

Course Title	: Earthquake Studies
Course Code	: GECGEO2A
Nature of Course	: Multi-Disciplinary Generic Elective
Total Credits	: 03 credits
Distribution of Marks	: 80 (End-Sem.) + 20 (In-Sem.)

COURSE OBJECTIVES: *The course is designed to provide students the basic concepts of earthquakes, along with some practice in analyzing seismological database.*

UNITS	CONTENTS	L	T	P	Total Hours
I (20 Marks)	Theory of elasticity, Generalized Hooke's law, Different types of elastic waves	11			11
II (20 Marks)	Earthquakes: Causes and effects, Various magnitude and intensity scales, Elastic rebound theory.	11			11
III (25 Marks)	Classification of earthquakes, Seismometers, Analysis of seismograms, Seismic networks and arrays, Earthquake prediction and forecasting, basics of paleoseismology.	14			14
IV (15 Marks)	Seismicity and seismo tectonics of India, Seismic hazard map of India.	09			09
	Total				45

Where, **L: Lectures** **T: Tutorials** **P: Practicals**

MODES OF IN-SEMESTER ASSESSMENT:

(20 Marks)

- **One Internal Examination** - **10 Marks**
- **Others (Any one)** - **10 Marks**
- **Group Discussion**
- **Seminar presentation on any of the relevant topics**
- **Debate**

LEARNING OUTCOMES: The Northeast region lies in the zone V of seismic zonation map of India. It has great experienced two great earthquakes: one of 1897 and another great earthquake of 1950. Therefore, the understanding of the earthquake is very important. Hence, this course in introduced in the Multi-Disciplinary Generic Course.

SUGGESTED READINGS:

1. Shearer, P.M. (2009). *Introduction to Seismology*. Cambridge University Press.
2. Lowrie, W. (2007). *Fundamentals of Geophysics*. Cambridge University Press.
3. Scholz, C.H. (2002). *The Mechanics of Earthquakes and Faulting*. Cambridge University Press.
4. Bullen, K.E. and Bolt, B.A. (1985). *An Introduction to the Theory of Seismology*. Cambridge University Press.
5. Gubbins, D. (1990). *Seismology and Plate Tectonics*. Cambridge University Press.

4th Semester: Geology
Core Course: C-9: Stratigraphic Principles and Indian Stratigraphy
Total Mark: 100 (60+40), Total Credit: 6 (4 Th + 2 Pr)

C9: GEOH402T4: Stratigraphic Principles and Indian Stratigraphy (Theory)
Credit 4: Marks 60 (End-sem 48+ In-sem 12) 48 Hours

Objectives: *The principles of stratigraphy help us to understand the order of superposition of rocks in space and time. Indian stratigraphy helps us to know distribution of different stratigraphic horizons in India and their significances.*

Unit 1: Principles of Stratigraphy

(L:6 T:2) 8 classes (Marks: 14)

- Principles of stratigraphy: Fundamentals of litho-, bio- and chrono-stratigraphy; Introduction to concepts of dynamic stratigraphy (chemostratigraphy, seismic stratigraphy, sequence stratigraphy).

Unit 2: Stratigraphic Nomenclature & Laws of Facies

(L:8 T:2) 10 classes (Marks: 14)

- Codes of stratigraphic nomenclature: International Stratigraphic Code – development of a standardized stratigraphic nomenclature. Concepts of Stratotypes. Global Stratotype Section and Point (GSSP). Codes of lithostratigraphy, biostratigraphy, chronostratigraphy, magnetostratigraphy, sequence stratigraphy.
- Principles of stratigraphic analysis. Facies concept in stratigraphy: Walther's Law of Facies. Concept of paleogeographic reconstruction.

Unit 3: Stratigraphy of India

(L: 15 T: 2) 17classes (Marks: 20)

- Physiographic and tectonic subdivisions of India. Introduction to Indian Shield. Introduction to Proterozoic basins of India. Geology of Vindhyan and Cudappah basins of India.
- Paleozoic Succession of Kashmir and its correlatives from Spiti and Zaskar Stratigraphy. Structures and hydrocarbon potential of Gondwana basins.
- Mesozoic stratigraphy of India: Triassic successions of Spiti, Jurassic of Kutch, Cretaceous, successions of Cauvery basins, Mesozoic rocks of NE India.
- Cenozoic stratigraphy of India: Kutch basin, Siwalik successions, Assam-Arakan basins.
- Stratigraphy and structure of Krishna-Godavari basin, Cauvery basin, Bombay offshore basin, Kutch and Saurashtra basins and their potential for hydrocarbon exploration.
- Volcanic provinces of India: Deccan, Rajmahal, Sylhet Traps.
- Stratigraphic boundaries: Important Stratigraphic boundaries in India - a. Precambrian-Cambrian boundary, b. Permian-Triassic boundary, and c. Cretaceous-Tertiary boundary.

5th Semester: Geology
Core Course: C-12: Geomorphology
Total Mark: 100 (60+40), Total Credit: 6 (4 Th + 2 Pr)

C12: GEOH502T4: Geomorphology (Theory)

Credit 4: Marks 60 (End-sem 48+ In-sem 12) 48 Hours

Objectives: *Geomorphology is the scientific study of the origin and evolution of landscapes and bathymetric features created by physical, chemical or biological processes operating at or near the Earth's surface.*

Unit 1: Introduction to Geomorphology

(L: 4)4classes (Marks: 5)

Concept of Geomorphology, Endogenic and Exogenic processes; uniformitarianism, geomorphic cycle.

Unit 2: Understanding Earth's Physiography

(L: 6)6classes (Marks: 6)

Geoid, Topography, Hypsometry, Global Hypsometry, Major Morphological features, Large Scale Topography - Ocean basins, mountain ranges (with emphasis on Himalayas).

Unit 3: Geomorphic Processes

(L: 15)15classes (Marks: 20)

Surficial Processes and geomorphology, Weathering and Erosion. Soil, Soil Profile and its classification. Mass movement and debris flow processes. Discussion on geomorphic processes and landforms of: Fluvial, Glacial, Aeolian, Coastal and Volcanic Environments.

Unit 4: Tectonics and Geomorphology

(L: 7)7classes (Marks: 10)

Role of plate tectonics in changing morphology of earth's surface. Features associated with different tectonic setup. Endogenic- Exogenic interactions, Rates of uplift and denudation, Tectonics and drainage development, Sea-level change, Long-term landscape development

Unit 5: Indian Geomorphology

(L: 4)4classes (Marks: 7)

Overview of Indian Geomorphology and the features of: Extra-Peninsular, Peninsular India, Great Indo-Gangetic-Brahmaputra Plain, Rann of Kutch, Coastal Areas and islands of India.

6th Semester: Geology

Discipline Specific Elective (DSE) Courses: DSE-3: Geology of North East India

Total Mark: 100 (60+40), Total Credit: 6 (4 Th + 2 Pr)

DSE-3: GEOHDSE601BT4: Geology of North East India (Theory)

Credit 4: Marks 60 (End-sem 48+ In-sem 12) 48 Hours

Objectives: *Aims to impart the knowledge about the Geology of the North east India, its physiographical and stratigraphical overview, understanding of the different geological features, occurrences of different economic minerals, seismic and flood associated hazards and disasters.*

Unit 1: Physiographical Overview

(L: 6) 6classes (Marks: 9)

Physiography of North-East India: Brahmaputra Plain, Sikkim-Arunachal Himalaya, Mishmi Hills, Naga-Patkai Range, Manipur Plain, Tripura-Cachar Belt, Meghalaya Plateau and Mikir Hills.

Major drainage systems of North-East India. Tectonic framework of North-East India and its control in physiographical development.

Unit 2: Stratigraphical Overview

(L: 8) 8classes (Marks: 10)

Stratigraphical units of North-East India: Archean, Proterozoic, Precambrian-Paleozoic rocks of Arunachal Pradesh, Sikkim and Arunachal Himalayas, Lower Gondwana Group, Cretaceous Alkaline-Carbonatite Complexes of Northeast India, Permian-Mesozoic volcanics, Late Mesozoic Ophiolites, Ophiolite Suite of Nagaland – Manipur, Cretaceous sediments of Meghalaya, Tertiary of Northeast India, Recent-Quaternary Sediments.

Unit 3: Geological Features

(L: 15) 15classes (Marks: 15)

Indo-Eurassian Collision and Accretion: ITSZ, Higher and Lesser Himalayan Crystalline Nappe and Windows, activation of MCT and MBT, Gondwana, Permian Volcanics, formation of Sub-Himalayas and activation of MFT. Eastern Himalayan Syntaxis (EHS), Po-Chu Fault, Jialifault, BameTutinFault, Lohit Thrust, Mishmi Thrust, Tidding suture.

Indo-Myanmar Collision and Accretion: Indo-Myanmar range and its relation to Andaman Nicobar Arc System, Naga and Disang Thrust System, Ophiolite zone of Nagaland and Manipur, Palaeogene fold belt, Surma basin, Termination of Oceanic Pelagic Sedimentation and development of Disang-Barail-Surma.

Brahmaputra and Meghalaya Plateau: Brahmaputra valley, basement faulting and high, Oldham fault, Dauki fault, Kopili Lineament, Dhansiri Valley. Arakan-Yoma Folded Belt.

Unit 4: Economic Significance

(L: 3) 3classes (Marks: 8)

Mineral Resources of: Assam, Meghalaya, Arunachal Pradesh, Nagaland, Mizoram, Tripura, Manipur and Sikkim. Petroliferous basins of Assam and Nagaland.

Unit 5: Natural hazards and disasters

(L: 3) 3classes (Marks: 6)

Past major earthquakes of North East India and assessment of disaster. Calamity caused by floods in last decayed and their sources.

DSE-3: GEOHDSE601BP2: Geology of North East India (Practical)
Credit 2: Marks 40 (End-sem 32+ In-sem 8) 24 Hours

Study of geological maps of North-East India(7 Marks)

Preparation of Mineral resource map of North-East India(7 Marks)

Study of geological structures of important oil fields of Assam(7 Marks)

Study of tectonic map of different areas of North-East India(7 Marks)

Note Book (2 Marks)

Viva Voce (2 Marks)