2011-2012 ICTP POSTGRADUATE DIPLOMA PROGRAMME
EARTH SYSTEM PHYSICS

Seismology (ESP-SEIS)
(12 lectures : 18 hrs)

Part I Seismic sources

1. Faulting

Rupture process. Faults and their geometry. Strike, dip, rake and slip
Brittle deformation and stresses. Tensile cracking. Shear fracture and Coulomb criterion Frictional sliding. Byerlee's law
Stresses and faulting. Stress cycle & Stick slip

2. Faults and their representation

Elastodynamic basic theorems
Elastodynamic Green function
Representation theorem

3. Faults and body forces

Equivalent body forces
Moment density tensor
Shear Dislocation Far source condition. Moment tensor. Seismic moment.
Double couple. Faults and moment tensor components
Application to a specific case

4. The elastodynamic Green function

Impulse response & Transfer function. Transformed domain. Convolution theorem
Spherically symmetric problem. Lamè theorem
GF in a isotropic and homogeneous medium. Near and far field
Response to a double-couple. Near, intermediate and far field

5. Focal mechanisms

Faulting and radiation pattern
Basic fault plane solutions
Faults and plates

Part II Earthquakes and their measurement

6. Earthquakes and seismometry

Extended faults. Haskell model. Rupture time.
Directivity
Source spectra. Omega square model
Seismometry. Inertial instruments. Mechanical and electromagnetic instruments
Response curves

7. Earthquakes size and seismometry

Astatic instruments
Digital signals; sampling & dynamic range
Broad band instruments; Feedback & Force balance
Strong motion; noise

8. Intensity and magnitude measurements

Intensity
Magnitude. M_L, m_b, M_S. Saturation
Similarity conditions: geometric and dynamic
Moment Magnitude

9. Viscoelasticity

Rheology. Viscoelasticity.
Viscoelastic models: Maxwell, Kelvin-Voigt.
Standard Linear Solid.

10. Viscoelasticity and attenuation

Complex moduli. Intrinsic Attenuation.
Q in the Earth. Intrinsic Dispersion.

Part III Inversion of seismological data

11. Inverse Problems

General formulation.
Explicit linear discrete case
Equi-, Over-, Under-determined problems
Introduction to the seismological inverse problems

12. Seismic tomography

The structure of the Earth from the surface to the core
Tomography as inverse problem
Introduction to the seismic tomography:
Body-wave tomography; Surface wave tomography

Tutorial

Lessons from the Tohoku eartquake

Tsunami physics