Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NGPC503	Computational Seismology	3	1	0	4

Course Objective
This subject will introduce a simulation of time-dependent processes in Earth science, physics, engineering, and many other fields. Comparative analysis of numerical methods. Clear presentation with code examples. Many exercises from simple to difficult. Ready-to-use computational tools.
Learning Outcomes
Any student of modern seismology would be master of its fundamental knowledge, and deepening his understanding with a coherent balance of theory, concepts and applications.

Unit No.	Description of Lectures	Lecture Hrs. (L + T)	Learning Outcomes
1.	Signal and System: Basic theory and introduction to signal and system, types of signals; Classification of signals, continuous and discrete signals. Types of noises; Energy and phase spectra, properties of time signal (time invariance, causality, linearity).	2 L + 1T	Understanding basic definitions and techniques for time series analysis
2.	Fourier transforms, utility of domain transformation; Inverse Fourier transform; Fast Fourier transforms; Discretization of continuous signals, Sampling theorem.	4L + 1T	Analysis and interpretation of signals
3.	Convolution theorem, convolution in time domain and in frequency domain; Correlation. Earth as a low pass filter: Basic concepts, types of filters.	3L + 1T	Learning techniques to understand and interpret geophysical signals
4.	Equations of continuity and motion, Work and Energy, Potential functions of displacements and forces, Theorems of reciprocity and representation.	3L + 1T	Basic laws for work and energy for elastic media and seismic waves propagation
5.	Relations between Stress Strain, Mohr-Coulomb Plastic Criterion, Estimation of MC parameters for for soil slope.	2L + 1T	Application of stress conditions to understand soil parameters
6.	The geometry of P and S wave displacements. Equation of motion of Rayleigh and Love waves. Stoneley waves	3L + 1T	Equations of seismic surface wave propagation

7.	Wave fronts and Rays, Waves of several frequencies, Displacement, velocity and acceleration. Determination of phase and group velocity for surface wave, Geometry of P and S wave displacements, Particular forms of the potentials.	**5L + 1T**	Kinematics of seismic waves
8.	Equivalent forces: Point sources, Force couples: Single and double couples	**2L + 1T**	Radiation patterns
9.	Fractures and dislocations, Circular and rectangular fracture modelling, Nucleation, propagation and arrest of rupture, Source time function. Green function for an infinite elastic medium, The radial force, An impulsive force in an arbitrary direction,	**4L + 1T**	Faults kinematics and dynamics
10.	Derivation of equation of near and far fields. Separation of near and far fields. Radiation patterns.	**4L + 1T**	Near and far field spectra
11.	First motion focal mechanisms, body wave and surface wave focal mechanisms	**3L + 1T**	Fault parameters during earthquakes
12.	H/V measurements, Nature of Ambient vibration wavefields, Wave types and their relation with H/V ratio.	**4L + 1T**	Response of seismogram to ground vibration
13.	Seismic Tomography and their applications in Near Surface	**3L + 2T**	Seismic Tomography
	Total:	**42L + 14T**	

Textbooks

1. Stein, S. and Wysession, M. 2003. An Introduction to Seismology, Earthquakes and Earth Structure, Oxford: Blackwell Publishing.
2. Agustin, U., 2000. Principles of Seismology, Cambridge: Cambridge University Press
3. Kramer, S. L., 2007. Geotechnical Earthquake Engineering

Reference Books

1. Shearer, P. 1999. Introduction to Seismology, Cambridge: Cambridge University Press
2. Lowrie, W., 2007. Fundamental of Geophysics, Cambridge: Cambridge University Press
3. Bullen, K. E. and Bolt, B. A. 1985. An Introduction to the Theory of Seismology, Cambridge: Cambridge University Press
4. Gubins D., 1990. Seismology and Plate Tectonics, Cambridge University Press, pp. 348.
5. Igel H., 2016. Computational Seismology-A Practical Introduction: Oxford University Press.
6. Aki, K., P. G. Richards, 2002. Quantitative Seismology, 2nd edition, University Science Books, Sausalito, California.
7. Scholz, C.H., 2019. The mechanics of earthquakes and faulting, Cambridge University Press, 494pp