Course Type	Course Code	Name of Course	L	T	P	Credit
DC	GPC508	**Earthquake Seismology**	**3**	**0**	**0**	**9**

Course Objective

The course presents fundamental concepts of applied earthquake seismology with the objective to provide the students with a broad overview. The topics are particularly relevant to students that continue with research within earthquake seismology. However, the concepts and methods taught are also relevant to the general geophysics student interested in Earth structure and earthquake physics.

Learning Outcomes

Upon successful completion of this course, students will:

Students will gain a deeper understanding of approaches such as forward modelling and inversion from the topics addressed within the earthquake seismology context. The student can demonstrate how the earthquake mechanism is derived from waveform data. Students will be able to the earthquakes, which will lead to improve Earth models. The student can discuss the different aspects of inverse problems in earthquake seismology.

Unit No.	Details of Lectures	Lecture Hrs.	Learning Outcomes
1.	Introduction to seismology, fracturing of rocks under different stresses, causes of earthquakes, Elastic Rebound Theory for earthquake generation. Classification of earthquakes. Earthquake, nuclear explosion, rock burst, volcanic earthquake.	**3**	Basic knowledge of earthquakes, causes and types of earthquakes
2.	Wadati-Benioff zone, Intra and inter plate earthquakes, Intra-plate strain-hardening model and inter-plate model for mega-earthquakes along subduction zone.	**2**	Global distribution of earthquakes
3.	Temporal and geographical distribution of earthquakes, seismicity and seismotectonics of India and the Himalaya.	**2**	Indian earthquakes and its historical perspective
4.	Effects of earthquake and tsunami. Foreshocks, Mainshocks, Aftershocks and Earthquake swarm. Omri's Law.	**2**	Impact of earthquakes
5.	Frequency - magnitude relation for b-value estimation. Significance of b-values. Micro-earthquakes, induced seismicity.	**2**	Earthquake magnitude scale and related parameters
6.	Wadati diagram for computation of origin time. Localizing of magnitude scale, various magnitude scales and their limitations, seismic energy, seismic moment, slip, slow slip, stress drop and dimension of rupturing of rock during earthquakes.	**3**	Quantitative analysis of source characteristics
7.	MM and MSK intensity scales. Earthquake hazard and risk. Seismic zonation of India	**2**	Qualitative size of earthquakes and hazards

8.	Body and surface forces. Law of equivalent body force. Single and double couple mechanisms for earthquake generation. Radiation patterns of P- and S-waves.	**2**	Earthquake mechanisms
9.	Elastic, inelastic and plastic behavior of materials.		Elasticity of materials
10.	Definitions of stress and strain. Generalized Hooke's law and Lame's constants for elastic materials. Stoke's law for ductile materials. Derivation of stress and strain matrices.	**2**	Basic laws of elasticity and inelasticity
11.	P-, S- and surface waves, Momentum equation, Derivation of P- and S-wave equations. The effects of gravity on seismic wave propagations.	**3**	Governing equations of seismic waves
13.	Propagation of various seismic body and surface waves inside the Earth.	**2**	Nature of seismic waves inside the earth
14.	Dispersion and Attenuation of seismic waves. Determination of phase and group velocities.	**2**	Characteristics of seismic wave inside the Earth
15.	Ray paths for horizontally and spherically stratified Earth. Travel Time Curves, Delay Time and Triplication, Ray Paths for Low Velocity Zone (LVZ). Velocity structure and V_P/V_S study.	**4**	wave phenomenon within the earth
16.	Principle and construction of seismometers. Damping, amplitude and phase characteristics.	**2**	Amplitude and phase characteristics of seismogram
17.	Short-period, Long-period and Broad-band seismometers, and their limitations.	**1**	Seismograph
18.	Earthquake prediction: dilatancy theory, short-term, middle-term and long-term prediction. Earthquake Early warning System.	**2**	Earthquake precursors and prediction
19.	Fault plane solutions and their interpretation. Moment tensors for different fault patterns.	**2**	Source dynamics and kinematics
20.	Introduction to free oscillations of the Earth.	**1**	Free oscillations of Earth during great earthquake
	Total:	**39**	

Text books

1. Shearer, P. 1999. Introduction to Seismology, Cambridge: Cambridge University Press.
2. Lowrie, W., 2007. Fundamental of Geophysics, Cambridge: Cambridge University Press.

Reference books

1. Stein, S. and Wysession, M. 2003. An Introduction to Seismology, Earthquakes and Earth Structure, Oxford: Blackwell Publishing.
2. Båth, M., 1976. Introduction to Seismology, Birkhäuser Basel.

2. Agustin, U., 2000. Principles of Seismology, Cambridge: Cambridge University Press.
3. KIyoo Mogi, 1985. Earthquake Prediction, Academic *Press.*
4. Kasara, K., 1981. Earthquake mechanics, Cambridge University Press.
5. Bullen, K. E. and Bolt, B. A. 1985. An Introduction to the Theory of Seismology, Cambridge: Cambridge University Press.
6. Richter, C. F. 1945. Elementary Seismology, W H Freeman, San Francisco, W. H. Freeman & Co.
7. Kulhanek, O. 1970. Anatomy of Seismograms, Seismological section, University of Uppsala, Uppsala, Sweden.
8. Leon Reiter, 1991. Earthquake Hazard Analysis, Columbia University Press, 254pp.
9. Scholz, C.H., 2019. The mechanics of earthquakes and faulting, Cambridge University Press, 494pp
13. Gubins D., 1990. Seismology and Plate Tectonics, Cambridge University Press, 348pp.