Geology 468K – Geophysics for Geological Sciences Majors

Spring 2012

Syllabus

Lectures: Monday, Wednesday, and Friday, 11:00–11:50 am; JGB 3.120
Laboratory: Tuesday, 9–11 am or Thursday, 10am–12pm; EPS 1.102

Instructor: Kyle Spikes
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Office Hours: Monday, 1–3 pm; Wednesday, 9–11 am; and by appointment

Teaching Assistant: Ryan Lester
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Office Hours: Monday and Wednesday, 9–10 am; and by appointment

University of Texas Honor Code
The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

Course Description: A survey of seismic, magnetic, gravitational, and other geophysical tools and their applications to global-scale, exploration, and environmental problems. The course consists of three lecture hours and two laboratory hours per week for one semester. It is normally offered in the spring semester only. It may not be counted toward the Bachelor of Science in Geological Sciences, Option II. Prerequisites are Mathematics 408D and either Physics 303L and 103N or 316 and 116L, with a grade of at least *C* in each.

Assignments, Assessment, and Evaluation: Most weeks a homework problem set will be assigned in the laboratory section. Additional assignments will be given in lecture. These homework sets and assignments, their issue dates, and their due dates will be posted on Blackboard and mentioned in class or lab. Each assignment will be due at the beginning of the laboratory or lecture period on the day that it is due. For each day an assignment is late, the grade for that assignment will be dropped 10%, down to a minimum of 50% as long as the assignment is submitted before the graded assignments are returned. After the graded assignments are returned, no credit will be given. *Basic knowledge of Microsoft Excel (e.g., constructing spreadsheets and making graphs) will be necessary for the assignments.*

Short quizzes will be given at the discretion of the instructor. These quizzes cannot be retaken nor made up at a later time.

Three in-class midterm exams and a final exam will be given. A midterm exam may be made up at the discretion of the instructor if the student can provide valid and substantiated reasons for the absence *prior* to the exam. Each midterm exam will take place during lecture. The final cannot be rescheduled.

Midterm Exam 1 Date: Wednesday, February 15th, in class.
Midterm Exam 2 Date: Friday, March 9th, in class.
Midterm Exam 3 Date: Friday, April 13th, in class.
Final exam date: Consult the final examination schedule.

Plus/minuses will be used to determine the final grade. e-Gradebook and/or My Grades on Blackboard will be used to disseminate grades.

Grade Percentage Basis
Laboratory assignments (37%), Homework (12%), and quizzes (1%): Subtotal 50%
Midterm exams: (10% each): Subtotal 30%
Final: Subtotal 20%
TOTAL: 100%

Attendance and Classroom policies: Because most of the information of the course will be provided in the lectures, it is critical that you attend in order to understand the concepts and ideas important for this course. ***Laboratory sections are mandatory***. If you must miss one, it is your responsibility to arrange, with the teaching assistant, to attend another section covering that material. This arrangement must be made prior to the absence. Some laboratory sessions will consist of experiments performed outdoors at different locations on campus. Arrive on time to know these locations.

Materials: Required textbook. *Whole Earth Geophysics: An Introductory Textbook for Geologists and Geophysicists, (Lillie, 1999)*, from which readings and problems will be assigned. Powerpoint presentations presented in lecture will be posted on Blackboard the day before the lecture. Laboratory materials will be given out at the discretion of the teaching assistant.

Use of E-Mail for Official Correspondence to Students
E-mail is recognized as an official mode of university correspondence; therefore, you are responsible for reading your e-mail for university and course-related information and announcements. You are responsible to keep the university informed about changes to your e-mail address. You should check your e-mail regularly and frequently—I recommend daily, but at minimum twice a week—to stay current with university-related communications, some of which may be time-critical. You can find UT Austin's policies and instructions for updating your e-mail address at
http://www.utexas.edu/its/policies/emailnotify.php

Documented Disability Statement
The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact Services for Students with Disabilities at 471-6259 (voice) or 232-2937 (video phone) or **http://www.utexas.edu/diversity/ddce/ssd**

Religious Holy Days
By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, I will give you an opportunity to complete the missed work within a reasonable time after the absence.

Behavior Concerns Advice Line (BCAL)
If you are worried about someone who is acting differently, you may use the Behavior Concerns Advice Line to discuss by phone your concerns about another individual's behavior. This service is provided through a partnership among the Office of the Dean of Students, the Counseling and Mental Health Center (CMHC), the Employee Assistance Program (EAP), and The University of Texas Police Department (UTPD). Call 512-232-5050 or visit http://www.utexas.edu/safety/bcal

Resources for Learning & Life at UT Austin. The University of Texas has numerous resources for students to provide assistance and support for your learning.

The UT Learning Center: **http://www.utexas.edu/student/utlc/**
Undergraduate Writing Center: **http://uwc.utexas.edu/**
Counseling & Mental Health Center: **http://cmhc.utexas.edu/**
Career Exploration Center: **http://www.utexas.edu/student/careercenter/**
Student Emergency Services: **http://deanofstudents.utexas.edu/emergency/**

Subject-to-change notice
Ground rules for participation in discussions or activities
A statement about plagiarism and the consequences of plagiarizing.
http://www.lib.utexas.edu/services/instruction/faculty/plagiarism/preventing.html
http://www.lib.utexas.edu/services/instruction/learningmodules/plagiarism
Assignments, Assessment, and Evaluation

The UT Learning Center: **http://www.utexas.edu/student/utlc/**
Undergraduate Writing Center: **http://uwc.utexas.edu/**
Counseling & Mental Health Center: **http://cmhc.utexas.edu/**
Career Exploration Center: **http://www.utexas.edu/student/careercenter/**
Student Emergency Services: **http://deanofstudents.utexas.edu/emergency/**

COURSE OUTLINE AND SCHEDULE

Topics: Listed below are the topics for the course. Although they must be separated to make this list, some will be mixed together and will come up in several contexts.

A) Earth model concepts

January 18th: Syllabus and introduction to the course; Consistent model of the formation of the universe, galaxy, solar system, the Earth, and moon, Part I.

January 20th: Consistent model of the formation of the universe, galaxy, solar system, the Earth, and moon, Part II.

B) Seismic waves: Fundamentals of seismic-wave propagation, earthquake location, seismogram inversion and tomography for describing Earth structure, basics of Earth's free oscillations.

January 23rd: Elastic waves, Part I

January 25th: Elastic waves, Part II

January 27st: Seismometry, Part I

January 30th: Seismometry, Part II

February 1st: Seismogram Inversion

February 3rd: Tomography and Free Oscillations

C) Earthquakes: Derivation and explanation of earthquake moments, moment magnitudes, and focal mechanisms, seismicity as it relates to plate tectonics and seismotectonics. Descriptions of seismic hazards, risks, and risk mitigation.

February 6th: Magnitudes, focal mechanisms, and ground motions

February 8th: Elastic rebound, seismic cycle model, coupling mechanisms, seismic moment tensors

February 10th: Seismic hazards, tsunamis, risk mitigation

D) Exploration and Controlled source Seismology: Introduction and description of controlled source field methods, including derivation of seismic refraction curves, travel-time curves, and seismic reflection fundamentals. Basics of velocity variations of crustal rocks associated with exploration, basics of data processing and seismic interpretation.

February 13th: Introduction to seismic field methods, Part I

February 15th: Introduction to seismic field methods, Part II

February 20th: Seismic refraction traveltime curves

February 22nd: Seismic reflection fundamentals, Dix equation, depth estimation, Part I

February 24th: Seismic reflection fundamentals, Dix equation, depth estimation, Part II

February 27th: Seismic Survey Overview

February 29th: Seismic reflection data processing, Part I

March 3rd: Seismic reflection data processing, Part II

March 5th: Seismic reflection data interpretation, Part I

March 7th: Seismic reflection data interpretation, Part II

---------- Spring Break ----------

E) Gravity: General features of the earth, including Earth's shape, rotation, and tides as controlled by gravity. Basics of gravitational measurements.

March 19th: Introduction to potential fields and gravity measurements and corrections

March 21st: Gravity, isostacy, and elastic rebound

March 23rd: Space-based gravity measurements

March 26th: Earth rotation and shape; tidal forces

March 28th: Gravity anomalies and interpretation, Part I

March 30th: Gravity anomalies and interpretation, Part II

F) Geomagnetism: Fundamentals of cause, measurement, and use of Earth's magnetic fields, paramagnetism, and residual magnetism. Introduction to practices of magnetic surveying.

April 2nd: Magnetism review, geomagnestism

April 4th: Magnetic inclination, declination, intensity, field lines, magnetic dating

April 6th: External fields; paleomagnetism

April 8th: Magnetic surveying and anomaly interpretation

G) Electrical, Electromagnetic methods, and Well-logging: Basis of electrical properties and their controls in Earth materials. Controlled source techniques for measuring electrical properties of the Earth. Electrical monitoring surveys for resistivity mapping. Introduction to ground penetrating radar theory and applications. Basics of downhole measurements for characterization.

April 11th: Introduction to electromagnetic methods

April 16th: Ground-penetrating radar

April 18th: Electrical resistivity, Part I

April 20th: Electrical resistivity, Part II

April 23rd: Well logging, Part I

April 25th: Well logging, Part II

April 27th: Controlled source electromagnetics

H) Heatflow: Introductory thermodynamic controls on temperature gradients and convection processes in the Earth's interior

April 30th: Thermodynamics, temperature gradients, and heat sources

May 2nd: Heat sources, heat-flow mechanisms, convection and heat budget

May 4th: Review session

LABORATORY SCHEDULE

Lab 1) Week of January 30st: Seismic Instrumentation

Lab 2) Week of February 6th: Global Seismograms

Lab 3) Week of February 13th: Seismic Hazards and Earthquakes

Lab 4) Week of February 20th: Seismogram interpretation

Lab 5) Week of February 27th: Seismic survey

Lab 6) Week of March 5th: Seismic reflection coefficients

Lab 7) Week of March 19th: Vibroseis

Lab 8) Week of March 26th: Gravity measurements

Lab 9) Week of April 2nd: Geomagnetism and magnetic surveying

Lab 10) Week of April 9th: Paleomagnetism

Lab 11) Week of April 16th: Electromagnetics and GPR Lab

Lab 12) Week of April 23rd: Review Problems