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Department of Geology

Semester-III

BSC. (HONS.) GEOLOGY

DISCIPLINE SPECIFIC CORE COURSE -7 (DSC-7) – : Palaeontology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
Palaeontology (DSC-7)	**4**	**3**	**0**	**1**	**B.Sc. Hons. Geology studento nly**	**Studied Stratigraphy, Sedimentology, and Earth System Science (or equivalent)**

Learning Objectives

To learn about the life forms of the geological past. To understand the diversity and evolution of past life. To know the evolutionary transitions and functional adaptations in different groups of animals and plants.

Learning outcomes

On successful completion of the course, the student will be able to: Appreciate how fossils get preserved in rocks, the nature of fossil record and how fossils are named in a taxonomic framework. Get to know different invertebrate fossil groups, their palaeobiology, and how they can be used in relative dating of rocks. Learn how vertebrates originated and their evolution through time. Understand important floral changes over time and the flora of the Indian coal-bearing sedimentary basins. Analyse the indirect evidences preserved in the rocks for the past existence of life. Critically analyse the role of fossils in relative dating of rocks, in interpreting past environments, past distribution of land and sea, and changes in ecosystems over time.

SYLLABUS OF DSC-7

UNIT – I (9 hours)

Detailed content

Fossilization processes and modes of preservation; nature and importance of fossil record

UNIT – II (9 hours)

Detailed contents

Brief introduction to important invertebrate groups (Bivalvia, Gastropoda, Brachiopoda, Graptolites, Trilobites) and their biostratigraphic significance. Significance of ammonites in

Mesozoic biostratigraphy and their palaeobiogeographic implications. Functional adaptation in trilobites and ammonoids.

UNIT – III (9 hours)

Detailed contents

Vertebrates: Origin of vertebrates and major steps in vertebrate evolution; Vertebrate evolution in the Palaeozoic Era; Mesozoic reptiles with special reference to origin diversity and extinction of dinosaurs

UNIT – IV (9 hours))

Detailed contents

Introduction to Palaeobotany; fossil record of plants through time; Gondwana Flora.

UNIT – V (9 hours)

Detailed contents

Introduction to Ichnology; Application of fossils in Stratigraphy, Fossils and paleobiogeography; Fossils as a window to the evolution of ecosystems.

Practical Component- (30 Hours)

Study of fossils showing various modes of preservation. Study of diagnostic morphological characters, systematic position, stratigraphic position and age of various invertebrate, vertebrate and plant fossils.

Essential/recommended readings

Raup, D. M. & Stanley, S.M. (1985). Principles of Paleontology, W.H.Freeman & Company
Clarkson, E. N.K. (2012) Invertebrate Paleontology and evolution 4th Edition by Blackwell

Suggestive readings

Raup, D. M. & Stanley, S.M. (1985). Principles of Paleontology, W.H.Freeman & Company
Clarkson, E. N.K. (2012) Invertebrate Paleontology and evolution 4th Edition by Blackwell.
Foote, M. & Miller, A. I. (2006). Principles of Paleontology, third edition.
Benton, M. (2014). Vertebrate Palaeontology, fourth edition.
Jones, R.W. (2011). Applications of Palaeontology - Techniques and Case Studies
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Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 8 (DSC-8): Sedimentary Geology

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Sedimentary Geology (DSC-8)	**4**	**3**	**0**	**1**	**B.Sc. Hons. Geology student only**	**Studied Stratigraphy, Earth System Science (or equivalent)**

Learning Objectives

Main objective of the course is to provide basic and advance knowledge to students about sediments origin, transport, and depositions and formation of the sedimentary rocks and their distribution in space and time.

Learning outcomes

Students will learn and appreciate the concepts of weathering and sedimentary flux, the basic concepts of sediment transport and formation of sedimentary structures. Grain size scales and analysis. Students will be able to appreciate sedimentary facies, classification of sedimentary rocks, sedimentary environments and provenance.

SYLLABUS OF DSC- 8

UNIT – I (9 hours)

Detailed contents

Introduction to Sedimentary Geology. Chemistry of weathering processes. Sediments: origin, transportation, deposition, consolidation and diagenesis

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UNIT – II (9 hours)

Detailed contents

Sediment granulometry: Grain size scales Udden-Wentworth and Krumbein (phi) scale, particle size distribution; mean, median, mode, standard deviation, skewness. Environmental connotation.

UNIT – III (9 hours)

Detailed contents

Sedimentary fabric, textures, Porosity and permeability. Sedimentary structures: Syn-sedimentary, Penecontemporaneous

UNIT – IV (9 hours)

Detailed contents

Ichnofossils: Sediment-organism interaction. classification of sedimentary rocks. Tectonics and Climate Diagenesis of terrigenous and chemical sediments

UNIT – V (9 hours)

Detailed contents

Concept of sedimentary facies, paleoenvironment and paleocurrent analyses. Introduction to sedimentary environment: aeolian, glacial, fluvial, near-shore and deep-marine environments. Introduction to carbonate rocks: classification

Practical Component- (30 Hours)

Study of megascopic characters of major sedimentary rocks:
Sketching of primary sedimentary structures in laboratory and museum specimen: ripple marks, cross beddings, sole marks, biogenic structures.
Microscopic study of textures and diagenetic features in sedimentary rocks:

Essential/recommended readings

Prothero, D.R., and Schwab, F. 2003. Sedimentary Geology. Freeman & Co.
Boggs Sam Jr. 1995. Principles of Sedimentology and Stratigraphy, Prentice Hall

Suggestive readings (if any)

Prothero, D.R., and Schwab, F. 2003. Sedimentary Geology. Freeman &Co.
Boggs Sam Jr. 1995. Principles of Sedimentology and Stratigraphy, Prentice Hall.
Stanley, S. M. 1985. Earth and Life through time. Freeman & Co.
Tucker, M., 1988 Techniques in sedimentology Blackwell scientific publications
Nicols, G., 2009 Sedimentology and Stratigraphy Wiley-Blackwell

DISCIPLINE SPECIFIC CORE COURSE– 9 (DSC-9): Metamorphic Geology

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Metamorphic Geology (DSC-9)	**4**	**3**	**0**	**1**	**B.Sc. Hons. Geology student only**	**Studied Earth System Science, Structural Geology, and Mineralogy (or equivalent)**

Learning Objectives

This course focuses on teaching about mineralogical and textural transformations in solid state. The main aim is to learn estimating natural state variables at the time of transformation as well as inferring the geodynamic settings of such changes.

Learning outcomes

This course will enable students to identify the mineral assemblages in hand specimen and through microscopic studies utilizing the concept of textural equilibrium, teach them to consider the rocks as chemical systems and apply the principle of phase rule as the major tool

for the study of metamorphic rocks. Students will specially learn to infer orogenic processes through metamorphic assemblages and textures.

SYLLABUS OF DSC-9

UNIT – I (9 hours)

Detailed contents

Metamorphism: Definition of metamorphism. Factors controlling metamorphism, Types of metamorphism. Structure and textures of metamorphic rocks, Relationship between metamorphism and deformation

UNIT – II (12 hours)

Detailed contents

Phase rule and Goldschmidt mineralogical phase rule. Chemographic projections, concept of compatible and incompatible assemblages, bulk composition influence on metamorphic assemblages.

UNIT – III (12 hours)

Detailed contents

Metamorphic zones, index minerals and isograds. Continuous and discontinuous reactions, basics of geothermobarometry.

UNIT – IV (12 hours)

Detailed contents

Metamorphism of various protoliths, metamorphic rock associations-schists, gneisses, charnockites and eclogites. Melting and migmatites. Tectonic setting of metamorphic rocks, paired metamorphic belts, concept of P-T-t path.

Practical Component- (30 Hours)

Hand specimen study of metamorphic rocks.
Textural and mineralogical study of metamorphic rocks in thin sections.
Inferring mineral growth versus deformation in metamorphic rocks
Graphical plots of metamorphic mineral assemblages using chemographic projections.
Application of mineral formula calculations in metamorphic rocks

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Essential/recommended readings

Winter, J. D. (2014).Principles of igneous and metamorphic petrology, Pearson.
Yardley, Bruce, and Clare Warren. (2021). An introduction to metamorphic petrology. Cambridge University Press.

Suggestive readings

Winter, J. D. (2014).Principles of igneous and metamorphic petrology, Pearson.
Yardley, Bruce, and Clare Warren. (2021). An introduction to metamorphic petrology. Cambridge University Press.
Philpotts, A. R., and Ague, J. J. (2022). Principles of igneous and metamorphic petrology. Cambridge University Press.
Metamorphic Phase Equilibria And Presure-Temperature-Time-Paths
Frank S. Spear (reprinted 1995)

Discipline Specific Elective: **DSE-1: Earth Surface Processes (L3, P1) *or* DSE-2: Surveying Techniques (L3, P1)**

One GE from GE pool (GE-3): Fossils and Applications (L3, P1)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
DSE-1 **Earth Surface Processes (L3, P1)**	**4**	**3**	**0**	**1**	**B.Sc. Hons. Geology students only**	**Studied Earth System Science and Structural Geology or Equivalent**

Learning Objectives

The course "Earth Surface Processes" is intended to provide a holistic approach to study the surficial features and the processes with emphasis on links and feedbacks between its components. The subject will serve as a dynamic and physical based account of the processes at planets surface with an integrated approach involving the principles of geomorphology and sedimentology.

Learning outcomes

After going through this course students will have sound idea about the Earth's Energy Balance, Hydrological cycle, Topography and bathymetry. This will enable them to learn about the sedimentary flux: origin, transport and deposition and the geomorphic and sedimentological processes related to fluvial, coastal, aeolian, and glacial regimes. Students will also appreciate about the environmental changes and its impact on surface processes and landforms.

SYLLABUS OF DSE-1

UNIT – I (9 Hours)

Detailed contents

Introduction to Earth Surface System. Earth's energy balance, hydrological cycle, carbon cycles, heat transfer, topography and bathymetry.

UNIT – II (9 Hours)

Detailed contents

Earth's critical zone, weathering and formation of soils, sediment routing systems, sediment and solute in drainage basins, importance and impact of climate change and tectonics on sediment yield and transport.

UNIT – III (9 Hours)

Detailed contents

Fluid and sediment dynamics and transport: Natural substances, settling of grains, types of flows and boundary separation layers, sediment continuity, modes of sediment transport, bedforms and stratification.

UNIT – IV (12 Hours)

Detailed contents

Sediment transport and deposition associated with fluvial, aeolian, glacial, coastal and marine regimes.

UNIT – V (6 Hours)

Detailed contents

Impact of environmental changes on Earth Surface processes.

Practical Component- (30 Hours)

Exercises on flexural isostasy.

Exercises related to settling of sediments.

Sediment flux exercises.

Preparation of river profiles (Hack Profile, calculation of SL index, Ksn).

Exercises related to fluvial geomorphology.

Exercises on rate of uplift and incision.

Essential/recommended readings

P. A. Allen, 2009, Earth Surface Processes. Wiley
John Bridge and Robert Demicco: Earth Surface Processes and Landforms and Sediment Deposits

Suggestive readings

P. A. Allen, 2009, Earth Surface Processes. Wiley
John Bridge and Robert Demicco: Earth Surface Processes and Landforms and Sediment Deposits
Bloom, A.L., 1998. Geomorphology: A Systematic Analysis of Late Cenozoic Landforms, Pearson Education

Summerfield, M.A., 1991. Global Geomorphology, Prentice Hall.

Jon D.Pelletier.2008. Quantitative Modelling of Earth Surface Processes. Cambridge University Press

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
DSE-2 **Surveying Techniques (L3, P1)**	**4**	**3**	**0**	**1**	**B.Sc. Hons. Geology students only**	**Studied Earth System Science and Structural Geology (or equivalent)**

Learning Objectives

The course "Surveying Techniques" is intended to teach the students basic techniques to operate modern surveying instruments and develop skill to carry out topographic mapping.

Learning outcomes

After going through this course students will have sound idea about the Surveying Method and various types mapping skills. For examples: (i) Principles of surveying techniques, (ii) Operate modern surveying instruments, (iii) Prepare maps

SYLLABUS OF DSE-11

UNIT – I (9 Hours)

Detailed Content

Basics of Surveying: Fundamental concepts and principles; Types of surveys; Classes of surveys; Surveying Instrumentation; Units of measurement; Locating position; Errors.

UNIT – II (12 Hours)

Detailed Content

Levelling – Theory and Methods: Coordinate system; Geoid; Datum; Curvature and refraction; Categories of levels; Traversing; Differential levelling; sources of error in levelling; Distance measurement; Angles, azimuth and bearings.

UNIT – III (12 Hours)

Detailed Content

Surveying Techniques: Principles and use of – Chain survey, Plane Table survey, Compass survey, Dumpy level survey, Theodolite survey, Total Station survey, Global Positioning System (GPS)

UNIT – IV (12 Hours)
Detailed Content
Map Preparation: Introduction to QGIS; Map design; Map layout; Basic map plotting procedures; Plotting contours; Lettering; Cartographic map elements; Sources of error in mapping.

Practical Component- (30 Hours)
Chain survey
Plane Table survey
Total Station survey
Survey using GPS
Survey using Drone (if drone is available)
Map making

Essential/recommended readings
Surveying – Vol – I – By S.K.Duggal, Tata McGraw Hill Book Co.
Surveying – Vol – II – By S.K. Duggal, Tata McGraw Hill Book Co

Suggestive readings
Surveying – Vol – I – By S.K.Duggal, Tata McGraw Hill Book Co.
Surveying – Vol – II – By S.K. Duggal, Tata McGraw Hill Book Co

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
GE-3 Fossils and Applications (L3, P1)	**4**	**3**	**0**	**1**	**12th Pass (with science stream)**	**Nil**

Learning Objectives
To provide some basic knowledge on fossils, their preservation in rocks and different groups of invertebrate, vertebrate and plant fossils. To impart knowledge on the utility of some of these fossils in determining the relative age of sedimentary rocks and implication in palaeoecological, palaeoenvironmental, palaeobiogeographical reconstruction. To equip the student with basic understanding of the role of fossils in hydrocarbon exploration.

Learning outcomes
Student will learn about different types of life forms that existed in the geological past. Students will learn about the evolutionary rates of certain important fossil groups and their role in dividing the rocks into distinctive units based on their stratigraphic ranges. Learn how fossils can be used in understanding the past environments, ecosystems, climate and distribution of land and sea. Student will also learn about the role of fossils in the exploration of fossil fuels.

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SYLLABUS OF GE-3

UNIT – I 9 hours)

Detailed contents

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

UNIT – II (9 Hours)

Detailed contents

Species concept: Definition of species, species problem in palaeontology, speciation, methods of description and naming of fossils, code of nomenclature.

UNIT – III (9 hours)

Detailed contents

Introduction to various fossils groups: Brief introduction of important fossils groups: invertebrate, vertebrate, microfossils, spore, pollens and plant remains. Important fossiliferous horizons of India

UNIT – IV (9 Hours)

Detailed contents

Application of fossils: Principles and methods of paleoecology, application of fossils in the study of paleoecology, paleobiogeography and paleoclimate; Role of fossils in palaeoenvironmental reconstructions.

UNIT – V (9 Hours)

Detailed contents

Societal importance of fossils: Implication of larger benthic and microfossil 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 coal deposits, fossils as indicators of pollution.

Practical Component- (30 Hours)

Exercises on flexural isostasy.

Exercises related to settling of sediments.

Sediment flux exercises.

Preparation of river profiles (Hack Profile, calculation of SL index, Ksn).

Exercises related to fluvial geomorphology.

Exercises on rate of uplift and incision.

Essential/recommended readings

Clarkson, E.N.K.1998. Invertebrate Paleontology and Evolution, George Allen &Unwin

Prothero, D.R. 1998. Bringing fossils to life - An introduction to Paleobiology, McGraw Hill.

Suggestive readings

Clarkson, E.N.K.1998. Invertebrate Paleontology and Evolution, George Allen &Unwin

Prothero, D.R. 1998. Bringing fossils to life - An introduction to Paleobiology, McGraw Hill.

Benton, M.J. 2005. Vertebrate Palaeontology (3rd edition), Blackwell Scientific, Oxford.

Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time, Edwin H. Colbert, Michael Morales, Eli C. Minkoff, John Wiley & Sons, 1991.

Benton, M.J. & Harper, D.A.T. (2016). Introduction to Palaeobiology and the fossil record. Wiley.

Jones, R.W. (2011). Applications of Palaeontology - Techniques and Case Studies

Raup, D.M. & Stanley, S.M. (1985), Principles of Paleontology, W.H. Freeman and Company

Shukla, A. C. & Mishra, S.P. (1982). Essentials of Palaeobotany