandemic.

Online format

Lectures will be done in a mixed asynchronous and synchronous fashion. Some content will be presented in form of pre-recorded videos. Other content will be synchronous, as are more interactive formats such as joint exercises. All course material and general communication will be organized via Ilias.

Zoom Details	Tuesdays	Thursdays
Meeting ID	867 3242 8599	816 5647 0121
Passcode	927118	559372
Link	ThursdayMeeting	TuesdayMeeting

Grading Scheme

- 20% Reports from applied exercises, 20% in total
- 80% Final written Exam

All three reports will be graded and you have to pass all of them in order to qualify for the exam. If your grade in the final exam is better than the average grade from the reports, *only* the final exam will count. The final exam needs to be passed in order to pass the course. Grades will follow the standard scale, curving is at the discretion of the professor.

Applied exercises

We will conduct in-person applied exercises for magnetics, geoelectrics and seismics. This gives you a steep learning curve and is (maybe) a once-in-a-lifetime chance to work with professional geophysical equipment. Groups should be a maximum number of six. The practical part of the exercises will typically take 0.5 days. We will strictly follow the current hygiene guidelines communicated prior to each exercise block. Exercises are mandatory and absence is only permissible with a substantiated excuse approved by the instructor before the exercise takes place. Reports are graded and can be submitted as a group or individually. Don't miss the submission deadline communicated by the instructor. If you fail you will have a chance to revise the report.

Exercises	Location	Time Frame
Magnetics	Tübingen Morgenstelle	11 - 21 May
Geoelectrics	Tübingen Kilchberg	01-11 June
Seismics	Tübingen Österberg	01-11 July

FAQs

? Is this course hard?

! Not sure, I am teaching it for the first time. Rumor has it that 'yes'. All of you took quite difficult math classes and we will use these, e.g., including differentiation, integration, some linear algebra (e.g. vector fields). We will also brush on computational techniques. Exam relevant content will stick to a BSc level, but hopefully you will also be prepared for higher MSc courses.

? How to pass the exam?

! Maybe don't google every question during the term. Other than that may the force be with you.

? Why do I have to suffer through this?

! Even if you don't like geophysics you will learn a mathematical & quantitative approach that people find useful later on. Because we know you don't trust us we made this course mandatory.

? Can I call myself a geophysicist after this course?

! Definitely go for it. This is not a protected term. I say this as your career-coach.

Combination with Plate Tectonics

For students in Geosciences the Geophysics lecture is coupled with Plate Tectonics (3 ECTS, Instructor: Dr. P. Eizenhöffer). Both lectures will have a joint exam. Students taking both lectures will be given adequately more time during the final exam. The final grade will be an average (weighted by the ECTS ratio) between the Geophysics grade mentioned above and the Plate Tectonics grade.

Material

Books in English

- Telford: *"Applied Geophysics"*, ca. 750p.
- Sharma: *"Environmental and Engineering Geophysics"*, ca. 470 p. (Cambridge University Press)
- Griffiths, King: *"Applied Geophysics for Geologists & Engineers"*, ca. 220 p. (Pergamon Press)
- Lowrie: *"Fundamentals of Geophysics"*, ca. 340 p. (Cambridge University Press)

Books in German

- Bender: *"Angewandte Geowissenschaften Bd.II: Methoden der Angewandten Geophysik und mathematische Verfahren in d. Geowissenschaften"*, ca. 750p.
- Militzer, Weber: *"Angewandte Geophysik"*, 3 Bände.
- Clauser: *"Einführung in die Geophysik: Globale physikalische Felder und Prozesse in der Erde"*, ca. 420p.
- Clauser: *"Grundlagen der angewandten Geophysik - Seismik, Gravimetrie: Globale physikalische Felder und Prozesse in der Erde"*, ca. 370p.
- Knödel, Krummel, Lange: *"Geophysik. Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) - Handbuch zur Erkundung des Untergrundes von Deponien und Altlasten"*, Band 3.

Other

Any other required information will be provide on Ilias.

Approximate Class Schedule

Part 1: Introduction & Gravimetry

Weeks 1-2	<ul style="list-style-type: none">• Course Outline• Introduction to Geophysics• Introduction Gravimetry• Gravimetry Principles• Earth's Gravity Field• Gravimetry Reduction & Examples	In-class exercises
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Part 2: Magnetics

Weeks 4-6	<ul style="list-style-type: none">• Magnetic Fundamentals• The Earth's Magnetic Field• Magnetic Measurements• Nuclear magnetic resonance• Examples	In-class exercises Applied exercises Report writing
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Part 4: Electrics

Weeks 4-6	<ul style="list-style-type: none">• Electrics• Self-Potential• DC Geoelectrics• VES & DOI & Pole Arrays & Profiling	In-class exercises Applied exercises Report writing
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Part 5: Electromagnetics

Weeks 6-7	<ul style="list-style-type: none">• Induced Polarization• EM-Induction & Signal Decomposition• DOI & Slingram & Examples	In-class exercises
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Part 6: Seismics

Weeks 7-9	<ul style="list-style-type: none">• seismic wave types & velocities• Seismic Amplitudes & Boundaries• Seismic Raypath & Principles of Measurements• Refraction & Reflection Seismic• Processing & Resolution	In-class exercises Applied exercises Report writing
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Part 7: Ground-penetrating radar

Weeks 11	<ul style="list-style-type: none">• Em-waves• Profiling & Wide Angle Measurements• Signal Processing• Radar Systems• Measurement examples• processing & resolution	In-class exercises Instrument Demonstration
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Part 8: What we have missed & Wrap up

Weeks 12

- Examples for Seismology
- Tomography Principles
- More details on forward modelling and inversion
- Why machine learning?