Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
DSE-3 **Paleoseismology** (L3, P1)	**4**	**3**		**1**	**12th pass with science**	**Studied Earth System Science and Structural Geology or Equivalent**

DSE-3:
Paleoseismology (L3, P1)
Credit: 4
Theory (45 hours), Practical (30 hours)

Learning Objectives

The goal of this course is to provide students an understanding about: Geological techniques to study the pre-instrumental earthquakes and its application to Seismic Hazard Assessment. What do past earthquakes look like in the geologic record in different environments? To estimate the magnitude of past and future earthquakes using trench logs and geochronology as a case study from different seismically active regions of the world, e.g., Himalaya, Japan, New Zealand, etc. Learn the deformation on short- and long-term time scales.

Learning outcomes

After going through this course, students will understand how the Earth deforms from individual earthquakes to systems of faults to the construction of mountain ranges. They can able to map the active faults and their recurrence time of earthquake and seismic hazard in a seismically active area.

SYLLABUS OF DSE-3
Theory (45 hours)

Unit-1 (9 hours)
Detailed Content
Landscape Response to Tectonics: Introduction to Seismicity, its causes and nucleation, Introduction to geodesy and short-term deformation. Earthquakes in the Indian Subcontinent. Tectonic landforms. Climate-Tectonic interaction in landscape evolution. Erosion and uplift in orogenic settings. Active tectonics and rivers.

Unit-2 (9 hours)
Detailed Content
Introduction to Paleoseismology: The Scope of Paleoseismology, Evidences to identify past earthquakes- Primary and Secondary evidences, On-fault and Off-fault structures, Recurrence time of earthquake, Slip-rate Determination and Magnitude Estimation, Development of Paleoseismology. Distinguishing Paleoseismic Features from Non-Seismic or Non-Tectonic Features.

Unit-3 (9 hours)
Detailed Content
Paleoseismic Investigation Techniques: Geomorphic expressions of fault, Surveying and Mapping Paleoseismic Landforms. Trenching, logging and sampling the fault scarps. Stratigraphic and Structural evidences of Paleoearthquakes. Quaternary Dating techniques- ^{14}C, OSL, surface exposures dating.

Unit-4 (9 hours)
Detailed Content
Paleoseismology of different Tectonic Environments: Introduction to paleoseismic investigations in Contractional, Extensional, and Strike-Slip Tectonic Settings. Surface Rupture studies in Himalaya. Interpreting the Paleoseismic History by Retro-deformation. Introduction to Long term deformation study, Quaternary and Neogene Geomorphic Responses to Tectonics- the Himalayan case.

Unit-5 (9 hours)
Detailed Content
Applications on different time scale: Seismic Hazard Assessment, Estimating Paleo-earthquake Magnitude and Recurrence Cycle, Fault Segmentation.

Practical Component- (30 Hours)
Exercises covering various practical based problems on paleoseismology and tectonic events, past earthquakes, and to assess magnitude and recurrence of the seismic events and futures perspectives.

Essential/Recommended readings
James P. McCalpin (editor), 2009, Paleoseismology (2nd edition), Elsevier/Academic Press: Burlington, MA, 629 pp.
Robert S. Yeats, Kerry E. Sieh, and Clarence R. Allen, 1997, Geology of Earthquakes, Seismological Research Letters 68(5).

Recommended readings
Jayangondaperumal, R., Thakur, V. C., Joevivek, V., Rao, P. S., & Gupta, A. K. (2018), Active Tectonics of Kumaun and Garhwal Himalaya. Singapore: Springer.
Douglas W. Burbank and Robert S. Anderson, 2012, Tectonic Geomorphology (2nd edition), Wiley-Blackwell: UK, 454 pp.
William B. Bull, 2008, Tectonic Geomorphology of Mountains: A New Approach to Paleoseismology, Wiley-Blackwell: Malden, MA, 328 pp.
William B. Bull, 2009, Tectonically Active Landscapes, Wiley-Blackwell: Malden, MA, 320 pp.
Edward A. Keller and Nicholas Pinter, 2002, Active Tectonics: Earthquakes, Uplift, and Landscape (2nd edition), Prentice Hall: Upper Saddle River, NJ, 362 pp.