课程大纲
COURSE SYLLABUS

1.	**课程代码/名称 Course Code/Title**	ESS5055 震源物理　Earthquake Physics
2.	**课程性质 Compulsory/Elective**	专业选修课程 Specialized Elective Courses
3.	**课程学分/学时 Course Credit/Hours**	3 学分/48 学时 3 Credits/48 Hours
4.	**授课语言 Teaching Language**	中英双语 English & Chinese
5.	**授课教师 Instructor(s)**	叶玲玲 副教授 Ye, Lingling Associate Professor
6.	**先修要求 Pre-requisites**	无 No

7. 教学目标 Course Objectives

本课程教学目标是讲授以下地震物理相关内容：地震运动学模型、动力学破裂理论及相关地质学和地球物理学观测约束。课程面向地震学及相关领域研究生和高年级本科生，侧重于介绍利用观测和理论来研究地震的基本物理机制。

The main objective of this course is to introduce some earthquake rupture concepts including kinematic and dynamic source models with geological and geophysical observations. The course aims for graduate students and senior undergraduate with basic training in understanding earthquake mechanics with observation and simple theory.

8. 教学方法 Teaching Methods

以课堂理论讲授为主，考核结合文献阅读、数据处理和编程应用

9. 教学内容 Course Contents

Section 1	**Weeks 1-3: Earthquakes and stress in the crust (地壳中的地震和应力)** Principal stresses and fault orientation, Strength of the crust: laboratory and field data, Big earthquake history, Earthquake Focal Mechanism, Moment tensors Introduction to Web Site Resources, Magnitude Distribution, Plate Motion and GMT plotting Earthquake triangulation, Least-squares location, Magnitude Stereonet construction, P wave first motion mechanism activity
Section 2	**Weeks 4-6: Quantifying earthquakes (量化地震)** Earthquake source parameters and observables: seismic source and displacement field, seismic moment and magnitude, strain and stress drop, radiated energy and potential energy, rupture mode, rupture speed and directivity, earthquake rupture pattern Seismic scaling relations for static and dynamic parameters Introduction to Finite-fault Inversion Method

	Section 3	**Weeks 7-11: Rupture Processes (动力学破裂理论)** Fracture mechanics: crack model, crack tip breakdown-zone, stability and growth of a crack Frictional sliding: static and kinematic friction, rate- and state-dependent friction The link between the crack model and the frictional model (Dc) Rupture energy budget Fault-zone processes: Melting, fluid pressurization and lubrication melting Linking processes to the seismic data: Radiation efficiency and its relationship with rupture speed
	Section 4	**Weeks 12-13: Earthquakes as a complex system (复杂统计模型)** The magnitude-frequency relationship: G-R relation Percolation model, ETAS model
	Section 5	**Weeks 14-15: Instability and triggering (不稳定性和地震触发)** Instability: stick-slip and instability, stiffness of the fault system, nucleation zone Triggering: observations, triggering with rate- and state-dependent frictional mechanism, triggering with the stress corrosion mechanism, aftershocks and Omori's law, Hydrologic barrier removal
	Section 6	**Week 16: Presentation of term projects (学期项目汇报)**

10. 课程考核 Course Assessment

出勤 Attendance 10%
平时作业 Assignments 40% 每周一篇英文文献阅读和总结
课程项目 Projects 30%
期末报告 Final 20%

11. 教材及其它参考资料 Textbook and Supplementary Readings

教材：Kanamori, H. and E. E. Brodsky, The physics of earthquakes, 2004.

其他参考资料：

Aki, K., and P. G. Richards, Quantitative Seismology, 1980 (2002).

Lay, T., and T. C. Wallace, Modern Global Seismology, 1995.

Scherbaum, F., Of Poles and Zeros, 1996.

Stein, S., and M. Wysession, An Introduction to Seismology, Earthquakes and Earth Structure, 2003.

Shearer, P., Introduction to Seismology, 2009.

Richter, C. F., Elementary Seismology, 1958.

Scholz, C. H., The Mechanics of Earthquakes and Faulting, 1990.

Kasahara, K., Earthquake Mechanics, 1981.

Segall, P., Earthquake and Volcano Deformation, 2010.

Haskell, N., Total energy and energy spectral density of elastic wave radiation from propagating faults, 1964, 1966.

Dahlen, F.A., The balance of energy in earthquake faulting, 1977.