Vidyasagar University

Curriculum for B.Sc. Honours in Geology [Choice Based Credit System]

Semester-I

Sl.No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
C1	**C1T:** Earth System Science	Core Course-1		4	0	0	6	75
	C1P: Earth System Science Lab (Practical)	Core Course1 [Practical]		0	0	4		
C2	**C2T:** Mineral Science	Core Course-2		4	0	0	6	75
	C2P: Mineral Science Lab (Practical)	Core Course-2 [Practical]		0	0	4		
GE-1	GE-1	GE					4/5	75
	GE-1	GE					2/1	
AECC	English	AECC					2	50
				Total Credits =20				

L=Lecture, T=Tutorial, P=Practical

AECC- Ability Enhancement Compulsory Course: English /Modern Indian Language

<u>Interdisciplinary/Generic Elective (GE) from other Department</u>

[**Four papers are to be taken and each paper will be of 6 credits**]:

[Papers are to be taken from any of the following discipline (**GE-1 Mathematics**)]: **Physics/Chemistry/Mathematics/Geography /Computer Sc/Botany/Zoology**

Semester-1

Core Courses

Core-1

CC-1: EARTH SYSTEM SCIENCE **Credits 06**

C1T: EARTH SYSTEM SCIENCE (Theory) **Credits 04**

THEORY

Unit 1: Earth System Science

1. Definition and scope; General characteristics and origin of the Universe, Solar System and its planets; the Terrestrial and Jovian planets.
2. Meteorites and Asteroids
3. Earth in the solar system - origin, size, shape, mass, density, rotational and revolution parameters and its age.

Unit 2: Solid Earth, Hydrosphere, Atmosphere and Biosphere

1.Internal constitution - its recognition vis-à-vis solid earth geophysics: crust, mantle, core, evidence from seismic waves
2. Earthquake and earthquake belts: Seismic waves and internal constitution of the Earth
3. Volcanoes and volcanism, distribution of volcanoes
4. Concept of isostasy
5.Hydrosphere, atmosphere and biosphere: Elementary idea
6. Nature of Earth's magnetic field and geothermal gradient.
7. Fossil, Evolution and Charles Darwin

Unit 3: Plate Tectonics

1. Historical development of the concept of continental drift and plate tectonics
2. Plates and Plate boundaries
3. Geodynamic elements of Earth: Mid Oceanic Ridges, trenches, transform faults and island arcs
4. Plate tectonics: mountain belts and rift valleys

Unit 4: Hydrosphere and Atmosphere

Oceanic current system and effect of Coriolis force
Concepts of eustasy
Land-sea interaction along coast
Weather and climatic changes

Unit 5: Earth surface processes

Weathering; erosion; mass wasting; Geological work of wind, river and glacier
Formation of soil, soil profile and soil types

Unit 6: Cosmic abundance of elements

Distribution of elements in solar system and in Earth

Introduction to chemical differentiation and composition of the Earth
General concepts about geochemical cycles

Unit 7: Understanding the past from stratigraphic records

1. Nature of stratigraphic records
2. Fundamental laws of stratigraphy: Laws of superposition and faunal succession, Concepts of neptunism, plutonism, uniformitarianism.
3. Concept of time and geological time scale. Absolute and relative time in Geology.
4. Concept of radiometric dating. Radiometric dating of rocks and minerals: U-Pb, Pb-Pb, K Ar, Rb-Sr, Sm-Nd method. Dating igneous and sedimentary rocks.

C1P: EARTH SYSTEM SCIENCE(Practical) Credits 02

1.Study of major geomorphic features and their relationships with outcrops through physiographic models and maps
2. Detailed study of topographic sheets and preparation of physiographic description of an area
3. Study of distribution of cratons, mobile belts and major sedimentary basins on the map of India.
4. Identification, state of preservation of fossils

Reference books:

Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.
- Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment. Cambridge University Press.
- Gross, M. G. (1977). Oceanography: A view of the earth.
- Tarback, E. J. and Lutgens, F.K. (2006). Earth Science. Pearson Prentice Hall. New Jersey
- Grotzinger, J., Jordan, T.H., Press, F and Siever, R. (2007) Understanding Earth (Fifth Edition). W. H. Freeman and company. New York.
- Environmental Science – Earth as a Living Planet. By – Daniel B. Botkin & Edward A. Keller, John Wiley & Sons.

Principles of Paleontology , Raupund Stanley, Foot and Miller.

CORE - 2

CC-2T: MINERAL SCIENCE Credits 06

C2T2: MINERAL SCIENCE (Theory) Credits 04

Unit 1: Crystallography

1.Elementary ideas about crystal morphology in relation to internal structures
2. Crystal parameters and Miller indices
3.Crystal symmetry and classification of crystals into point groups, space groups and crystal systems
4. Stereographic projections of symmetry elements and forms, Herman Mauguin notation

Unit 2: Rock forming minerals

1.Minerals - definition and classification, physical and chemical properties
2. Chemical classification of minerals
3. Composition of common oxides, carbonated, sulphides and sulphates and phosphates
4. Composition of common rock-forming minerals

Unit 3: Atomic arrangements and Mineralogical structure

1. Crystal structure and its controls: bonding and coordination principles, atomic arrangement: unit cell, CCP and HCP structures.
2. Brief idea about Pauling's rules, Solid solution, Pseudomorphism and Polymorphism: elementary concept on principle types – common polymorphic forms of C, SiO_2 and Al_2SiO_5
3. Classification of silicate groups based on structure and derivation of structural formulae based on composition.

Unit 4: Optical mineralogy

1.Optical behaviour of crystals – Isotropic and anisotropic minerals; Nicol prism and its principle;
2.Refractive index of minerals; Uniaxial & Biaxial minerals; Optical indicatrix of uniaxial and biaxial minerals; Birefringence, Interference colour and use of interference colour chart; Relation between crystallographic and optical axes of crystals
3.Pleochroism and pleochroic scheme; Extinction; Study of interference figures; Optic sign of uniaxial and biaxial minerals

C2P: MINERAL SCIENCE (Practical) Credits 02

1. Study of the symmetry of crystals
2. Study of physical properties of minerals in hand specimen: Olivine, Garnet, SilIimanite, Kyanite, Staurolite, Beryl, Tourmaline, Pyroxene, Actinolite, Tremolite, Hornblende, Serpentine, Talc, Muscovite, Biotite, Quartz, Alkali feldspar, Plagioclase, Nepheline, Sodalite, Zeolite
Pyrite, Chalcopyrite, Galena, Sphalerite, Graphite, Magnetite, Haematite, Fluorite, Calcite, Dolomite, Gypsum, Asbestos, Ilmenite, Chromite, Pyrolusite, Psilomelane, Bauxite
3.Study of optical properties of common rock-forming minerals: quartz, orthoclase, microcline, plagioclase, perthite, nepheline, olivine, orthopyroxene, clinopyroxene, hornblende, staurolite, garnet, muscovite, biotite, calcite

References:

1. Klein, C., Dutrow, B., Dwight, J., & Klein, C. (2007). The 23rd Edition of the Manual of Mineral Science (after James D. Dana). J. Wiley & Sons.
2. Kerr, P. F. (1959). Optical Mineralogy. McGraw-Hill.
3. Verma, P. K. (2010). Optical Mineralogy (Four Colour). Ane Books Pvt Ltd.
4. Deer, W. A., Howie, R. A., & Zussman, J. (1992). An introduction to the rock-forming minerals (Vol. 696). London: Longman.

Generic Elective Syllabus

GE-1 [Interdisciplinary for other department]

GE-1: Essentials of Geology — Credits 06

GE1T: Essentials of Geology — Credits 04

Essentials of Geology
Unit 1
Introduction to geology: scope, sub-disciplines and relationship with other branches of sciences.
Unit 2
Earth in the solar system, origin **Earth's size, shape, mass, density, rotational and evolutional parameters** **Solar System- Introduction to Various planets - Terrestrial Planets Solar System- Introduction to Various planets - Jovian Planets**
Unit 3: Solid Earth, Hydrosphere, Atmosphere and Biosphere
Mechanical layering of the Earth: lithosphere, asthenosphere, mantle and core. **Earthquake and earthquake belts: seismic waves and internal constitution of the Earth.** **Volcanoes and volcanism, distribution of volcanoes.** **Concept of isostasy.** **Formation of core, mantle, crust, atmosphere, hydrosphere and biosphere.** **Convection in Earth's core and production of its magnetic field.** **Geothermal gradient and internal heat of the Earth.**
Unit: 4. Rocks, Mineral and fossils
Definition. General character. Usefulness.
Unit5: Plate Tectonics
Fundamental Earth process: Plate tectonics. **Plates and plate boundaries.** **Origin of oceans, continents, mountains and rift valleys**
Unit6: Earth's Surface Processes
Weathering and Erosion. **Landforms in deserts, glaciated region and river valleys.**
Unit 7:
Age of the earth; radioactivity and its application in determining the age of the Earth.
Reference Books
► Holmes' Principles of Physical Geology. (1992). Chapman & Hall. ► Emiliani, C, (1992). Planet Earth, Cosmology, Geology and the Evolution of Life and Environment. Cambridge University Press. ► Gross,M.G. (1977). Oceanography: A view of the Earth. Prentice Hall.

GE1 P: Essentials of Geology Lab Credits 02

Essentials of Geology
PRACTICALS

1. **Study of topographic sheets and description of physiographic features of an area.**
2. **Study of geological maps with simple outcrop patterns.**
3. **Study of distribution of major lithostratigraphic units on the map of India.**
4. **Study of important rocks, minerals and fossils (the items may be fixed by the department concern).**

Vidyasagar University

Curriculum for B.Sc. Honours in Geology [Choice Based Credit System]

Semester-II

Sl.No.	Name of the Subject	Nature	Code	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
C3	**C3T:** Elements of Geochemistry	Core Course-3		4	0	0	6	75
	C3P: Elements of Geochemistry (Lab)	Core Course-3 [Practical]		0	0	4		
C4	**C4T:** Structural Geology	Core Course-4		4	0	0	6	75
	C4P: Structural Geology(Lab)	Core Course-4 [Practical]		0	0	4		
GE-2	GE-2	GE					4/5	75
	GE-2	GE					2/1	
AECC -2	Environmental Studies	AECC					4	100
				Total Credits =22				

L=Lecture, T=Tutorial, P=Practical

AECC- Ability Enhancement Compulsory Course: Environmental Studies.

Interdisciplinary/Generic Elective (GE) from other Department
[**Four papers are to be taken and each paper will be of 6 credits**]:
[Papers are to be taken from any of the following discipline (**GE-2 from Mathematics**)]:
Physics/Chemistry/Mathematics/Geography /Computer Sc/Botany/Zoology

Semester-II

Core Courses

Core-3

CC-3 : Elements of Geochemistry **Credits 06**

C3 T : Elements of Geochemistry **Credits 04**

Unit 1: Basic Concepts

1. Introduction to properties of elements: The periodic table
2. Chemical bonding, states of matter and atomic environment of elements
3. Geochemical classification of elements

Unit 2: Layered structure of Earth and geochemistry

1. Composition of the bulk silicate Earth
2. Composition of core
3. Composition of mantle: depleted mantle and enriched mantle
4. Composition of crust: Continental and Oceanic
5. Isotope geology: Isotopic and elemental fractionation
6. Radiogenic and stable isotopes in Earth materials

Unit 3: Element transport

1. Advection and diffusion Chromatography
2. Aqueous geochemistry- basic concepts and speciation in solutions, Eh, pH relations
3. Elements of marine chemistry
4. Mineral reactions- diagenesis and hydrothermal reactions.

Unit 4: Geochemistry of solid Earth

Geochemical variability of magma and its products. Melting processes.

Unit 5: Geochemical behavior of selected elements

Si, Al, K, Na, Ca, Fe, Mg, Ti.

Reference Books

- Mason, B. (1986) Principles of Geochemistry. 3rd Edition, Wiley New York.
- Rollinson, H. (2007) Using geochemical data – evaluation, presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical.
- Walther, J. V. (2009). Essentials of geochemistry. Jones & Bartlett Publishers.
- Albarède, F. (2003). Geochemistry: an introduction. Cambridge University Press.
- Faure, Gunter and Teresa M. Mensing (2004). Isotopes Principles and Applications,Wiley India Pvt. Ltd

C3 P : Elements of Geochemistry(Lab) **Credits 02**

List of Practical

1. Geochemical variation diagrams and its interpretations:

    a. Bivariate and trivariate plots to delineate the control of different compositional variables:

        i. Harker variation diagram
        ii. AFM diagram
        iii. MgO diagram

    b. Chemical variation diagrams based on major elements:

        i. Alkali-lime index
        ii. Iron enrichment index
        iii. Aluminium saturation index
        iv. Alkalinity index diagrams

Core-4

CC-4: Structural Geology **Credits 06**

C4T: Structural Geology **Credits 04**

Unit 1: Basic structural elements

1. Diastrophic and non- diastrophic structures
2. Structural elements: planar and linear structures, concept of strike and dip, trend and plunge, rake/pitch
3. Application of primary sedimentary and igneous structure in structural geology. Unconformity and its types; recognition of Unconformity
4. Concept of scale of observation of structures
5. Topographic maps. Outcrop patterns of different structures

Unit 2: Stress and strain in rocks

1. Concept of rock deformation: Concept of Stress. Basic idea of Shear zone
2. Concept of Strain: Homogeneous and inhomogeneous strain, Rotational and irrotational strain in rocks,
3. Strain ellipsoids of different types and their geological significance.
4. Flinn and Ramsay's diagram
5. Concept of Rock deformation: Brittle and ductile deformation.

Unit 3: Folds

1. Fold morphology
2. Geometric and genetic classification of folds
3. Introduction to the mechanics of folding: Buckling, Bending, Flexural slip and flow folding

Foliation and lineation

Description and origin of foliations: axial plane cleavage and its tectonic significance Description and origin of lineation and relationship with the major structures

Fractures and faults

1. Geometric and genetic classification of fractures and faults Effects of faulting on the outcrops
2. Geologic/geomorphic criteria for recognition of faults and fault plane solutions

Reference Books

- Davis, G. R. (1984) Structural Geology of Rocks and Region. John Wiley Billings, M. P. (1987) Structural Geology, 4th edition, Prentice-Hall. Park, R. G. (2004) Foundations of Structural Geology.Chapman & Hall.
- Pollard, D. D. (2005) Fundamental of Structural Geology. Cambridge University Press. Ragan, D. M. (2009) Structural Geology: an introduction to geometrical techniques (4th Ed). Cambridge University Press (For Practical) Lahee F. H. (1962) Field Geology. McGraw Hill

C4 P: Structural Geology (Lab) **Credits 02**

List of Practical

1. Basic idea of topographic maps, Topographic sheets of various scales
2. Interpretation of topographic maps
3. Interpretation of Geological maps with unconformity, fault, fold and igneous bodies Construction of structural cross section
4. Stereographic projections of planes and lines
5. True dip and apparent dip problems, 3-point problems, fold problems, fault problems and their solutions through stereographic projection methods

Generic Elective Syllabus

GE-2 [Interdisciplinary for other department]

GE2: Physics and Chemistry of Earth **Credits 06**

GE2 T - Physics and Chemistry of Earth **Credits 04**

Unit 1
1. Continents, continental margins, oceans

Unit 2
1. Earth's interior - variation of physical quantities and seismic wave velocity inside the earth, major sub divisions and discontinuities.
2. Concepts of Isostasy; Airy and Pratt Model
3. Constitutions of Core and mantle: Seismological and other geophysical constraints
4. Convection in the mantle

Unit 3
1. Earth's magnetic field: Character and genesis.
2. Secular variation and westward drift
3. Solar activity and magnetic disturbance

Unit 4
1. Origin of elements/nucleosynthesis. Abundance of the elements in the solar system / planet earth geochemical classification of elements.
2. Earth accretion and early differentiation
3. Isotopes and their applications in understanding Earth processes. Stable isotopes: Stable isotope fractionation. Oxygen isotopes

Unit 5
1. Basic concept of environmental geochemistry
2. Geological disposal of nuclear waste
3. Lead and other heavy metals in environment and their effect on human health

Reference Books

- Holmes, A., Principles of Physical Geology, 1992, Chapman and Hall
- Condie, K.C. Plate Tectonics and Crustal Evolution, Pargamon Press, 1989.
- Krauskopf, K. B., & Dennis, K. Bird, 1995, Introduction to Geochemistry. McGraw-Hill
- Faure, G. Principles and Applications of Geochemistry, 2/e (1998), Prentice Hall, 600 pp.
- Anderson, G. M. (1996). Thermodynamics of natural systems. John Wiley & Sons Inc.
- Steiner, E. (2008). The chemistry maths book. Oxford University Press.
- Yates, P. (2007) Chemical calculations. 2nd Ed. CRC Press.
- Turcotte, D. and Schubert, G. Geodynamic. Second Edition. Cambridge

GE2 P – Physics and Chemistry of Earth (Lab) **Credits 02**

List of Practical

1. Method of plotting in triangular diagrams
2. Projection of major element data on Harker's diagram to characterize magmatic differentiation
3. Study of trace elements through
   a) Projection of chondrite/primitive normalized trace elements to characterize sources
   b) Projection of trace elements on tectonic discrimination diagrams
4. Problems on isostasy

Vidyasagar University

Curriculum for B.Sc (Honours) in Geology
[Choice Based Credit System]

Semester-III

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC-5		**C5T:** Igneous Petrology	Core Course - 5	4	0	0	6	75
		C5P: Igneous Petrology– II Lab		0	0	4		
CC-6		**C6T:** Sedimentary Petrology	Core Course - 6	4	0	0	6	75
		C6P: Sedimentary Petrology Lab		0	0	4		
CC-7		**C7T:** Paleontology	Core Course - 7	4	0	0	6	75
		C7P: Paleontology Lab		0	0	4		
GE-3		TBD	Generic Elective -3				6	75
SEC-1		**SEC-1:** Field Geology I- Basic Field Training **Or** **SEC-1:** Field Geology II-Geological Mapping and Structural Geology Field	Skill Enhancement Course-1	1	1	0	2	50
Semester Total							**26**	**350**

L=Lecture, **T=** Tutorial, **P=**Practical, **CC =** Core Course, **GE**= Generic Elective, **SEC** = Skill Enhancement Course, **TBD =** to be decided

Generic Elective (GE) (Interdisciplinary) from other Department [**Four papers are to be taken and each paper will be of 6 credits**]: Papers are to be taken from any of the following discipline: **Physics/Chemistry/Mathematics/Geography /Computer Sc/Botany/Zoology**

Modalities of selection of Generic Electives (GE): A student shall have to choose **04** Generic Elective (GE1 to GE4) strictly from **02** subjects / disciplines of choice taking exactly **02** courses from each subjects of disciplines. Such a student shall have to study the curriculum of Generic Elective (GE) of a subject or discipline specified for the relevant semester

Semester-III
Core Course (CC)

CC-5: Igneous Petrology — Credits 06

C5T: Igneous Petrology — Credits 04

Unit 1: Introduction to Igneous petrology

1. Modes of magma formation in the crust and upper mantle
2. Physical properties of magma - temperature, viscosity, density and volatile content
3. Modes of emplacement of igneous rocks: volcanic, hypabyssal, plutonic

Unit 2: Forms of Igneous rock bodies

1. Mode of occurrence of Igneous rocks
2. Forms of igneous rocks

Unit 3: Texture and microstructure of Igneous rocks

1. Crystallinity, granularity, shapes and mutual relations of grains; nucleation and growth of igneous minerals
2. Description of the following textures and microstructures with their occurrence in different rocks - panidiomorphic, hypidiomorphic, allotriomorphic, porphyritic, vitrophyric, poikilitic, ophitic, sub-ophitic, intergranular, intersertal, pilotaxitic, trachytic, graphic, granophyric, rapakivi, orbicular, corona, perthitic, myrmekitic, variolitic, speherulitic & spinifex
3. Binary and Ternary Phase diagrams in understanding crystal-melt equilibrium in basaltic and granitic magmas
4. Magma generation in crust and mantle, their emplacement and evolution

Unit 4: Classification of igneous rocks

1. Bases of classification of igneous rocks: mineralogical, textural, chemical, chemico-mineralogical and associational; Norm and mode; Standard classification schemes – Niggli, Wells & Wells and IUGS. TAS diagram for volcanic rocks
2. Composition and texture of important igneous rocks: Granitoids, Pegmatite, Syenite, Monzonite, Diorite, Norite, Gabbro, Anthrothosite, Dolerite, Pyroxenites, Peridotite, Lamprophyres, Carbonatite, Rhyolite, Andesite, Dacite, Basalt, Komatiite

Unit 5: Phase Diagrams

Phase Rule and its application to eutectic, peritectic and solid solution system: 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 6: Petrogenesis of Igneous rocks

1. Magma generation in crust and mantle, their emplacement and evolution
2. Petrogenesis of Felsic and Mafic igneous rocks: Granitoids, Basalt, Gabbros, Anorthosite, Komatiites, Alkaline rocks, Kimberlites

Unit 7: Magmatism in different tectonic settings

1. Magmatism in the oceanic domains (MORB, OIB)
2. Magmatism along the subduction zones: Island arcs andcontinental arcs
3. Magmatism along continental rifts

Reference Books:

1. Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge University Press.
2. Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson.
3. Rollinson, H. R. (2014). Using geochemical data: evaluation, presentation, interpretation. Routledge.
4. Raymond, L. A. (2002). Petrology: the study of igneous, sedimentary, and metamorphic rocks. McGraw-Hill Science Engineering.
5. Myron G. Best (2001). Igneous and Metamorphic Petrology,
6. K. G. Cox, J. D. Bell. (1979). The Interpretation of Igneous Rocks. Springer/Chapman & Hall.
7. Bose M.K. (1997). Igneous Petrology.
8. Frost B. R. and Frost C. D (2014). Essentials of Igneous and Metamorphic Petrology. Cambridge University Press.

C5P: Igneous Petrology– II Lab **Credits 02**

List of Practical

1. Study of important igneous rocks in hand specimens and thin sections: granite, granodiorite, diorite, syanite, nepheline syenite, gabbro, anorthosites, ultramafic rocks, basalts, andesites, trachyte, rhyolite, dacite
2. Norm calculation. Visual estimation of modes from thin sections
3. Plotting of mode in IUGS classification of plutonic rocks (Streckeisen diagram)

CC-6: Sedimentary Petrology Credits 06

C6T: Sedimentary Petrology **Credits 04**

Unit 1: Introduction to Sedimentology

Outline of sedimentation process: Definition of sediment; origin of sediments: mechanical and chemical sediments; source rock or provenance

Unit 2: Granulometry

Grain size: concept and size scale, particle size distribution, environmental connotation; particle shape and fabric; Sedimentary textures

Unit 3: Basic hydraulics and Sedimentary structures

1. Fluid flow: Types of fluids, Laminar and turbulent flow, subcritical, critical and supercritical flows; concept of mean flow velocity, unit discharge and bed shear stress; flow profile and flow separation; particle entrainment, transport and deposition
2. Mass flow: types, mechanisms and controlling factors, process-product relationship

3. Penecontemporaneous deformation: mechanisms and controlling factors
4. Sedimentary structure: Primary and penecontemporaneous deformation structures
5. Bedform stability diagram
6. Paleocurrent analysis: Data acquisition, methodology, different palaeocurrent patterns

Unit 4: Sedimentary rocks

1. Siliciclastic rocks: Components and classification(s) of conglomerates and sandstones
2. Tectonic control on sandstone composition
3. General introduction to Mudrocks, Carbonate rocks; controlling factors of carbonate deposition; components and classifications of limestone; dolomite and dolomitisation

Unit 5: Diagenesis

1. Concepts of diagenesis
2. Stages of diagenesis: diagenetic changes in sand and carbonate deposits, lithification

Reference Books:

1. Prothero, D. R., & Schwab, F. (2004). Sedimentary geology. Macmillan.
2. Tucker, M. E. (2006) Sedimenary Petrology, Blackwell Publishing.
3. Collinson, J. D. & Thompson, D. B. (1988) Sedimentary structures, Unwin-Hyman, London.
4. Nichols, G. (2009) Sedimentology and Stratigraphy Second Edition. Wiley Blackwell

C6P: Sedimentary Petrology Lab **Credits 02**

List of Practical

1. Identification of sedimentary structures
2. Particle size distribution and statistical analysis
3. Paleocurrent analysis
4. Petrographic study of clastic and non-clastic rocks through hand specimens and thin sections

CC-7: Paleontology Credits 06

C7T: Paleontology **Credits 04**

Unit 1: Fossilization and fossil record

1. Fossilization: definition of fossil, fossilization processes and modes of preservation, exceptional preservation
2. Taphonomy: definition, different types of taphonomic filters

Unit 2: Taxonomy and Systematics

1. Taxonomy: concept of taxonomy and taxonomic hierarchy
2. Biological and morphological species concept

Unit 3: Evolution and History of Life

1. Theory of organic Evolution: theory, concept of adaptation and variation, Natural Selection. Precambrian – doubtful organic traces of life during the Precambrian, Ediacaran fauna
2. Paleozoic – Cambrian Explosion of life. Episodes of mass extinction
3. Plants: Appearance of angiosperma and gymnosperma
4. Appearance of fish, amphibia, reptiles, birds, mammals and humans
5. Mass extinction: five major extinction episodes and their causes; effect of extinction

Unit 4: Invertebrates and Vertebrates

1. Brief introduction to important invertebrate groups (Bivalvia, Gastropoda, Brachiopoda) and their biostratigraphic significance
2. Significance of ammonites in Mesozoic biostratigraphy and their paleobiogeographic implications. Functional adaptation in trilobites and ammonoids
3. Origin of vertebrates and major steps in vertebrate evolution
4. Mesozoic reptiles with special reference to origin, diversity and extinction of dinosaurs
5. Evolution of horse and intercontinental migrations
6. Human evolution

Unit 5: Introduction to Paleobotany, Gondwana Flora Introduction to Ichnology.

1. Introduction to Paleobotany, Gondwana Flora, Plants as indicator of past climate
2. Ichnology and its application in paleoecology

Unit 6: Application of fossils in Stratigraphy

1. Definitions: Biozones, index fossils, stratigraphic correlation, examples - significance of ammonites in Mesozoic paleobiostratigraphy
2. Application of fossils in Paleoenvironmental analysis
3. Fossils and paleobiogeography, biogeographic provinces, dispersals and barriers.Paleoenvironmental analysis

Reference Books:

1. Raup, D. M., Stanley, S. M., Freeman, W. H. (1971) Principles of Paleontology
2. Clarkson, E. N. K. (2012) Invertebrate paleontology and evolution 4th Edition by Blackwell Publishing.
3. Benton, M. (2009). Vertebrate paleontology. John Wiley & Sons.
4. Benton, M. J., Harper, D. A. T. (2010). Introduction to Paleobiology and the Fossil Record , Wiley-Blackwell.
5. Shukla, A. C., & Misra, S. P. (1975). Essentials of paleobotany. Vikas Publisher

C7P: Paleontology Lab **Credits 02**

List of Practical

1. Study of fossils with various modes of preservation
2. Study of systematic position, stratigraphic position and age of various invertebrate, vertebrate and plant fossils
3. Study of functional morphological characters of different groups (Bivalvia, Gastropods, Brachiopoda, Echinodermata, Ammonoidea, Gondwana flora, vertebrates)
4. Identification of feeding habits from vertebrate (horse, elephants, Sus) teeth
5. Hard part morphology and identification of common Brachiopoda, Anthozoa, Trilobita, Echinoidea, Gastropoda. Identification of Gondwana flora

Skill Enhancement Course (SEC)

SEC-1: Field Geology I- Basic Field Training Credits 02

Unit 1
Topographic sheet: Methods of naming. Features scale. Map reading.

Unit 2
1. Use of topographic sheets in field. Marking location in topographic sheet using physical
   features and bearing.
2. Use of GPS in field.
3. Distance, height and pace approximation in field.

Unit 3
1. Identification of rock types.
2. Identification of sedimentary and tectonic structures in field.

Unit 4
1. Clinometer and Brunton compass: Use of the instruments in measuring geological data in field. Techniques of measurement of orientation data in field.
2. Litholog measurement

Unit 5
1. Recording field data in maps and notebooks.
2. Report writing.

OR

SEC-1: Field Geology II-Geological Mapping and Structural Geology Field Credits 02

Unit 1
Preparation of a geological map of a small area with homoclinal or gently folded beds.

Unit 2
Stereographic plots of orientation data and their interpretation.

Generic Elective Syllabus
GE-3 [Interdisciplinary for other department]

GE-3 - Fossils and Their Applications **Credits 06**

GE3T - Fossils and Their Applications **Credits 04**

Unit 1: Introduction to Fossils

Definition of fossil, fossilization processes (taphonomy), taphonomic attributes and its implications, modes of fossil preservation, role of fossils in development of geological time scale and fossils sampling techniques.

Unit 2: Species concept

Definition of species, species problem in paleontology, speciation, methods of description and naming of fossils, code of systematic nomenclature

Unit 3: Introduction to various fossils groups

Brief introduction of important fossils groups: invertebrate, vertebrate, microfossils, spore, pollens and plant fossils. Important age-diagnostic Fossiliferous horizons of India

Unit 4: Application of fossils

Principles and methods of paleoecology, application of fossils in the study of paleoecology, paleobiogeography and paleoclimate

Unit 5: Economic importance of fossils

Implication of larger benthic and micropaleontology in hydrocarbon exploration: identification of reservoirs and their correlation. Application of spore and pollens in correlation of coal seams, spore and pollens as indicator of thermal maturity of hydrocarbons reservoirs, fossils associated with mineral deposits, fossils as an indicator of pollution.

Reference Books

1. Schoch, R.M. 1989. Stratigraphy, Principles and Methods.VanNostrand Reinhold.
2. Clarkson, E.N.K.1998. Invertebrate Paleontology and Evolution George AlIen&Unwin Prothero, D.R. 1998. Bringing fossils to life - An introduction to Paleobiology, McGraw Hill.
3. Benton, M.J. 2005. Vertebrate paleontology (3rd edition). Blackwell Scientific, Oxford.
4. Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time, EdwinH. Colbert, Michael Morales, Eli C. Minkoff, John Wiley & Sons, 1991.

GE3P: Fossils and their Applications Lab **Credits 02**

List of Practical

1. Study of fossils showing various modes of fossilization
2. Study of important fossils from India (list may be prepared by the department concern)