Department of Geology
University of Lucknow

Syllabus for 4-Year B.Sc. programme
As per
New Education Policy 2020

For session 2024-2025 onwards

Programme outcomes (POs):

- ✓ The 4-Year B.Sc. programme with Geology as a Major Subject is designed with the objective of educating students for success as a geo-scientist having employability in government sector, public sector, private sector, research institutes, or further qualifying JAM, NET, GATE or other national examinations so as to pursue further study including Doctoral studies.

- ✓ The students are likely to get regular placements in GSI, ONGC, CIL, etc. apart from reputed private organizations related to oil industries, mineral exploration & mining industries and organizations working in the fields of exploration using remote sensing & GIS Techniques.

- ✓ The holistic development of students helps them in getting placements in various national institutes like BSIP, WIHG, PRL, NGRI etc.

Programme Specific Outcomes (PSOs):

- ✓ During the proposed eight semesters, students will be able to identify, examine and understand different geological materials, geological settings and associations.

- ✓ The students with their robust foundation learn to interpret various geological maps, prepare cross sections, geologic field mapping, understanding of stratigraphic concepts, geological successions of Precambrian to Recent rocks, sediments and their lateral and vertical disposition; rock identification on the basis of minerals composition and basic physical, megascopic and microscopic characters.

- ✓ They learn about the origin and evolution of landforms, fossil identification up to generic level, their evolution and mode of life, in-depth understanding of the sedimentary structures and facies analysis, various rock types based on petrological thin sections, palaeoclimatic and palaeogeographic changes, origin and distribution of economic mineral and energy resources of the country etc.

- ✓ The students also develop basic aptitude and understanding of the environmental issues related to planet earth.

- ✓ Geological excursion would be an important component of the 4-year B.Sc. Programme in Geology for laying a robust foundation for the budding geologists. Students will get exposure of actual rocks during geological excursion. Students will learn about data collection, measurements and their interpretations.

- ✓ Exploration for economically useful Earth material is another important outcome of the present program.

- ✓ During the Major Project, students will take-up a geological problem utilize theoretical knowledge along with analytical or experimental approach to solve it. The students will have to defend their Project outcome in an open forum.

- ✓ The course 'Research Methodology' has been designed to make the students learn the basics of research work, to develop research skills and to encourage them to pursue research in various fields of Geology.

Department of Geology
Syllabus for 4-Year B.Sc. programme as per NEP 2020

Year	Sem.	Paper	Paper Type	Theory/ Lab work	Title	Credit
1st Year	I	Paper-1	Core	Theory	Physical Geology	4
		Paper-2	Core	Theory	Mineralogy and Crystallography	4
		Q-1	For Minors	Theory	Elementary Physical Geology	2
			CC-1	Theory	Indian Physiography	2
	II	Paper-3	Core	Theory	Structural Geology and Tectonics	4
		Paper-4	Core	Lab work	Practical-I	4
		Q-2	For Minors	Theory	Elementary Structural Geology	2
			VC-1	Theory	Geo-tourism	2
2nd Year	III	Paper-5	Core	Theory	Palaeontology	4
		Paper-6	Core	Theory	Igneous Petrology	4
		Q-1	For Minors	Theory	Elementary Palaeontology	2
			CC-2	Theory	Planetary Geosciences	2
	IV	Paper-7	Core	Theory	Sedimentology	4
		Paper-8	Core	Lab work	Practical-II	4
		Q-1	For Minors	Theory	Elementary Sedimentology	2
			VC-2	Theory	Geoarchaeology	2
3rd Year	V	Paper-9	Core	Theory	Metamorphic Petrology	4
		Paper-10	Core	Theory	Applied Geology	4
		Summer Internship/ Term Paper/ Minor Project in Geology Major				**4**
	VI	Paper-11	Core	Theory	Stratigraphy	4
		Paper-12	Core	Lab work	Practical-III	4
		Paper-13 A	Optional	Theory	Economic Geology and Mineral Exploration	4
		Paper-13 B	Optional	Theory	Gemmology	4
4th Year	VII	Paper-14	Core	Theory	Sedimentary Basins and Sequence Stratigraphy	4
		Paper-15	Core	Theory	Micropaleontology and Oceanography	4
		Paper-16	Core	Theory	Geospatial Technology and Petroleum Geology	
		Paper-17	Core	Lab work	Geological Field Training	4
		Paper-18A	Optional	Theory	Medical Geology	4
		Paper-18B	Optional	Theory	Environmental Geology and Natural Hazards	4
		Paper-18C	Optional	Theory	Geochemistry and Geochronology	4
	VIII	Paper -19	Core	Theory	Research Methodology	4
		Paper -20	Core	Theory	Term Paper	4
		Major Research Project or Dissertation				**12**

Paper Title:	Physical Geology	Theory
Year: 1 | Sem: I	Paper-1 | Core Paper	Credit: 04

Course outcome: Study of landforms and the related processes form the traditional concept to the contemporary development in Physical Geology. Physical Geology provides base for understanding other branches of geology (Petrology, Economic geology, Engineering geology, Remote Sensing). This paper helps to explore one's interest in earth sciences and geo-technologies.

Unit I

Science of landforms: Endogenic and exogenic processes; Geological Timescale; Scale in geomorphology (Temporal and spatial); Landscape evolution (Davisian cycle, Penck model, King model and Budel model); Weathering and associated landforms.

Unit II

Aeolian landforms (small, intermediate and large-scale forms; Dunes: morphology and classification); Glacier: characteristics, distribution and classification; Glacial large-scale and small-scale surface landforms; Periglacial landforms (Patterned ground, ground-ice phenomena, asymmetrical valleys).

Unit III

Karst topography; Coastal landforms (Cliffs, Beaches, Tidal flats, Deltas, Coastal dunes, Reefs); Mass movement processes and slope system; Landforms associated with extrusive and intrusive igneous activities; Introduction to geomorphology of Moon and Mars.

Unit IV

Fluvial landforms (drainage basin, alluvial channels: plan form; depositional landforms: floodplains, alluvial fans and river terraces); Geomorphology of Indian sub-continent (the Himalaya, the Indo-Ganga Alluvial Plain, Peninsular regions); Introduction to geomorphology of the Indian Ocean.

Suggested Reading:

1. M. A. Summerfield. 2013, Global Geomorphology, Routledge.
2. V. S. Kale and A. Gupta. 2018, Introduction to Geomorphology, The Orient Blackswan.
3. B.J. Skinner and S.C. Porter. 1995, The Blue Planet: An Introduction to Earth System Science, John Wiley & Sons, Inc.
4. G.R. Thompson and J. Turk. 1998, Introduction to Physical Geology, Saunders College Publishers, Fort Worth.
5. D.M. Thompson. 2007, Processes that Shape the Earth –Infobase Publishing, NY.
6. L.D. Leet, S. Judson and M.E. Kauffman, 1982, Physical Geology, Prentice-Hall Inc.
7. P. McL. D. Duff, A. 1993, Holmes, Holme's Principles of Physical Geology, Fourth Edition. Stanley Thornes (Publishers) Ltd.

Paper Title:	Mineralogy and Crystallography	Theory
Year: 1 | Sem: I	Paper-2 | Core Paper	Credit: 04

Course outcome: This paper provides base for understanding other branches of geology (Petrology, Economic geology, Physical geology Engineering geology etc. and provides foundations needed to study other branches of geology like petrology and geochemistry.

Unit I

Crystal morphology; Laws of crystallography; Crystallographic axes; Crystal symmetry and symmetry classes; crystallographic notations; Hermann-Mauguin Symbols; Clinographic and Stereographic Crystal projections; Crystal forms; Crystal aggregates; Twinning and twin laws.

Unit II

Symmetry and Forms present in Cubic (Galena type, Pyrite type and Tetrahedrite type), Tetragonal (Zircon type), Hexagonal (Beryl type and Calcite type), Orthorhombic (Barytes type), Monoclinic (Gypsum type) and Triclinic (Axinite type) crystal Systems.

Unit III

Definition of mineral; Atomic bonding; Silicate structure; Physical properties of minerals: colour, lustre, form, hardness, fracture, cleavage, specific gravity; pseudomorphism and polymorphism; Mineral characters based on heat, electricity, magnetism and radioactivity; Clay minerals: properties and classification.

Unit IV

Physical properties, chemical composition, occurrences and uses of minerals belonging to the Feldspathoid, Amphibole, Pyroxene, Olivine, Mica, Garnet, Silica and Feldspar families.

Suggested Reading:

1. A. Putnis 1992, Introduction to Mineral Sciences, Cambridge publication.
2. C. Klein and B. Dutrow, 2007, The manual of Mineral Science, Wiley Publication
3. D. Perkins, Mineralogy, 3rd Edition Pearson New International Edition.
4. H. H. Read, 1970, Rutley's Elements of Mineralogy, Twenty-Sixth Edition. Thomas Murby & Co.
5. D.W. Nesse, 1986, Optical Mineralogy. McGraw Hill.
6. E.G. Ehlers, Optical Mineralogy: Theory and techniques. 1987. Wiley-Blackwell.

Paper Title:	Elementary Physical Geology	Theory
Year: 1 | Sem: I	Paper-Q1 | Minor Paper	Credit: 02

Course outcome: Study of landforms and the related processes form the traditional concept to the contemporary development in Physical Geology. Physical Geology provides base for understanding other branches of geology (Petrology, Economic geology, Engineering geology, Remote Sensing). This paper helps to explore one's interest in earth sciences and geo-technologies.

Unit I

Geological Timescale; Science of landforms: Endogenic and exogenic processes; Scale in geomorphology (Temporal and spatial); Landscape evolution (Davisian cycle); Weathering and associated landforms.

Unit II

Aeolian landforms (small, intermediate and large-scale forms; Dunes: morphology and classification); Glacier: characteristics; Glacial large-scale and small-scale surface landforms.

Unit III

Karst topography; Coastal landforms (Cliffs, Beaches, Tidal flats, Deltas, Coastal dunes, Reefs); Mass movement processes and slope system.

Unit IV

Fluvial landforms (drainage basin, alluvial channels: plan form; depositional landforms; Geomorphology of Indian sub-continent (the Himalaya, the Indo-Ganga Alluvial Plain).

Suggested Reading:

8. M. A. Summerfield. 2013, Global Geomorphology, Routledge.
9. V. S. Kale and A. Gupta. 2018, Introduction to Geomorphology, The Orient Blackswan.
10. B.J. Skinner and S.C. Porter. 1995, The Blue Planet: An Introduction to Earth System Science, John Wiley & Sons, Inc.
11. G.R. Thompson and J. Turk. 1998, Introduction to Physical Geology, Saunders College Publishers, Fort Worth.
12. D.M. Thompson. 2007, Processes that Shape the Earth –Infobase Publishing, NY.
13. L.D. Leet, S. Judson and M.E. Kauffman, 1982, Physical Geology, Prentice-Hall Inc.
14. P. McL. D. Duff, A. 1993, Holmes, Holme's Principles of Physical Geology, Fourth Edition. Stanley Thornes (Publishers) Ltd.

Paper Title:	Indian Physiography	Theory
Year: 1 | Sem: I	Paper CC-1 | Co-curricular Paper	Credit: 02

Course outcome: Study of landforms and the related processes form the traditional concept to the contemporary development in Physiography. Indian Physiography provides base for understanding important physiographic features of India and helps to explore one's interest in Indian Physiographical features.

Unit I

Physiographic sub-divisions of India; the Himalayas-geomorphology, origin and evolution, rocks and minerals, climate and vegetation.

Unit II

The Great North Indian Plains-geomorphology, origin and evolution, rocks and minerals, climate and vegetation.

Unit III

Peninsular Plateau-geological formations, Central Highlands, Deccan Plateau, Western Ghats, Eastern Ghats; Indian Desert, Coastal plains and islands.

Unit IV

River systems: Himalayan rivers, Peninsular rivers; River basins, Regional development and planning, Hydropower projects, major dams, West-flowing and east-flowing rivers; Interlinking of rivers, Drainage Systems; Drainage Patterns; Drainage System of India.

Suggested Reading:

1. Physical Geology of India, S.M. Mathur, National Book Trust, First Edition. Geology of India.
2. M. Ramakrishnan and R. Vaidyanadhan, Geological Society of India, Bangalore, Volume 1 & 2
3. V.K. Verma, Geomorphology (With Indian Examples), (Contributing Editors: Devesh Walia & Benidhar Deshmukh), Rawat Publication.
4. N. Prasad P. K. Sen, An Introduction to the Geomorphology of India, , Allied Publishers Pvt. Ltd.; Ist edition.

Course outcome: Due to the dynamic instability of the lithosphere, continuous and discontinuous deformation takes place within the rocks in solid or semi-solid state, at different scales, which manifests in a variety of complex structures in these rocks. The present course will teach the students how to gain an insight into underlying deformation processes and mechanisms through an accurate geometric and kinematic analysis of these natural structures.

Unit I

Introduction to structural geology; Crustal processes, behaviour of the crust during deformation; Basic concepts of stress and strain; Estimation of strain in naturally deformed rocks; Mechanisms of rock deformation, Mohr diagrams.

Unit II

Study of outcrop; Identification of bedding; Measurement of dip, strike and thickness of beds; Forms of igneous bodies: concordant and discordant; Unconformities: their classification, recognition and geological significance, onlap and offlap; Simple deformational structures: Fold morphology, their geometric and genetic classification; Mechanics of folding and buckling; Superposed folding.

Unit III

Geometric and genetic classification of Faults (normal, reverse and strike-slip faults); Recognition of faults in the field; Causes and dynamics of faulting; Effects of faults on folded beds; Geometric and genetic classification of Joints; Foliation: descriptive terminology, origin and relation to major structures; Lineation: descriptive terminology, kinds and origin, and relation to major structures; Shear zones: Geometry and rock types of shear zones.

Unit IV

Types of Tectonites; Recognition of top and bottom beds; Sea-floor spreading; Basic concepts of plate-tectonics, Causes of Plate motion; Mantle Plumes and Plume mechanics; Structure and tectonic evolution of the Himalaya; Anatomy of Mountain belts.

Suggested Reading:

1. B. Bailey, 1992, Mechanics in Structural Geology, Springer.
2. G. H. Davis, and S. J. Reynolds, 1996, Structural Geology of rocks and regions, John Wiley. and Sons.
3. S. K. Ghosh, 1993, Structural Geology: Fundamentals, and modern developments, Pergamon Press.
4. P. R. Leyson, and R. J. Lisle, 1996, Stereographic projection techniques in structural geology, Cambridge University Press.
5. C. Passhier, and R. A. J. Trouw, 2005, Microtectonics. Springer, Berlin.
6. D. D. Pollard, and R. C. Fletcher, 2005, Fundamentals of structural geology, Cambridge University Press.
7. J. G. Ramsay, and M. I. Huber, 1983, Techniques of Modern Structural Geology: vol. I & II. Academic Press.
8. J. G. Ramsay, 1967, Folding and Fracturing of Rocks, McGraw-Hill Book Company, New York.
9. S. M. Rowland, E. Duebendorier, and I. M. Schiefelbein, 2007, Structural analysis and synthesis: a laboratory course in structural geology, Blackwell pub.
10. J. Suppe, 1985, The Principles of Structural Geology, Prentice-Hall, Inc., New Jersey.
11. R. J. Twiss, and E.M. Moores, 2007, Structural Geology. Freeman.
12. B. A. Van der Pluijm, and S. Marshak, 2004, Earth structure: an introduction to structural Geology.

Paper Title:		Practical-I	Lab work
Year: 1 | Sem: II	Paper-4	Core Paper	Credit: 04

Course outcome: The knowledge of interpret the geological maps is basic and essential. The sub-surface information interpretation is possible with the help geological structural maps. The Basic constituent of rock is mineral. The knowledge of identification of mineral is essential and is possible by the study of hand samples of minerals.

Course outcome: The knowledge of interpret the geological maps is basic and essential. The sub-surface information interpretation is possible with the help geological structural maps. The Basic constituent of rock is mineral. The knowledge of identification of mineral is essential and can be possible by study of hand samples of minerals.

Unit I

Verification of Euler's formula; Graphical construction of crystallographic axes of Cubic system; Clinographic projections of typical crystals of Cube, Rhombdodecahedron, Tetrahexahedron, Pyritohedron, Tetrahedron, Zircon, Calcite, Beryl and Barytes; Stereographic projections and calculation of axial elements of Zircon, Calcite, Barytes and Hornblende.

Unit II

Determination of physical properties of rock-forming minerals: quartz family, Feldspar family, Pyroxene Family, Amphibole Family, Garnet Family; Mica Family.

Unit III

Understanding the basic concepts of strike, horizontal equivalent, True and apparent dip; Dip and strike problems using orthographic projections; solving dip-strike problems using stereographic projection; Contour maps and completion of outcrops; Study and interpretation of topographical maps; Use of Clinometer compass; Basic Surveying problems.

Unit IV

Drawing profile and geological cross sections along a given section line in geological maps; Interpretation of geological maps exhibiting the effect of: repetition of beds, erosion, unconformity, different types of faults, folds and igneous intrusions on outcrop; Describing topography, structures, order of superposition and sequence of events for different maps; Determination of thickness of beds and throw of faults in geological maps.

Suggested Reading:

1. H. H. Read, 1970, Rutley's Elements of Mineralogy, Twenty-Sixth Edition. Thomas Murby & Co.
2. C. D. Gribble and A. J. Hall, 1992, Optical Mineralogy: Principles and Practice, UCL Press Limited
3. P. R. Leyson, and R. J. Lisle, 1996, Stereographic projection techniques in structural geology, Cambridge University Press.
4. E J W Whittaker, The stereographic projection, Series: Second series pamphlets, 11, International Union of Crystallography by University College Cardiff Press.
5. H. Pichler C. Schmitt-Riegraf, 1998, Rock-forming Minerals in Thin Section, Chapman &. Hall.
6. R. J. Lisle, 2004, Geological Structures and Maps: A practical guide, Elsevier Butterworth-Heinemann.
7. B. Simpson, 1998, Geological Maps, Pergamon Press.

Paper Title:	Elementary Structural Geology	Theory
Year: 1 | Sem: II	Paper-Q2 Minor Paper	Credit: 02

Course outcome: Due to the dynamic instability of the lithosphere, continuous and discontinuous deformation takes place within the rocks in solid or semi-solid state, at different scales, which manifests in a variety of complex structures in these rocks. The present course will teach the students how to gain an elementary insight into underlying deformation processes and mechanisms through an accurate geometric and kinematic analysis of these natural structures.

Unit I

Basic concepts of stress and strain; Estimation of strain in naturally deformed rocks

Unit II

Study of outcrop; Identification of bedding; Measurement of dip, strike and thickness of beds; Unconformities: their classification, Fold morphology, their geometric and genetic classification

Unit III

Geometric and genetic classification of Faults (normal, reverse and strike-slip faults); Geometric and genetic classification of Joints;

Unit IV

Sea-floor spreading; Basic concepts of plate- tectonics, Causes of Plate motion.

Suggested Reading:

1. B. Bailey, 1992, Mechanics in Structural Geology, Springer.
2. G. H. Davis, and S. J. Reynolds, 1996, Structural Geology of rocks and regions, John Wiley. and Sons.
3. S. K. Ghosh, 1993, Structural Geology: Fundamentals, and modern developments, Pergamon Press.
4. P. R. Leyson, and R. J. Lisle, 1996, Stereographic projection techniques in structural geology, Cambridge University Press.
5. C. Passhier, and R. A. J. Trouw, 2005, Microtectonics. Springer, Berlin.
6. D. D. Pollard, and R. C. Fletcher, 2005, Fundamentals of structural geology, Cambridge University Press.
7. J. G. Ramsay, and M. I. Huber, 1983, Techniques of Modern Structural Geology: vol. I & II. Academic Press.
8. J. G. Ramsay, 1967, Folding and Fracturing of Rocks, McGraw-Hill Book Company, New York.
9. S. M. Rowland, E. Duebendorier, and I. M. Schiefelbein, 2007, Structural analysis and synthesis: a laboratory course in structural geology, Blackwell pub.
10. J. Suppe, 1985, The Principles of Structural Geology, Prentice-Hall, Inc., New Jersey.
11. R. J. Twiss, and E.M. Moores, 2007, Structural Geology. Freeman.
12. B. A. Van der Pluijm, and S. Marshak, 2004, Earth structure: an introduction to structural Geology.

Paper Title:	Geo-tourism	Theory
Year: 1 | Sem: II	Paper VC-1 | Vocational Paper	Credit: 02

Course Outcomes: India like any other country has unique geological and geomorphologic features distributed throughout the country that constitutes its geoheritage. Over time, the development process obliterates many of these features and this loss necessitates the preservation of representative and/or spectacular features which explain the geological process over geological time Geoheritage has been a neglected feature in the conservation landscape of India. Due to the lack of awareness and stringent laws little efforts are being made to preserve these national treasures. Unfortunately, beyond declaration as geological monuments little else has been done to protect these marvels of the nature. There is an immediate need to make the public aware of the country's national treasures. During the present course an attempt will be made to familiarise the above fact in the mind of common man. The concept of developing geoparks and geotourism will be introduced and a need for making laws to preserve them would be emphasized.

UNIT I

Introduction and importance of Geodiversity, Geoheritage, Geoconservation; Geoparks and Geotourism; History of the concept

UNIT II

Geological outcrops and society; Threats to geodiversity; Conservation, protection, maintenance of geological sites and related features of National importance; Conservation of geosites as a tool to protect geoheritage.

UNIT III

Potential geoparks and geosites in India; Rajasthan, Odisha, Karnataka, Andhra Padesh, Madhya Pradesh, Telangana, Tamil Nadu, Kerala, Gujarat, Himachal Pradesh

UNIT IV UNESCO geoparks, Geopark networks across the globe; Geotourism and National geological Monuments.

UNIT V

Guidelines for selection of Geosites; Geoheritage laws, Role of local, state and national governments; Current status of Geoheritage protection in the country; Global geoheritage and protection laws.

Suggested Readings

1. A Monograph on National geoheritage monuments of India, Indian National Trust for Art and Cultural Heritage, Natural Heritage Division, New Delhi
2. Ranawat, P. S., George, S., 2016 Potential Geoheritage & Geotourism Sites in India International Journal of Scientific and Research Publications, Volume 9, Issue 6, June 2019
3. Ezzoura Errami, Margaret Brocx (Ed.) 2009. Geoheritage, Geoparks and Geotourism Conservation and Management Series Springer. P 268.

Paper Title:	Palaeontology	Theory
Year: 2 | Sem: III	Paper-5 | Core Paper	Credit: 04

Course outcome: Making students understand the evolution of life in geological past is an important aspect of geology. Palaeontology, the study of fossils includes the study of vertebrate and invertebrate fossils, micro-fossils, plant fossils, trace fossils their evolution and distribution in time and space. These aspects are fundamental not only to geology and stratigraphy but inter-disciplinary fields of botany, zoology and branches of science.

The study of Palaeontology encompasses the aspects of appearance, evolution and extinction of life through the geologic time. The knowledge of palaeontology would enable the students to understand the biological changes that occurred in the history of the earth and relate them with their field observations. The students will acquire skills of describing fossils and their taxonomic classification. They will also be introduced to the application of palaeontology and the use of fossils in hydrocarbon exploration, establishing biostratigraphy, inferring palaeoecology, palaeobiogeography, palaoeneurology of the geological past.

Unit I

Introduction to palaeontology; processes of fossilisation; Preliminary idea of the origin of life; Basic idea of trace fossils and their uses; Morphology and geological history of Bivalvia.

Unit II

Morphology and geological history of Brachiopoda, Gastropoda and Cephalopoda.

Unit III

Morphology and geological history of Echinoidea and Anthozoa; Morphology and geological history of Trilobita.

Unit IV

Introduction to Palaeobotany; Important Lower and Upper Gondwana plant fossils; Brief idea of Biostratigraphy; Palaeobiogeography; Palaeoecology; Introduction to evolution of man, Horse and Elephant; A brief idea of Siwalik Vertebrate fauna.

Suggested Reading:

1. R. Cowen, 2000, History of Life, Blackwell Science.
2. E. N. K. Clarkson 2013, Invertebrate palaeontology and Evolution, Blackwell Science
3. R.M. Black, 1989, The Elements of Palaeontology, Cambridge University Press
4. M. Benton, 2005, Vertebrate Palaeontology, Blackwell Publishing
5. P. W. Jackson, 2019, Introducing Palaeontology: A Guide to Ancient Life, Dunedin Academic Press Ltd.
6. R. Enay 2012, Palaeontology of Invertebrates, Springer-Verlag.
7. P. Doyle, Understanding Fossils: An Introduction to Invertebrate Palaeontology.
8. M. Davies 2008, An Introduction to Palaeontology, Read Books.
9. S. Jain 2017, Fundamentals of Invertebrate Palaeontology: Macrofossils, Springer India
10. R. Goldring, 2014, Field Palaeontology, Routledge
11. C.Z. Johansson, M. R. Underwood, 2019, Evolution and development of Fishes, Cambridge University Press.
12. P. K. Saraswati, M.S. Srinivasan, 2016, Micropaleontology: Principles and Applications, Springer International Publishing Switzerland.
13. M. Benton, A. T. H. David, 2009, Introduction to Paleobiology and the Fossil Record, Wiley-Blackwell.
14. E.H. Colbert, and E. C. Minkoff, 2001, Evolution of vertebrates, Wiley Liss.

Paper Title:	Igneous Petrology	Theory
Year: 2 | Sem: III	Paper-6 | Core Paper	Credit: 04

Course outcome: Study of igneous rocks is the primary component of any geology curriculum because these are not only the primary rocks but abundant throughout the Earth's crust. These rocks dominate upper mantle environments that provide understanding to composition of melt generation, crystallization and differentiation mechanisms, production of diverse rock types and link to tectonic settings; volcanic hazards including climatic ramification.

Unit I

Introduction to Igneous Petrology; Magma emplacement: volcanic, hypabyssal, plutonic, magma evolution; Bowen's reaction series; Physical properties of magma - temperature, viscosity, density and volatile content; Magma formation in the crust and upper mantle.

Unit II

Bases of classification of igneous rocks; IUGS classification of Igneous rocks; Textures of Igneous rocks Crystallinity, granularity, shapes and mutual relations of grains; Magmatism in different tectonic settings.

Unit III

Phase equilibria in the following binary and ternary systems, and their petrogenetic significance: diopside – anorthite, forsterite – silica, albite – anorthite, albite – orthoclase, diopside – albite – anorthite, forsterite – diopside – silica and nepheline - kalsilite – silica.

Unit IV

Petrogenesis of granitoids, basalts, anorthosite, komatiites, carbonatite, kimberlites, ophiolite.

Suggested Reading:

1. K. G. Cox, J. D. Bell, and R. J. Pankhurst, 1979, Interpretations of igneous rocks. George Allen and Unwin, London.
2. A. Philpotts and J. Ague, 2009, Principles of Igneous and Metamorphic Petrology. Cambridge.
3. J. D. Winter, 2014, Igneous and Metamorphic Petrology. Prentice Hall.
4. M. G. Best, 2013, Igneous and Metamorphic Petrology. Wiley Blackwell.
5. B. R. Frost and C. D. Frost, 2014, Essentials of Igneous and Metamorphic Petrology. Cambridge University Press.
6. L. A., Raymond, 2007, Petrology: the study of igneous, sedimentary, and metamorphic rocks. Waveland Pr. Inc; 2nd edition.
7. H. R. Rollinson, 2014, Using geochemical data: evaluation, presentation, interpretation. Routledge.
8. Bose, M.K., 1997, Igneous Petrology, World Press, Kolkata.

Paper Title:	Elementary Palaeontology	Theory
Year: 2 | Sem: III	Paper-Q3| Minor Paper	Credit: 02

Course outcome: Making students understand the evolution of life in geological past is an important aspect of geology. Palaeontology, the study of fossils includes the study of vertebrate and invertebrate fossils, micro-fossils, plant fossils, trace fossils their evolution and distribution in time and space. These aspects are fundamental not only to geology and stratigraphy but inter-disciplinary fields of botany, zoology and branches of science.

The study of Palaeontology encompasses the aspects of appearance, evolution and extinction of life through the geologic time. The knowledge of palaeontology would enable the students to understand the biological changes that occurred in the history of the earth and relate them with their field observations. The students will acquire skills of describing fossils and their taxonomic classification. They will also be introduced to the application of palaeontology and the use of fossils in hydrocarbon exploration, establishing biostratigraphy, inferring palaeoecology, palaeobiogeography, palaeoneurology of the geological past.

Unit I

Introduction to palaeontology; processes of fossilisation; Preliminary idea of the origin of life

Unit II

Morphology and geological history of Bivalvia, Brachiopoda.

Unit III

Morphology and geological history of Trilobita.

Unit IV

Introduction to Palaeobotany; Important Lower and Upper Gondwana plant fossils; A brief idea of Siwalik Vertebrate fauna.

Suggested Reading:

15. R. Cowen, 2000, History of Life, Blackwell Science.
16. E. N. K. Clarkson 2013, Invertebrate palaeontology and Evolution, Blackwell Science
17. R.M. Black, 1989, The Elements of Palaeontology, Cambridge University Press
18. M. Benton, 2005, Vertebrate Palaeontology, Blackwell Publishing
19. P. W. Jackson, 2019, Introducing Palaeontology: A Guide to Ancient Life, Dunedin Academic Press Ltd.
20. R. Enay 2012, Palaeontology of Invertebrates, Springer-Verlag.
21. P. Doyle, Understanding Fossils: An Introduction to Invertebrate Palaeontology.
22. M. Davies 2008, An Introduction to Palaeontology, Read Books.
23. S. Jain 2017, Fundamentals of Invertebrate Palaeontology: Macrofossils, Springer India
24. R. Goldring, 2014, Field Palaeontology, Routledge
25. C.Z. Johansson, M. R. Underwood, 2019, Evolution and development of Fishes, Cambridge University Press.
26. P. K. Saraswati, M.S. Srinivasan, 2016, Micropaleontology: Principles and Applications, Springer International Publishing Switzerland.
27. M. Benton, A. T. H. David, 2009, Introduction to Paleobiology and the Fossil Record, Wiley-Blackwell.
28. E.H. Colbert, and E. C. Minkoff, 2001, Evolution of vertebrates, Wiley Liss.

Paper Title:	Planetary Geosciences	Theory
Year: 2 | Sem: III	Paper-CC-2| Co-curricular Paper	Credit: 02

Course outcome: The course content provides the students with an over-all knowledge about the different geological processes and features of various celestial bodies within our solar system, including planets, moons, asteroids and comets. The students will get acquainted with the various satellites, launch vehicles and important contributions of Indian Space Research Organisation to space.

Unit I

Universe, Space, Galaxy, Stars, Planets, Satellites, Asteroids, Meteorites, Origin of Universe, Origin of Solar System.

Unit II

Basic concepts of solar system; Earth and its solar system, Rotation and Revolution of Earth.

Unit III

Indian space mission: Chandyayaan-1, 2 & 3; Aditya-L1 Mangalyaan-1 & 2; Gaganyaan-1.2 3; Shukrayaan-1; GSLV, PSLV, ASLV.

Unit IV

Societal and economic aspects of planetary geosciences; Geological Time-scale; Major Events in the Earth's history.

Suggested Reading:

1. Davis A. M., 2005. Meteorites, Comets, and Planets, Elsevier.
2. Harry, Y. Me Sween, Jr., 1999. Meteorites and Their Parent Planets (Second edition), Cambridge Univ.Press
3. McBride, N. and Gilmour, I, 2003. An Introduction to the Solar System, Cambridge Univ.Press.
4. Norton, O. R., 2002. The Cambridge Encyclopedia of Meteorites, Cambridge Univ. Press.
5. Zanda, B. and Rotaru, M., 2001. Meteorites: Their Impact on Science and History, Cambridge Univ. Press.
6. https://www.isro.gov.in/
7. https://www.pass.gov

Paper Title:	Sedimentology	Theory
Year: 2 | Sem: IV	Paper-7 | Core Paper	Credit: 04

Course outcome: The course content provides the students with an over-all knowledge about how the different types of sedimentary rocks are formed. With the different hydrodynamic processes operative in the regime, the sediments start moving and getting deposited as sedimentary rocks. During the process, the internal as also the external characteristics of sedimentary rocks vary, which are analysed to predict the environment of deposition. The course content specifies the study of different sedimentary structures, both internal and external as also the depositional environments. The subsequent variations in sedimentary rocks are also studied.

Unit I

Introduction to sedimentary rocks; Origin of sedimentary rocks; Sediment grain parameters; Classification of Sedimentary Rocks; Diagenesis and Lithification.

Unit II

Fluid Dynamics; Laminar flow and turbulent flow; Reynold Number; Froude Number; Entrainment velocity; Bed forms and Flow regime; Texture of clastic sedimentary rocks.

Unit III

Sedimentary structures: physical, chemical and biological; Terrigenous clastics, and chemically precipitated rocks and their classification.

Unit IV

Concept of facies; Walther's Law of facies; General idea about shallow marine environments; Fluvial system; Delta system; Deep-Sea systems.

Suggested Reading:

1. D.R. Prothero, 2013, Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy. W. H. Freeman; Third edition
2. H.G. Reading, 2009, Sedimentary Environments: Processes, Facies and Stratigraphy. John Wiley & Sons.
3. S.M. Sengupta, 2018, Introduction to Sedimentology. CBS Publishers & Distributors Pvt. Ltd.
4. M. R. Leeder, 2009, Sedimentology and Sedimentary Basins: from Turbulence to Tectonics. John Wiley & Sons.
5. N.W. Gokhale, 2017, Fundamentals of Sedimentary Rocks. CBS Publishers & Distributors Pvt. Ltd.
6. P.A. Allen, 1997, Earth Surface Processes, Blackwell publishing.
7. H.E. Reineck, and I. B. Singh, 1980, Depositional Sedimentary Environments: With Reference to Terrigenous Clastics, Springer.
8. J.D. Collinson, and D.B. Thompson, 1988, Sedimentary Structures, Unwin Hyman, London.
9. D. R. Prothero, F. Schwab, 2004, Sedimentary Geology, Freeman
10. A.D. Miall, 1999, Principles of Sedimentary Basin Analysis. Springer Verlag, New York.
11. G. Nichols, 1999, Sedimentology and Stratigraphy, Blackwell publishing.
12. S. Boggs, 1995, Principles of Sedimentology and Stratigraphy, Prentice Hall, New Jersey.
13. D.S. Singh, 2018, Indian Rivers: Socio-economic aspects, Springer.
14. M.E. Tucker, 2006, Sedimentary Petrology. Blackwell Publishing.

Web references:

Video Lectures on Sedimentology by Prof. Dhruv Sen Singh, Department of Geology, University of Lucknow, https://www.youtube.com/channel/UC2fYhO88hm3gBmV8v-VUrPg

Paper Title:	Practical-II	Lab work
Year: 2 | Sem: IV	Paper-8 | Core Paper	Credit: 04

Course outcome: The study of rocks in hand-specimens and in thin-sections will help in the identification of rocks based on the mineral constituent and texture. Sedimentary Structures helps for interpreting palaeodepositional environments. The study of Palaeontology encompasses the aspects of appearance, evolution and extinction of life through the geologic time. The knowledge of palaeontology would enable the students to understand the biological changes that occurred in the history of the earth and relate them with their field observations. The Geological Field Training helps to visualise geological cross-sections, features like folds and folds, and develop an interpretative skill for geological exposures.

Unit I

Modes of fossilisation; Types of fossils; Study of the morphology of representative invertebrate fossils of Mollusca (Bivalvia, Gastropoda and Cephalopoda), Brachiopoda, Echinodermata (Echinoidea) and Cnidaria (Anthozoa); Graptolithina and Trilobita; Study of important Gondwana plant fossils; Study of important trace fossils. Study of important vertebrate fossils.

Unit II

Ordinary and polarized lights; Nicol Prism and its construction; Polarizing microscope, its parts and functioning; Common optical properties observed under polarized light and crossed polars; Study of common rock-forming minerals in thin sections.

Unit III

Study of important igneous rocks in hand specimens and thin sections: granite, granodiorite, diorite, syenite, nepheline syenite, gabbro, ultramafic rock, basalt, andesite, rhyolite. Norm calculation; Visual estimation of modes from thin sections; Plotting of mode in IUGS classification of plutonic rocks (Streckeisen diagram).

Unit IV

Identification of important sedimentary rocks in hand-specimens; Identification of important terrigenous and carbonate sedimentary rocks in thin sections; Study of sedimentary structures in hand specimens such as ripple marks, cross-bedding, graded-bedding, mud cracks, salt pseudomorphs, rain prints etc.

Geological Field Training: It will involve visit to important geological sections in India. Excursion would be conducted by faculty members and if required the research scholars may accompany the faculty members. The marks would be given by faculty member/s on the basis of activity and performance of student in during field work, Field diary/field report and viva voce.

Suggested Reading:

1. C. Klein and B. Dutrow, 2007, The manual of Mineral Science, Wiley Publication
2. D.W. Nesse, 1986, Optical Mineralogy. McGraw Hill.
3. D. Perkins, Mineralogy. 3rd edition. Pearson.
4. E. N. K. Clarkson 2013, Invertebrate palaeontology and Evolution, Blackwell Science
5. R. M. Black, 1989, The Elements of Palaeontology, Cambridge University Press
6. J.D. Collinson, and D.B. Thompson, 1988, Sedimentary Structures, Unwin Hyman, London.
7. D. R. Prothero, F. Schwab, 2004, Sedimentary Geology, Freeman
8. A.D. Miall, 1999, Principles of Sedimentary Basin Analysis. Springer Verlag, New York.
9. G. Nichols, 1999, Sedimentology and Stratigraphy, Blackwell publishing

Paper Title:	Elementary Sedimentology	Theory
Year: 2 | Sem: IV	Paper-Q4 | Minor Paper	Credit: 02

Course outcome: The course content provides the students with an over-all knowledge about how the different types of sedimentary rocks are formed. With the different hydrodynamic processes operative in the regime, the sediments start moving and getting deposited as sedimentary rocks. During the process, the internal as also the external characteristics of sedimentary rocks vary, which are analysed to predict the environment of deposition. The course content specifies the study of different sedimentary structures, both internal and external as also the depositional environments. The subsequent variations in sedimentary rocks are also studied.

Unit I

Introduction to sedimentary rocks; Origin of sedimentary rocks; Classification of Sedimentary Rocks; Diagenesis and Lithification.

Unit II

Fluid Dynamics; Bed forms and Flow regime; Texture of clastic sedimentary rocks.

Unit III

Sedimentary structures: physical, chemical and biological; Terrigenous clastics, rocks and their classification.

Unit IV

Concept of facies; Walther's Law of facies; General idea about shallow marine environments; Fluvial system; Delta system.

Suggested Reading:

15. D.R. Prothero, 2013, Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy. W. H. Freeman; Third edition
16. H.G. Reading, 2009, Sedimentary Environments: Processes, Facies and Stratigraphy. John Wiley & Sons.
17. S.M. Sengupta, 2018, Introduction to Sedimentology. CBS Publishers & Distributors Pvt. Ltd.
18. M. R. Leeder, 2009, Sedimentology and Sedimentary Basins: from Turbulence to Tectonics. John Wiley & Sons.
19. N.W. Gokhale, 2017, Fundamentals of Sedimentary Rocks. CBS Publishers & Distributors Pvt. Ltd.
20. P.A. Allen, 1997, Earth Surface Processes, Blackwell publishing.
21. H.E. Reineck, and I. B. Singh, 1980, Depositional Sedimentary Environments: With Reference to Terrigenous Clastics, Springer.
22. J.D. Collinson, and D.B. Thompson, 1988, Sedimentary Structures, Unwin Hyman, London.
23. D. R. Prothero, F. Schwab, 2004, Sedimentary Geology, Freeman
24. A.D. Miall, 1999, Principles of Sedimentary Basin Analysis. Springer Verlag, New York.
25. G. Nichols, 1999, Sedimentology and Stratigraphy, Blackwell publishing.
26. S. Boggs, 1995, Principles of Sedimentology and Stratigraphy, Prentice Hall, New Jersey.
27. D.S. Singh, 2018, Indian Rivers: Socio-economic aspects, Springer.
28. M.E. Tucker, 2006, Sedimentary Petrology. Blackwell Publishing.

Web references:

Video Lectures on Sedimentology by Prof. Dhruv Sen Singh, Department of Geology, University of Lucknow, https://www.youtube.com/channel/UC2fYhO88hm3gBmV8v-VUrPg

Paper Title:	Geoarchaeology	Theory
Year: 2 | Sem: IV	Paper-VC-2 | Vocational Paper	Credit: 02

Course outcome: The course content provides the students with the historical application of minerals, gemstones and rocks through time. The students will be able to learn about the important Geoarchaeological sites of India.

UNIT I

Geological time scale with special reference to Pleistocene epoch chronology and Quaternary period; Dating methods - Absolute & Relative dating techniques; C^{14} dating and its application.

UNIT II

Introduction to Geoarchaeology and its scope; Rocks, gems and jewellery; Tool types and tool making technology during Palaeolithic, Mesolithic and Neolithic ages.

UNIT III

Environmental and evolutionary development of Palaeolithic (lower, middle and upper), Mesolithic and Neolithic ages; Geoenvironment with special reference to human habitat and adaptation during Palaeolithic Mesolithic, Neolithic, Iron age and Chalcolithic ages.

UNIT IV

Vedic Geology, Geoheritage of ancient world civilization including Indus Valley Civilization; Megalithic culture; Cave art and material; Geoarchaeological sites of Uttar Pradesh and other parts of Indian subcontinent.

Suggested Readings:

1. Encyclopedia of Geoarchaeology, ISBN 978-94-007-4827-9 by Allen S. Gilbert, 2017.
2. Principles of Geoarchaeology: A North American Perspective, Publisher University of Arizona Press, ISBN 0816509891 by Michael R. Waters, 1992.
3. Practical and Theoretical Geoarchaeology, Blackwell Publishing Ltd. Print ISBN:9780632060443 Online ISBN:9781118688182 by Paul Goldberg, Richard I. Macphail, 2005.
4. Digital Geoarchaeology: New Techniques for Interdisciplinary Human-Environmental Research, Springer International Publishing by Christoph Siart, Markus Fordriger, Olaf Bubenzer, 2017.
5. Geoarchaeology in the Great Plains, University of Oklahoma Press by Rolfe D. Mandel, 2021.
6. The archaeology of India, Online book by D.P. Agarwal, 2021.

Paper Title:	Metamorphic Petrology	Theory
Year: 3 | Sem: V	Paper-9 | Core Paper	Credit: 04

Course outcome: This course aims to enable the students to have broader perspective of metamorphic processes and metamorphic rocks and provide theoretical basis for interpreting the geodynamic processes.

Unit I

Definition, agents, types and grades of metamorphism; Limits of metamorphism; Metamorphic processes; Structures, textures and classification of metamorphic rocks; nature of metamorphic reactions.

Unit II

Isograds and reaction isograds; Concept and classification of metamorphic facies; Metamorphic facies series; Metamorphism of pelitic rocks, Mineralogical phase rule in closed and open systems; Graphic representation of mineral assemblages (ACF, AKF and AFM projections).

Unit III

Metasomatism; Origin and structure of migmatites; Regional metamorphism and its relation to plate tectonics; Paired metamorphic belts.

Unit IV

Concept of Pressure-Temperature-Time path; Introduction to ultrahigh pressure (UHP) and ultrahigh temperature (UHT) metamorphism.

Suggested Reading:

1. A.J. Barker, 2004, Introduction to Metamorphic Textures and Microstructures, Routledge.
2. K. Bucher, and R. Grapes, 2011, Petrogenesis of Metamorphic Rocks, Springer.
3. R. Kretz, 1994, Metamorphic Crystallization, Wiley-Blackwell.
4. R. Mason, 1990, Petrology of the Metamorphic Rocks, Unwin Hyman Ltd.
5. A. Philpotts, and J. Ague, 2009, Principles of Igneous and Metamorphic Petrology, Cambridge University Press.
6. F. S. Spear, 1993, Metamorphic Phase Equilibria and Pressure–Temperature–Time Paths, Mineralogical Society of America.
7. A. Spry, 1969, Metamorphic Textures, Pergamon Press.
8. R.H. Vernon, and G.L. Clarke, 2008, Principles of Metamorphic Petrology, Cambridge University Press.
9. J.V. Walther, and B.J. Wood, 1986, Fluid-Rock Interactions during Metamorphism, (Advances in Physical Geochemistry Book 5), Springer
10. J.D. Winter, 2009, Principles of Igneous and Metamorphic Petrology, Pearson.
11. B.W.D. Yardley, 1996, An introduction to Metamorphic Petrology, Prentice Hall.
12. B.W.D. Yardley, MacKenzie, W.S. and C. Guilford, 1990, Atlas of Metamorphic Rocks and their textures, Longman Scientific & Technical.

Paper Title:	Applied Geology	Theory
Year: 3 | Sem: V	Paper-10 | Core Paper	Credit: 04

Course outcome: This course aims to enable the students to have applied perspective of subject and provide the understanding about Remote sensing, Engineering Geology, water cycle and Environmental aspects.

Unit I

Remote Sensing: concepts; Application of Remote Sensing in geology; Types and acquisition of aerial photograph; Scale and resolution, Indian Remote Sensing Satellite missions.

Unit II

Introduction to geotechnical properties of rocks; Geological consideration for geo-engineered structures; Landslides: classification and mitigation.

Unit III

Hydrological cycle, Groundwater and its vertical distribution; Aquifers and geological considerations; Rainwater harvesting; River and groundwater pollution.

Unit IV

Concept of Environmental Geology; Geological Hazards: Earthquakes, Floods, Tsunamis and Cyclones; Processes of soil formation; types of soils; soil degradation; Environmental changes due to influence of anthropogenic activity.

Suggested Readings

1. D. P. Krynine and W. R. Judd, 1957, Principles of Engineering Geology and Geotechnics, CBS publishers and Distributors Pvt. Ltd.
2. B. Singh and R. K. Goel, 1999, Rock Mass Classification: A Practical Approach in Civil Engineering, Elsevier Science.
3. J. C. Jaeger, N. G.W. Cook, and R. W. Zimmerman, 2007, Fundamentals of Rock Mechanics, Blackwell Publishing
4. S. Gangopadhyay, 2013, Engineering Geology, Oxford University Press.
5. Vinay Kumar Pandey and Ajai Mishra, Handbook of Engineering Geology, CBS Publishers and Distributors Pvt Ltd
6. N. Kresic, 2009. Groundwater resources: sustainability, management and restoration, McGraw Hill, New York.
7. D.K. Todd, 1988, Ground Water Hydrology, John Wiley & Sons, New York.
8. S.N. Davies, and R.J.N. De-West, 1966, Hydrogeology, John Wiley & Sons, New York.
9. Ground Water and Wells,1977, UOP, Johnson, Div. St. Paul. Min. USA.
10. T. M. Lillesand and P. W. Kiefer, 2016, Remote Sensing and Image Interpretation. Wiley
11. R. P. Gupta, 2016, Remote Sensing Geology, Springer
12. F. F. Sabins, 2007, Remote Sensing, Principal and Interpretation Waveland Pr Inc
13. P. R. Wolf and B. A. Dewitt, 2004, Elements of Photogrammetry with applications in GIS.
14. G. Joseph and C. Jeganathan, 2018, Fundamentals of Remote Sensing: Universities Press (India) Private Limited
15. E. A. Keller, Environmental Geology, Prentice Hall publication
16. K. S. Valdiya, Environmental Geology, McGraw Hill publication
17. Carla W. Montgomery, Environmental Geology. McGraw Hill publication.

Paper Title:	Stratigraphy	Theory
Year: 3 | Sem: VI	Paper: 11 | Core Paper	Credit: 04

Course outcome: The course is intended to familiarise the student with stratigraphic principles and nomenclature, major stratigraphic units, methods of stratigraphic correlation, depositional environments and tectonostratigraphic framework of various lithostratigraphic units of India spanning Archaean to Holocene, and mass extinction boundaries.

Unit I

Basic concepts and principles of Stratigraphy; Lithostratigraphic, Chronostratigraphic and Biostratigraphy units; Concepts of Magnetostratigraphy, Chemostratigraphy and Event stratigraphy.

Unit II

Physical and structural subdivisions of the Indian subcontinent; Brief idea about Archaean successions of Peninsular India with special reference to the Dharwar Supergroup, Singhbhum craton, Bundelkhand craton; Unmetamorphosed Proterozoic successions of India with special reference to Cuddapah and Vindhyan Supergroups; Kaladgi Supergroup, Kurnool Group, Bhima Group, Marwar Supergroup; Stratigraphy of the Lesser Himalayan sedimentary belts. Precambrian-Cambrian boundary.

Unit III

Palaeogeography and important events of the Palaeozoic Era; Gondwana Supergroup; Marine Palaeozoic sequences of the Himalaya and Peninsular India; Permian – Triassic boundary; Marine Triassic successions of India; Palaeogeography and important events of the Jurassic and Cretaceous periods; Jurassic Succession of India (Kutch); Cretaceous successions of Trichinopoly; Stratigraphy of the Deccan Traps and Intertrappean beds; Cretaceous successions of Narmada valley;

Unit IV

Cretaceous- Tertiary (K–T) boundary; Palaeogene and Neogene global events; Neogene-Quaternary boundary; Cenozoic stratigraphy of India: Assam Group, Siwalik Group; Quaternary Period and Meghalayan Stage; Anthropocene Epoch.

Suggested Reading:

1. P. Doyle, and M.R. Bennett, 1996, Unlocking the Stratigraphic Record, John Willey.
2. C.O. Dunbar, and J. Rodgers, 1957, Principles of Stratigraphy. John Wiley & Sons.
3. M.S. Krishnan, 1982, Geology of India and Burma, C.B.S. Publishers, Delhi
4. S.M. Naqvi, 2005, Geology and Evolution of the Indian Plate: From Hadean to Holocene4 Ga to 4 Ka. Capital Pub., New Delhi.
5. E.H. Pascoe, 1968, A Manual of the Geology of India & Burma (Vols.IN), Govt. of India Press, Delhi.
6. C. Pomerol,1982, The Cenozoic Era - Tertiary and Quaternary. Ellis Harwood Ltd., Halsted Press.
7. R.M. Schoch, 1989, Stratigraphy: Principles and Methods, Van Nostrand Reinhold, New York.
8. R. Vaidyanathan & M. Ramakrishnan, 2008, Geology of India, Geological Society of India.