

Department of Geophysics

Instructor: Prof. Ilya Tsvankin

COURSE NUMBER AND NAME

GPGN552: Introduction to Seismology. Offered in the Fall semester.

COURSE OBJECTIVES

To introduce students to basic concepts of elasticity and seismic wave propagation.

CATALOG DESCRIPTION

Discussion of basic principles of elasticity including Hooke's law, wave equation, Green's function, uniqueness and representation theorems, and reciprocity. Seismic moment tensor, description of dislocation and volume sources, point-source radiation in homogeneous isotropic media. Boundary conditions, reflection/transmission coefficients of plane waves, plane-wave propagation in horizontally layered models.

Prerequisites: GPGN461/561 or consent of instructor.

Credits: 3 hours lecture, 3 semester hours.

Texts: *Quantitative Seismology* by K. Aki and P. G. Richards (required), *Seismic Wavefields in Layered Isotropic Media* by I. Tsvankin (chapter 2 – required), *Waves in Layered Media* by L. M. Brekhovskikh (optional).

COURSE SYLLABUS

Basics of elasticity – 4 weeks

- Deformation in a continuum, strain and stress tensors, traction vector
- Hooke's law, stiffness and compliance tensors
- Wave equation, Green's function for elastodynamics
- Uniqueness, representation, and reciprocity theorems

Description of seismic sources – 3.5 weeks

- Wavefields generated by displacement and traction discontinuities
- Equivalent body forces and the notion of force couples
- Seismic moment tensor for dislocation sources
- Volume sources and their moment tensor

Seismic wavefields in a homogeneous medium – 4.5 weeks

- Scalar and vector isotropic wave equations, Lamé's theorem
- Derivation of the Green's function for a homogeneous isotropic medium
- Properties of the far-field and near-field displacement
- Wavefields from a point dislocation source and point explosion

Plane waves in layered isotropic media – 3 weeks

- Homogeneous and evanescent plane waves, equations of motion for P/SV- and SH-waves
- Boundary conditions for different types of interfaces
- Reflection/transmission of plane waves at a fluid/fluid interface
- Plane-wave reflection/transmission coefficients for elastic media; surface waves
- Plane waves in horizontally layered models, matrix propagators