Department of Geophysics

Instructor: Prof. Ilya Tsvankin

COURSE NUMBER AND NAME

GPGN553: Introduction to Seismology (second half of a two-semester course that includes GPGN552 and GPGN553). Offered in the Spring semester.

COURSE OBJECTIVES

To introduce students to basic problems and methods of seismology, discuss the physics of wave propagation.

CATALOG DESCRIPTION

The course is focused on a comprehensive physical description of wave phenomena in layered media and on the importance of wave-theory results in exploration and earthquake seismology. Topics include reflection and transmission problems for spherical waves, methods of steepest descent and stationary phase, point-source radiation in layered isotropic media, surface and nongeometrical waves. Brief discussion of seismic modeling methods and fundamentals of wave propagation in anisotropic media.

Prerequisites: GPGN552 or consent of instructor.

Credits: 3 hours lecture; 3 semester hours.

Texts: *Seismic Wavefields in Layered Isotropic Media* by I. Tsvankin (required; available online at Samizdat Press), *Quantitative Seismology* by K. Aki and P. G. Richards (optional), *Waves in Layered Media* by L. M. Brekhovskikh (optional).

COURSE SYLLABUS

Reflection/transmission problem for an acoustic spherical wave – 3 weeks

- Review of plane-wave propagation in layered media
- Properties of the Rayleigh wave at a free surface
- Plane-wave decomposition of point-source radiation
- Integral solutions for the reflected and transmitted waves

Analysis of reflected and transmitted acoustic wavefields – 5.5 weeks

- Stationary-phase method, zero-order and first-order approximations
- Method of steepest descent for the reflected wavefield
- Generation and properties of head waves
- Asymptotic description of the transmitted wavefield
- Properties of nongeometrical (pseudospherical and leaking) waves

Point-source radiation in elastic media – 4.5 weeks

- Reflection/transmission problem for a spherical wave at a solid/solid boundary
- Description of the reflected and transmitted PP and PS wavefields
- Nongeometrical waves in elastic media, field-data examples
- Time-domain ray series expansion
- Contribution of additional terms of the ray series; PS-waves at normal incidence

Seismic modeling methods and introduction to anisotropy – 2 weeks

- Reflectivity method and its extension to "quasi-2D" models
- Review of ray-tracing and finite-difference algorithms
- Plane waves in anisotropic media and the Christoffel equation