Policy about course outlines can be found in Section 23.4 (2) of the University Calendar

GEOPH 624: Theoretical Seismology

Instructor: Dr. Jeff Gu
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Office hours: None officially, but can be arranged via phone, email, or walk-in, etc.
Class Time: 2:00-3:20 Tu, Th
Place: CCIS L1-047
Website:
www.ualberta.ca/~ygu/courses/geo624 **(constantly being updated)**

Objective:

This is a graduate course that emphasizes the theories and applications of seismic body and surface waves, normal modes, earthquake source, seismic tomography, anisotropy, and attenuation. In addition to in-class lectures, this course will involve reading of key studies in each topic, student presentations and a term project. The course also offers a lab component (mainly in the form of assignments) aimed at helping students work with scientific data pertaining to plate tectonics and petrology of the earth's crust and mantle. Do not be intimidated by the word "theoretical" since I am more data-oriented anyway.

Reference Text (not required):

1. *Introduction to Seismology*
   By Peter M. Shearer, Cambridge University Press.
   ISBN: 0521669537
2. *An Introduction to Seismology, Earthquakes, and Earth Structure*
   By Seth Stein and Michael Wysession, Blackwell Publishing.
   ISBN: 0865420785
3. *Modern Global Seismology*
   By Thorn Lay and Terry C. Wallace, Academic Press.

ISBN: 012732870X

4. *Arrays and Array Methods in Global Seismology*
Y. J. Gu Eds, Springer
ISBN: 978-90-481-3679-7

Course weights:

1. Assignment: 25%
2. Class participation: 5% (after 1 unexcused absence, each absence will cost 1%, no higher than 5%)
2. Paper presentations: 20% total
3. Project presentation: 10% (date TBD)
4. Term paper: 40% (Final Exam period)

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provision of the Code of Student Behavior (online at www.ualberta.ca/secretariat/appeals.htm) and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

Course outline:

1. Seismic body waves and travel times
   - Waves, ray theory
   - Plane waves in layered medium, travel times
   - Fresnel and 3D effects
   - Lab on SAC, xmgrace plotting, phase identification
   - Lab on data processing and seismic phases
   - Presentations
2. Amplitude, surface waves and free oscillations
   - Simple string analysis
   - Rayleigh and Love waves
   - Normal Mode theory
   - Reflectivity method & waveform modeling
   - Lab on surface waves and spherical harmonics
   - Lab on 1D synthetic seismogram computation
   - Lab on combined synthetic waveform, reflection
   - Presentations
3. Seismic tomography

- Composition of the Earth
- Inverse problems
- Historical overview of tomography and major battles
    * Travel time inversion
    * Waveform inversion
- Lab on inversions and plotting 2D maps
- Lab on 3D Earth model evaluation
- Presentations

4. Earthquake source
    - Discription of source, mechanisms, beachballs
    - Distribution of earthquakes and spectra
    - Lab on focal mechanisms
    - Lab on earthquake catalogues
    - Presentations
5. Attenuation and anisotropy
    - Anisotropy representation, measuring methods
    - Quality factor and representation
    - Lab on attenuation and anisotropy
    - Presentations
6. Final project presentation

Emphasis: This course will be offered more as a seminar course (60%-70% lectures and the rest are presentations, discussions and critiques by all participants). There are no exams. The objective for this course is to train graduate students not only on the background information (the lecture part), but also on the ability to read published papers critically and understand the key methods in some of the signature geophysical studies. The final paper will aid graduate students in conducting thorough literature review or formulating his/her innovative experiments based on the methods reviewed in this course.