VIDYASAGAR UNIVERSITY

Curriculum for 3-Year BSc (General)
in

Geology

Under Choice Based Credit System (CBCS)
[w.e.f 2018-2019]

VIDYASAGAR UNIVERSITY

B Sc (General) in Geology

[Choice Based Credit System]

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
1	I	SEMESTER-I					CA	ESE	TOTAL
		Core-1 (DSC-1A)		Physical and Structural Geology - **Lab**	6	4-0-4	15	60	75
		Core-2 (DSC-2A)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		Core-3 (DSC-3A)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		AECC-1 (Elective)		English/MIL	2	1-1-0	10	40	50
				Semester - I : Total	**20**				**275**
	II	SEMESTER-II							
		Core-4 (DSC-1B)		Crystallography and Mineralogy - **Lab**	6	4-0-4	15	60	75
		Core-5 (DSC-2B)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		Core-6 (DSC-3B)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		AECC-2 (Elective)		Environmental Studies	4		20	80	100
				Semester - 2 : Total	**22**				**325**

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
2	III	SEMESTER-III					CA	ESE	TOTAL
		Core-7 (DSC-1C)		Petrology - **Lab**	6	4-0-4	15	60	75
		Core-8 (DSC-2C)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		Core-9 (DSC-3C)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		SEC-1		**SEC-1:** Photo Geology and Remote Sensing **Or** Field Geology-I	2	1-1-0/ 0-0-4	10	40	50
				Semester - 3 : Total	**20**				**275**
	IV	SEMESTER-IV							
		Core-10 (DSC-1D)		Stratigraphy and Palaeontology - **Lab**	6	4-0-4	15	60	75
		Core-11 (DSC-2D)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		Core-12 (DSC-3D)		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		SEC-2		**SEC-2:** Geomorphology and Geo-tectonics **Or** Field Geology-II	2	1-1-0/ 0-0-4	10	40	50
				Semester - 4 : Total	**20**				**275**

Year	Semester	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
3	V	SEMESTER-V					CA	ESE	TOTAL
		DSE-1A		Discipline-1(Geology)	6	4-0-4/ 5-1-0	15	60	75
		DSE-2A		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		DSE-3A		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		SEC-3		**SEC-3:** Environmental Geology **Or** Field Geology – III	2	1-1-0/ 0-0-4	10	40	50
				Semester - 5 : Total	**20**				**275**
	VI	SEMESTER-VI							
		DSE-1B		Discipline-1(Geology)	6	4-0-4/ 5-1-0	15	60	75
		DSE-2B		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		DSE-3B		Other Discipline/TBD	6	4-0-4/ 5-1-0	15	60	75
		SEC-4		**SEC-4:** Geochemistry **Or** Field Geology - IV	2	1-1-0/ 0-0-4	10	40	50
				Semester - 6 : Total	**20**				**275**
	Total in all semester:				**122**				**1700**

CC = Core Course , **AECC** = Ability Enhancement Compulsory Course , **GE** = Generic Elective , **SEC** = Skill Enhancement Course , **DSE** = Discipline Specific Elective , **CA**= Continuous Assessment , **ESE**= End Semester Examination , **TBD**=To be decided , **CT** = Core Theory, **CP**=Core Practical , **L** = Lecture, **T** = Tutorial, P = Practical, **MI**L = Modern Indian Language , **ENV**S = Environmental Studies ,

List of Core and Elective Courses

CORE COURSES (CC)

DSC-1A: Physical and Structural Geology
DSC-1B: Crystallography and Mineralogy
DSC-1C: Petrology
DSC-1D: Straigraphy and Palaeontology

DISCIPLINE SPECIFIC ELECTIVE (DSE)

DSE-1: Economic Geology and Hydrology
Or
DSE-1: Introduction to Fuel Geology
Or
DSE-1: Geo-tectonics
Or
DSE-1: Basics of River science
DSE-2: Natural Hazards and Disaster Management
Or
DSE-2: Fossils and their applications
Or
DSE-2: Evolution of life through time
Or
DSE-2: Earth and Climate

SKILL ENHANCEMENT COURSE (SEC)

SEC-1: Photo Geology and Remote Sensing
Or
SEC-1: Field Geology-I
SEC-2: Geomorphology and Geo-tectonics
Or
SEC-2: Field Geology-II
SEC-3: Environmental Geology
Or
SEC-3: Field Geology – III
SEC-4: Geochemistry
Or
SEC-4: Field Geology - IV

Core Courses (CC)

DSC-1A (CC-1): Physical and Structural Geology **Credits 06**

DSC-1AT (CC-1): Physical and Structural Geology (Theory) **Credits 04**

Course Contents:

Unit-I: Introduction to geology and its scope, Earth and solar system: origin, size, shape, mass, density and its atmosphere.

Unit-II: A brief account of various theories regarding the origin and age of the earth; Brief idea of interior of earth and its composition.

Unit-III: Weathering and erosion: factors, types and their effects.

Unit-IV: Earthquakes: nature of seismic waves, their intensity and magnitude scale; Origin of earthquake and preventive measures; Volcanoes: types, products and causes of volcanism.

Unit-V: Introduction to Structural Geology; contours, topographic and geological maps; Elementary idea of bed, dip and strike; Outcrop, effects of various structures on outcrop. Clinometer / Brunton compass and its use.

Unit-VI: Elementary idea of types of deformation, Concept of stress strain, Foliations and lineations; Folds: nomenclature and types of folds.

Unit-VII: Faults: nomenclature, geometrical and genetic classifications, normal, thrust and slip faults.

Unit-VIII: Definition, kinds and significance of joints and unconformity.

DSC-1AP: Practical **Credits 02**

Physical Geology:
Study of important geomorphological models; Reading topographical maps of the Survey of India; Identification of geomorphic features.

Structural Geology:
Study of clinometers/Brunton compass; Identification of different types of folds/faults from block models; Exercises on structural problems: preparation of cross section profile from a geological map.

Suggested Readings:

1. Arthur Holmes, 1992. Principles of Physical Geology. Chapman and Hall, London.
2. Miller, 1949. An Introduction to Physical Geology. East West Press Ltd.
3. Spencer, E.V., 1962. Basic concepts of Physical Geology.Oxford & IBH.
4. Mahapatra, G.B., 1994. A text book of Physical geology.CBS Publishers.

5. Billings, M.P., 1972. Structural Geology.Prentice Hall.
6. Davis, G.R., 1984. Structural Geology of Rocks and Region. John Wiley
7. Hills, E.S., 1963. Elements of Structural Geology.Farrold and Sons, London.
8. Singh, R. P., 1995. Structural Geology, A Practical Approach. Ganga Kaveri Publ., Varanasi.

DSC-1B (CC-2): Crystallography and Mineralogy **Credits 06**

DSC1BT: Crystallography and Mineralogy (Theory) **Credits 04**

Course Contents:

Unit-I: Crystals and their characters:

Unit-II: Crystal form, face, edge, solid angle; Interfacial angle and their measurements; Crystallographic axes and angles.

Unit-III: Crystal parameters, Weiss and Miller system of notations.

Unit-IV: Symmetry elements and description of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems.

Unit-V: Introduction to Mineralogy, Definition and characters of mineral.

Unit-VI: Common physical properties of minerals; Chemical composition and diagnostic physical properties of minerals such as: Quartz, Orthoclase, Microcline, Hypersthene, Hornblende, Garnet, Muscovite, Biotite, Chlorite, Olivine, Epidote, Calcite.

Unit-VII: Polarizing microscope, its parts and functioning; Ordinary and polarized lights; Common optical properties observed under ordinary, polarized lights and crossed nicols.

Unit-VIII: Optical properties of some common rock forming minerals (Quartz, Orthoclase, Microcline, Olivine, Augite, Hornblende, Muscovite, Biotite, Garnet, Calcite).

DSC1BP: Practical **Credits 02**

Crystallography:

Study of symmetry elements of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems.

Mineralogy:

Study of physical properties of minerals mentioned in theory course.Use of polarizing microscope; Study of optical properties of common rock forming minerals mentioned in theorycourse.

Geological Field Training:

Students will be required to carry out 03 days field work in a suitable geological area to study the elementary aspects of field geology and submit a report thereon.

Suggested Readings:

1. Dana, E.S. and Ford, W.E., 2002. A textbook of Mineralogy (Reprints).
2. Flint, Y., 1975. Essential of crystallography, Mir Publishers.
3. Phillips, F.C., 1963. An introduction to crystallography.Wiley, New York.
4. Berry, L.G., Mason, B. and Dietrich, R.V., 1982. Mineralogy. CBS Publ.
5. Nesse, D.W., 1986. Optical Mineralogy.McGraw Hill.
6. Read, H.H., 1968. Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.
7. Berry and Mason, 1961. Mineralogy. W.H. Freeman & Co.
8. Kerr, B.F., 1995. Optical Mineralogy 5th Ed. McGraw Hill, New York.

DSC-1C (CC-3): Petrology **Credits 06**

DSC1C: Petrology (Theory) **Credits 04**

Course Contents:

Igneous Petrology

Unit-I: Magma: definition, composition, types and origin; Forms of igneous rocks; textures and structures of igneous rocks.

Unit-II: Reaction principle; Differentiation and Assimilation; Crystallization of unicomponent and bicomponent (mix-crystals); Bowen's reaction series.

Unit-III: Mineralogical and chemical classification of igneous rocks.

Unit-IV: Detailed petrographic description of Granite, Granodiorite, Rhyolite, Syenite, Diorite, Basalt, Gabbro.

Sedimentary Petrology

Unit-V: Processes of formation of sedimentary rocks; Classification, textures and structures of sedimentary rocks;

Unit-VI: Petrographic details of important siliciclastic and carbonate rocks such as - conglomerate, breccia, sandstone, greywacke, shale, limestones.

Metamorphic Petrology

Unit-VII: Process and controlling factors of metamorphism; Type of metamorphism. Facies, zones and grade of metamorphism; Textures, structures and classification of metamorphic rocks.

Unit-VIII: Petrographic details of some important metamorphic rocks such as - slate,schists, gneiss, quartzite, marble.

DSC1CP: Practical **Credits 02**

Igneous Petrology:

Identification of rocks: On the basis of their physical properties in hand specimen; and optical properties in thin sections.

Sedimentary and metamorphic Petrology:

Identification of sedimentary and metamorphic rocks both in hand specimen and thin sections.

Suggested Readings:

1. Turner, F.J. &Verhoogen, J., 1960, Igneous & Metamorphic petrology. McGraw Hill Co.
2. Bose, M.K., 1997. Igneous petrology. World press
3. Tyrell, G. W., 1989. Principles of Petrology.Methuren and Co (Students ed.).
4. Ehlers, WG, and Blatt, H., 1987. Petrology, Igneous, Sedimentary and Metamorphic rocks, CBS Publishers
5. Moorhouse, WW., 1969. The study of rocks in thin sections.Harper and sons.
6. Friedman & Sanders, 1978. Principles of Sedimentology.John Wiley and sons.
7. Pettijohn, F.J., 1975. Sedimentary rocks, Harper & Bros. 3rd Ed.
8. Prasad, C., 1980. A text book of sedimentology.
9. Sengupta. S., 1997.Introduction to sedimentology.Oxford-IBH.
10. Turner, F.J., 1980. Metamorphic petrology.McGraw Hill.
11. Mason, R., 1978. Petrology of Metamorphic Rocks. CBS Publ.
12. Winkler, H.G.C., 1967. Petrogenesis of Metamorphic Rocks.Narosa Publ.

DSC-1D(CC-4): Straigraphy and Palaeontology **Credits 06**

DSC1DT: Straigraphy and Palaeontology (Theory) **Credits 04**

Course Contents:

Unit I: Definition, Principle of stratigraphy; Geological Time Scale and stratigraphic classification; Physiographic division of India.

Unit II: Study of following Precambrian succession: Dharwar, Cuddapha, Vindhyan and Delhi Supergroups; Brief idea of Palaeozoic succession of northwestern Himalaya; Triassic of Spiti; Mesozoic type seccession of Kutch and Rajasthan; Cretaceous of Tiruchirapalli;

Unit III: Study of following type localities: Gondwana and Deccan Trap.

Unit IV: Palaeogene-Neogene sequences of northwest Himalaya and Assam.

Unit-V: Palaeontology: definition, Fossils: definition, characters, binomial nomenclature in taxonomy, mode of preservation, condition of fossilization and significance of fossils.

Unit VI: Morphology and geological distribution of brachiopods, pelecypods, cephalopods and gastropods.

Unit VII: Morphology and geological distribution of trilobite, echinoidea.

Unit VIII: Evolutionary history of horse; Morphology, distribution and significance of Gondwana flora.

DSC1DP: Practical **Credits 02**

1. Morphological characters, systematic position and age of fossil genera pertaining to brachiopods, pelecypods, cephalopods, gastropods, trilobite.

2. Preparation of lithostratigraphic maps of India showing distribution of important geological formations.

Suggested Readings:

1. Wadia, D., 1973. Geology of India.McGraw Hill Book co.
2. Krishnan, M.S., 1982. Geology of India and Burma, 6th Edition. CBS Publ.
3. Ravindra Kumar, 1985. Fundamentals of Historical Geology & Stratigraphy of India.Wiley Eastern.
4. Shrock, R.R. &Twenhoffel, W.H., 1952. Principles of Invertebrate Paleontology. CBS Publ.
5. Swinerton, HH., 1961. Outlines of Paleontology. Edward Arnold Publishers
6. Jain, P.C. &Anantharaman, M.S., 1983. Paleontology: Evolution & Animal Distribution. Vishal Publ.
7. Lehmann, U., 1983. Fossil Invertebrate.Cambridge Univ. Press.
8. Rastogi, 1988. Organic evolution. Kedrnath and Ramnath Publ.

Discipline Specific Electives (DSE)

DSE-1: Economic Geology and Hydrology **Credits 06**

DSE1T: Economic Geology and Hydrology (Theory) **Credits 04**

Course Contents:

Unit-I: Concept of ore and ore deposits, ore minerals and gangue minerals; Tenor of ores; Metallic and non-metallic ore minerals; Strategic, Critical and essential minerals.

Unit-II: Processes of formation of ore deposits; Magmatic, contact metasomatic, hydrothermal, sedimentation,

Unit-III: Study of important metallic (Cu, Pb, Zn Mn, Fe, Au, Al) and non-metallic (industrial) minerals (gypsum, magnesite, mica).

Unit-IV: Distribution of coal and petroleum in India;.

Unit-V: Definition of hydrogeology, Hydrological cycle;

Unit-VI: Hydrological parameters - Precipitation, evaporation, transpiration and infiltration.

Unit-VII: Origin of groundwater; Vertical distribution of groundwater; Types of aquifers; Water bearing properties of rocks - Porosity and Permeability; specific yield, specific retention.

Unit-VIII: Surface and subsurface geophysical and geological methods of ground water exploration; Ground water provinces of India.

DSE1P: Practical **Credits 02**

Economic Geology:

Study of ore and economic minerals in hand specimen; Preparation of maps showing distributionof important metallic and non-metallic deposits and important coal and oil fields of India.

Hydrology:

Study of hydro-geological models, Estimation of porosity and permeability from the given data;Preparation and interpretation of water table maps.

Suggested Readings:

1. Brown, C. and Dey, A.K.1955. Indian Mineral Wealth.Oxford Univ.
2. Gokhale, K.V.G.K. and Rao, T.C., 1983. Ore Deposits of India. East West Press Pvt. Ltd.
3. Jense, M.L. and Bateman A.M., 1981. Economic Mineral Deposits.John Wiley and Sons.
4. Krishnnaswamy, S., 1979. India's Minerals Resources. Oxford and IBH Publ.
5. Deb, S., 1980. Industrial minerals and Rocks of India.Allied Publishers Pvt. Ltd.
6. Umeshwar Prasad, 2003. Economic Geology.CBS Publishers and distributers.
7. Sharma, N.L. and Ram, K.V.S., 1972. Introduction to India's Economic Minerals, Dhanbad.
8. Karanth, K. R., 1989. Hydrogeology.Tata McGraw Hill Publ.
9. Raghunath, H. M., 1990. Groundwater.Wiley Eastern Ltd.
10. Subramaniam, V., 2000. Water-Kingston Publ. London.

Or

DSE – 1: Introduction to Fuel Geology **Credits 06**

DSE1T: Introduction to Fuel Geology (Theory) **Credits 04**

Course Contents:

Unit 1: Energy Resources

Different Sources of energy: Global and Indian scenario

Unit 2: Coal

1. Definition and origin of Coal
2. Basic classification of coal.
3. Fundamentals of Coal Petrology - Introduction to lithotypes, microlithotypes and macerals in coal
4. Proximate and Ultimate analyses
5. Major coal basins of India

Unit 3: Coal as a fuel

1. Concept of clean coal technology
2. Coal Bed Methane (CBM): global and Indian scenario
3. Underground coal gasification
4. Liquefaction of coal

Unit 4: Petroleum

1. Chemical composition and physical properties of crudes oil
2. Origin and migration of petroleum
3. Kerogen: Maturation of kerogen; Biogenic and Thermal effect

Unit 5: Petroleum Reservoirs and Traps

1. Reservoir rocks: general attributes and petro-physical properties.
2. Cap Rocks: definition and general properties
3. Hydrocarbon traps: definition, Classification of hydrocarbon traps - structural, stratigraphic and combination
    a. Time of trap formation and time of hydrocarbon accumulation.
    b. Petroliferous basins of India

Unit 6: Other fuels

1. Nuclear Fuel
2. Gas Hydrate

Suggested Readings:

1. Chandra D. (2007). Chandra's Textbook on applied coal petrology. Jijnasa Publishing House.
2. Shelly R. C. (2014). Elements of Petroleum geology: Third Edition, Academic Press
3. Bjorlykke, K. (1989). Sedimentology and petroleum geology. Springer-Verlag.
4. Bastia, R., &Radhakrishna, M. (2012). Basin evolution and petroleum prospectively of the continental margins of India (Vol. 59). Newness.

DSE-1P: Introduction to Fuel Geology- Lab **Credits 02**

Introduction to Fuel Geology (Practical)

List of Practical

1. Study of hand specimens of coal
2. Reserve estimation of coal
3. Section correlation and identification of hydrocarbon prospect
4. Panel and Fence diagrams

Or

DSE -1: Geotectonic **Credits 06**

DSE1T: Geotectonic (Theory) **Credits 04**

Course Contents:

Unit 1: Introduction

1. Definition. Continents and oceans. Continental and oceanic crust. Internal processes of earth
2. Concept of lithosphere and asthenosphere. Physical character of lithosphere and a sthenosphere. Concept of plate.
3. Concept of hot spot and mantle plume. Ophiolites. Palaeomagnetism.

Unit 2: Plate and Plate boundaries

1. Plates: Physical character of plates. Macro and micro plates.
2. Plate boundaries: types, character, Identification of boundaries. Movement of plates along boundaries. Plate velocities.
3. Volcanic arcs, island arcs, trenches, accretionary prisms, oceanic ridges, transform faults. Magmatism in oceanic ridges and in subduction zones

Unit 3: Continental Drift, Sea floor spreading and Plate tectonics

1. Wegner Continental drifts hypothesis and its evidences. Continental position in the past
2. Sea-floor spreading process and its evidences.
3. Plate tectonics model and its evidences. Distribution of plates in the Earth

Unit 4: Plate Motion

1. Palaeomagnetism and motion of plates
2. Driving mechanisms of plates. Plate tectonics and mantle convection.
3. Supercontinents and their breakup and assembly. Wilson cycle

DSE1P: Geotectonic - Lab **Credits 02**

1. Position of Indian sub-continent during different geological times between break-up of Gondwanaland and formation of the Himalayas.
2. Different stages of Atlantic Ocean formation with respect to continental rift system.
3. Distribution of volcanoes along Ring of Fire in Pacific Ocean.
4. Schematic drawings of different stages of ocean-continent collision and continent-continent collision.

Suggested Readings:

1. Turcotte, D.L. and Schubert, G. Geodynamics. Second Edition. Cambridge
2. Kearey, p., Klepeis, K. A., and Vine, F. J. (2009). Global Tectonics. Third edition. Wiley-Blackwell, Oxford.

Or

DSE – 1: Basics of River Science **Credits 06**

DSE1T: Basics of River Science (Theory) **Credits 04**

Course Contents:

Unit 1: Stream hydrology

1. Basic stream hydrology
2. Physical properties of water, sediment and channel flow
3. River discharge

Unit 2: River basin

1. Sediment source and catchment erosion processes Sediment load and sediment yield
2. Sediment transport processes in rivers
3. Erosion and sedimentation processes in channel.

Unit 3: Drainage

1. Drainage network
2. Evolution of drainage network in geological time scale.

Unit 4: Rivers in time and space

1. River diversity in space, Patterns of alluvial rivers - braided, meandering and an a branching channels, Dynamics of alluvial rivers
2. Channel patterns in stratigraphic sequences

Unit 5: Channels and Landscapes

1. Bedrock channels, Bedrock incision process
2. River response to climate, tectonics and human disturbance
3. Bedrock channel processes and evolution of fluvial landscapes.

DSE1P: Basics of River Science - Lab **Credits 02**

List of Practical

1. Stream power calculation, longitudinal profile analysis
2. Study of drainage pattern

Suggested Readings:

1. Davies, T. (2008). Fundamentals of hydrology. Routledge Publications.
2. Knighton, D. (1998). Fluvial forms and processes: A new perspective. Amold Pubs.
3. Richards. K. (2004). Rivers: Forms and processes in alluvial channels. Balckburn Press.
4. Bryirely and Fryirs (2005). Geomorphology and river management. Blackwell Pub.,
5. Julien, P.Y. (2002). River Mechanics. Cambridge University Press. Robert, A. (2003) River Processes: An introduction to fluvial dynamics. Arnold Publications.
6. Vanoni, V.A. (2006). Sedimentation Engineering. ASCE Manual, Published by American Society of Civil Engineering,

7. Tinkler, K.J., Wohl, E.E. (eds.) 1998. Rivers over rock. American Geophyscial Union Monograph, Washington, DC.

DSE-2: Natural Hazards and Disaster Management **Credits 06**

DSE2T: Natural Hazards and Disaster Management

Course Contents:

Unit -1:
Natural Hazards: Concept. Types of hazards.

Unit -2:
Types of disaster: natural and manmade - cyclone, flood, land slide, land subsidence, fire and earthquake, tsunami and volcanic eruption, meteorite impacts.Issues and concern for various causes of disasters.

Unit -3:
Disaster management, mitigation, and preparedness.Techniques of monitoring and design against the disasters management issues related to disaster.

Unit -4:
Disaster management in India: risk, vulnerability and hazard mitigation through capacity building.Legislative responsibilities of disaster management; disaster mapping, assessment pre-disaster risk and vulnerability reduction.Disaster preparation: pre- disaster: reduction of risk and vulnerability; syn-disaster and Post-disaster: recovery and rehabilitation.

Unit -5:
Hazard zonation mapping.Remote-sensing and GIS applications in real time disaster monitoring prevention and rehabilitation

Suggested Readings:

1. Bell, F.G., 1999. Geological Hazards, Routledge, London.
2. Bryant, E., 1985. Natural Hazards, Cambridge University Press.
3. Smith, K., 1992. Environmental Hazards. Routledge, London.
4. Subramaniam, V., 2001. Textbook in Environmental Science, Narosa International

Or

DSE- 2: Fossils and their applications **Credits 06**

DSE2T: Fossils and their applications (Theory) ` **Credits 04**

Course Contents:

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

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

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.

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

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.Biogenic mineral deposits.

DSE-2P: Fossils and Their Applications- Practical **Credits 02**

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).

Suggested Readings:

1. Schoch, R.M. 1989. Stratigraphy, Principles and Methods.VanNostrand Reinhold.
2. Clarkson, E.N.K.1998. Invertebrate Paleontology and Evolution George AlIen&Unwin
3. Prothero, D.R. 1998. Bringing fossils to life - An introduction to Paleobiology, McGraw Hill.
4. Benton, M.J. 2005. Vertebrate paleontology (3rd edition). Blackwell Scientific, Oxford.
5. 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.

Or

DSE -2: Evolution of Life through Time **Credits 06**

DSE8T: Evolution of Life through Time

Course Contents:

Life through ages
Fossils and chemical remains of ancient life.Geological Time Scale with emphasis on major bio-events.Biomineralization and skeletalization

Principle

Mechanism of evolution.Evolutionary lineages.Species as basic unit of linea.Costraints in lineage reconstruction.

Geobiology
Biosphere as a system, processes and products.Biogeochemical cycles.Abundance and diversity of microbes, extremophiles. Microbes-mineral interactions, microbial mats

Origin of life
Possible life sustaining sites in the solar system, life sustaining elements and isotope records.Archean life: Earth's oldest life, transition from Archean to Proterozoic; the oxygen revolution and radiation of life. Precambrian macrofossils – The garden of Ediacara The Snow Ball Earth hypothesis.

Paleozoic Life
The Cambrian explosion. Origin of vertebrates and radiation of fishes Origin of tetrapods - life out of water. Early land plants and impact of land vegetation.

Mesozoic Life
Life after the largest (P/T) mass extinction, life in the Jurassic seas.Origin of mammals.Rise and fall of dinosaurs.Origin of birds; spread of flowering plants.

Cenozoic Life
Aftermath of end Cretaceous mass extinction – radiation of placental mammals evolution of modern grasslands and co-evolution of hoofed grazers. Rise of modern plants and vegetation Back to water – evolution of whales

The age of humans
Hominid dispersals and climate setting. Climate Change during the Phanerozoic - continental break-ups and collisions. Plate tectonics and its effects on climate and life. Effects of life on climate and geology.

Applications of evolution
Bio-stratigraphy and chronostratigraphy in the context of organic evolution.Role of fossils in correlation.Basis of stage boundaries in the Phanerozoic.

Suggested Readings:

1. Stanley, S.M., (2008). Earth System History.
2. Jonathan I. LumineW.H.Freeman Earth-Evolution of a Habitable World, Cambridge University Press.
3. Canfield, D.E. &Konhauser, K.O., (2012). Fundamentals of Geobiology Blackwell.
4. Cowen, R. (2000) History of Life, Blackwell.

Or

DSE-2: Earth and Climate **Credits 06**

DSE2T: Earth and Climate (Theory) **Credits 04**

Course Contents:

A. Climate system: Forcing and Responses

Components of the climate system.Climate forcing, Climate controlling factors.Climate system response, response rates and interactions within the climate system.Feedbacks in climate system.

B. Heat budget of Earth

Incoming solar radiation, receipt and storage of heat transformation. Earth's heat budget.Interactions amongst various sources of earth's heat.

C. Atmosphere – Hydrosphere

Layering of atmosphere and atmospheric Circulation.Atmosphere and ocean interaction and its effect on climate. Heat transfer in ocean. Global oceanic conveyor belt and its control on earth's climate.Surface and deep circulation.Sea ice and glacial ice.

D. Response of biosphere to Earth's climate

Climate Change: natural vs. anthropogenic effects. Humans and climate change. Future perspectives. Brief introduction to archives of climate change. Brief introduction to palaeoclimate..Palaeoclimate data from India.

E. Orbital cyclicity and climate

Milankovitch cycles and variability in the climate .Glacial-interglacial stages. The Last Glacial maximum (LGM). Pleistocene Glacial-Interglacial cycles. Younger Dryas.Isotope Palaeontology.

F. Monsoon

Mechanism of monsoon.Monsoonal variation through time.Factors associated with monsoonal intensity .Effects of monsoon.

DSE2P: Earth and Climate - Practical **Credits 02**

Practical

1. Study of distribution of major climatic regimes of India on map
2. Distribution of major wind patterns on World map
3. Preparation of palaeo-geographic maps (distribution of land and sea) of India during specific geological time intervals
4. Numerical exercises on interpretation of proxy records for palaeoclimate

Suggested Readings:

1. Rudiman, W.F., 2001. Earth's climate: past and future. Edition 2, Freeman Publisher.
2. Rohli, R.V., and Vega, A.J., 2007. Climatology. Jones and Barlatt
3. Lutgens, F., Tarbuck, E., and Tasa, D., 2009. The Atmosphere: An Introduction to Meteorology. Pearson Publisher
4. Aguado, E., and Burt, J., 2009. Understanding weather
5. Environmental Geology – an Earth System Science Approach,By – Dorothy J. Merritts, Andrew De Wet & Kristen Menking,W.H. Freeman & Company, New York.

Skill Enhancement Courses (SEC)

SEC-1: Photo Geology and Remote Sensing **Credits 02**

SEC-1T: Photo Geology and Remote Sensing

Unit-I: Elementary idea about photo geology: electro-magnetic spectrum, types & geometry ofaerial photographs; factors affecting aerial photography; types of camera, film and filters; factorsaffecting scale;

Unit-II: Fundamentals of remote sensing; remote sensing systems; remote sensing sensors; signatures of rocks, minerals and soils. Application of remote sensing in geosciences and geomorphological studies.

Unit-III: Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification.

Unit-IV: Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing.

Suggested Readings:

1. Bhatta, B., 2008. Remote Sensing and GIS. Oxford, New Delhi.
2. Gupta, R.P., 1990. Remote Sensing Geology. Springer Verlag.
3. Lilleasand, T.M. and Kiffer, R.W., 1987. Remote Sensing and Image Interpretation.John Wiley.
4. Pandey, S.N., 1987. Principles and Application of Photogeology. Wiley Eastern, New Delhi.
5. Sabbins, F.F., 1985. Remote Sensing – Principles and Applications. Freeman.
6. Siegal, B.S. and Gillespie, A.R., 1980. Remote Sensing in Geology.John Wiley.
7. Rampal K.K. 1999. Hand book of aerial photography and interpretation. Concept publication.

Or

SEC -1: Field Geology – I **Credits 02**

SEC1P: Field Geology I - Basic Field Training **Credits 02**

Course Contents:

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.

SEC-2: Geomorphology and Geotectonic **Credits 02**

SEC-2T: Geomorphology and Geotectonic

Unit-I: Basic principles of Geomorphology, geomorphological cycles, weathering and erosion; Geomorphic mapping- tools and techniques.

Unit-II: Epigene / exogenic processes: degradation and aggradation. Hypogene / endogenic processes; Diastrophism and volcanism, Extraterrestrial processes; Geological work of wind, glacier, river, underground water and ocean.

Unit-III: Earth as a dynamic system. Elementary idea of continental drift, sea-floor spreading and mid-oceanic ridges. Paleomagnetism and its application.

Unit-IV: Plate Tectonics: the concept, plate margins, orogeny, deep sea trenches, island arcs andvolcanic arcs.

Suggested Readings:

1. Allen, P., 1997. Earth Surface Processes. Blackwell
2. Bloom, A.L., 1998. Geomorphology: A systematic Analysis of Late Cenozoic Landforms (3rd Edition). Pearson Education, Inc.
3. Keary, P. and Vine, F.J., 1997. Global Tectonics. Blackwell and crustal evolution. Butterworth-Heinemann.
4. Kale, V.S. and Gupta, A., 2001. Introduction to Geomorphology. Orient Longman Ltd.
5. Moores, E and Twiss. R.J., 1995.Tectonics. Freeman.
6. Patwardhan, A. M., 1999. The Dynamic Earth System.Prentice Hall.
7. Summerfied, M.A., 2000. Geomorphology and Global tectonic. Springer Verlag.
8. Valdia, K.S., 1988. Dynamic Himalaya. Universities Press, Hyderabad.
9. WD Thornbury, 2002. Principles of Geomorphology. CBS Publ. New Delhi.

Or

SEC-2: Field Geology II

SECP: Field Geology II - Geological Mapping and Structural Geology Field

Credits 02

Course Contents:

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.

SEC-3: Environmental Geology **Credits 02**

SEC-3T: Environmental Geology

Course Contents:

Unit-I: Earth and its spheres: atmosphere, hydrosphere, lithosphere, biosphere and Man; Earth Material.

Unit-II: Energy budget: Solar radiation; Global environments: coastal, riverine, desertic, tropical, cold, polar; Concept of global warming and climate change.

Unit-III: Geoloigcal hazards: Earthquakes, volcanism, landslides, avalanches, floods, droughts; Hazard mitigation.

Unit IV: Resource Management: Energy resources (Conventional and non-conventional), watershed management, land use planning, management of water resources, land reclamation.

Suggested Readings:

1. Verma, V.K., 1986. Geomorphology Earth surface processes and form. McGraw Hill.
2. Chorley, R. J., 1984. Geomorphology. Methuen.
3. Selby, M.J., 1996. Earths Changing Surface. Oxford University Press UK.
4. Thornbury W. D., 1997. Principles of Geomorphology Wiley Eastern Ltd., New Delhi.
5. Valdiya, K. S., 1987. Environmental Geology - Indian Context.Tata McGraw Hill New Delhi.
6. Keller, E. A., 2000. Environmental Geology.Shales E. Merril Publishing Co., Columbus, Ohio.
7. Montgomery, C., 1984. Environmental Geology. John Wiley and Sons, London.
8. Bird, Eric, 2000. Coastal Geomorphology: An Introduction. John Wiley & Sons, Ltd. Singapore.
9. Liu, B.C., 1981. Earthquake Risk and Damage, Westview.

Or

SEC- 3: Field Geology III

SEC3P: Field Geology III - Stratigraphy and Paleontology related field

Credits 02

Course Contents:

List of Visits

1. Preparation of a Geological map of a small area with folded/faulted beds.
2. Interrelation between different structural elements and their interpretations.

SEC-4: Geochemistry **Credits 02**

SEC-4T: Geochemistry

Course Contents:

Unit-I: Introduction to geochemistry: basic knowledge about crystal chemistry. Types of chemical bonds, coordination number; Colloids in geological systems, ion exchanges and geological evidence for earlier colloids; Elementary idea of Periodic Table.

Unit-II: Cosmic abundance of elements; Composition of the planets and meteorites; Geochemical evolution of the earth and geochemical cycles;

Unit-III: Gold Schmidt's geochemical classification of elements; Distribution of major, minorand trace elements in igneous, metamorphic and sedimentary rocks.

Unit-IV: Elements of geochemical thermodynamics; Isomorphism and polymorphism; Isotopegeochemistry.

Suggested Readings:

1. Hoefs, J., 1980. Stable Isotope Geochemistry.Springer-Verlag.
2. Klein, C. and Hurlbut, C.S., 1993. Manual of Mineralogy. John Viley and Sons, New York.
3. Krauskopf, K.B., 1967. Introduction to Geochemistry.McGraw Hill.
4. Mason, B. and Moore, C.B., 1991. Introduction to Geochemistry.Wiley Eastern.
5. Rollinson, H.R., 1993. Using geochemical data: Evaluation, Presentation, and Interpretation.Longman.

Or

SEC- 4: Field Geology- IV (Stratigraphy Sediment logy - related field/ Himalayan Geology Field/Economic Geology Field / Visit to Engineering/Exploration geology Project sites) **Credits 02**

SEC4P: Field Geology IV - Stratigraphy Sediment logy-related field

1. Field training in a sedimentary basin. Documentation of stratigraphic details in the field.
2. Collection of sedimentological, and stratigraphical and paleontological details and their representation.

Or

SEC4P: Field Geology IV - Himalayan Geology Field

Preparation of a geological transect map in the Himalayas

Or

SEC4P:Field Geology IV - Economic Geology Field

1. Visit to an underground or open cast mine
2. Underground mapping/Bench mapping Study

Or

SEC4P: Field Geology IV - Visit to Engineering/Exploration geology Project sites

1. Geological mapping of a project site (Dam sites, tunnel, etc).
2. Identification of environmental problems of a project site and remedial measures to be taken.