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DEPARTMENT OF GEOLOGY
SEMESTER – II

B.SC. (Hons.) Geology

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DISCIPLINE SPECIFIC CORE COURSE -4 (DSC-4) – : Structural 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		
Structural Geology (DSC-4)	4	3	0	1	B.Sc. Hons. Geology students only	Completion of Semester 1 in Geology

Learning Objectives

Structural geology essentially deals with the geometry, kinematics and dynamics of deformation of rocks. In response to the instability of the lithosphere produced by complex plate tectonic movements, continuous and discontinuous deformation takes place within the rocks in solid or semi-solid state, at different scales and at different depths, which manifests in a variety of complex structures in these rocks.

Learning outcomes

The undergraduate CBCS course of structural geology will teach the students the different geometric features of deformation, different types of deformation-induced structures, basic techniques of measurement of different parameters in deformed rocks, and will also give them a glimpse of the underlying deformation processes and mechanisms.

SYLLABUS OF DSC-4

UNIT – I (3 Weeks)

Detailed contents

Introduction to Structure and Topography: Understanding a topographic map; Effects of topography on structural features: Rule of V; Planar and linear structures; Concept of dip and strike, trend and plunge.

UNIT – II (3 Weeks)

Detailed contents

Stress and strain in rocks: Concept of rock deformation: Definition of Stress and Strain, Strain ellipses of different types and their geological significance. Mohr circle for stress and its application.

UNIT – III (3 Weeks)

Detailed contents

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

UNIT – IV (3 Weeks)

Detailed contents

Foliation and lineation: Description and origin of foliations: axial plane cleavage and its tectonic significance; different types of foliations: crenulation cleavage, disjunctive cleavage, salty cleavage, schistosity, gneissosity etc. Description and origin of lineation and relationship with major structures; stretching lineation and its relationship with strain.

UNIT – V (2 Weeks)

Detailed contents

Fractures and faults: Geometric and genetic classification of fractures and faults; Effects of faulting on the outcrops; Geologic/geomorphic criteria for recognition of faults and Mechanism of faulting: Anderson theory of faulting. Joints – different types of joints and their geological significance – columnar joint, pinnate joint, plumose structure.

UNIT – VI (1 Weeks)

Detailed contents

Shear Zones: Introduction, Geometry, strain profile, shear zones rocks and shear sense indicators.

Practical component -

Basic idea of topographic contours, Topographic sheets of various scales.
Structural contouring and 3-point problems of dip and strike
Introduction to Geological maps: Drawing profile sections and interpretation of geological maps of different complexities.
Exercises of stereographic projections

Essential/recommended readings

Fossen, H. (2010) Structural Geology. Cambridge University Press
Park, R. G. (2004) Foundations of Structural Geology. Chapman & Hall.

Suggestive readings

Fossen, H. (2010) Structural Geology. Cambridge University Press.
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.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 5 (DSC-5): Igneous Petrology

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		
Igneous Petrology (DSC-5)	4	3	0	1	B.Sc. Hons. Geology students only	Completion of Semester 1 in Geology

Learning Objectives

To develop an understanding of the types of magma as well as types of igneous rocks. Magma generation in relation to different geodynamic settings and its relation with the petrological and geochemical features of the igneous rocks.

Learning outcomes

On completion of the course, the student should be able to:
a) Identify the igneous rocks using petrographical, mineralogical and geochemical indices
b) Determine the evolution of igneous rocks in relation to different geodynamic settings

SYLLABUS OF DSC- 5

UNIT – I (3 Weeks)

Detailed contents

Introduction to Igneous Petrology: Scope of Igneous petrology, classification of Igneous rocks, igneous textures, igneous structures.

UNIT – II (3 Weeks)

Detailed contents

Introduction to silicate melts and magmas: Physical properties of magma, the ascent of magmas, magmatic differentiation.

UNIT – III (3 Weeks)

Detailed contents

Introduction to Igneous Phase diagrams. The phase rule, the lever rule, Two Component systems involving melt: Binary system with a Eutectic, Binary system with a peritectic, Binary system thermal barrier, Binary system with solid solution.

UNIT – IV (3 Weeks)

Detailed contents

The chemistry of igneous rocks. Modal mineralogy, normative mineralogy, variation diagrams based on major elements, trace elements and their significance, application of radioactive isotopes in igneous petrology.

UNIT – V (3 Weeks)

Detailed contents

Introduction to igneous environments: Basalts and mantle structure, Magma generation and igneous rocks associated with various plate tectonic settings.

Practical component :

Study of important igneous rocks in hand specimens and thin sections- granite, granodiorite, diorite, gabbro, anorthosites, ultramafic rocks, basalts, andesites, trachyte, rhyolite.
Classification of Igneous Rocks.
Plotting and interpretation of variation diagrams.
Igneous rock occurrences in Indian context.

Essential/recommended readings

Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson.
Wilson, M. (1989) Igneous Petrogenesis, Springer-Verlag Berlin Heidelberg.
Frost, B. R. and Frost, C. D., (2013)Essentials of Igneous and Metamorphic Petrology Cambridge University Press.

Suggestive readings (if any)

Frost, B. R. and Frost, C. D., (2013)Essentials of Igneous and Metamorphic Petrology Cambridge University Press.
Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge University Press.
Winter, J. D. (2014). Principles of igneous and metamorphic petrology. Pearson.
Rollinson, H. R. (2014). Using geochemical data: evaluation, presentation, interpretation. Routledge.
Sen, G. (2014) Petrology Principles and Practice, Springer-Verlag Berlin Heidelberg
Bose M.K. (1997). Igneous Petrology.
Wilson, M. (1989) Igneous Petrogenesis, Springer-Verlag Berlin Heidelberg.

DISCIPLINE SPECIFIC CORE COURSE– 6 (DSC-6): Elements of Geochemistry

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		
Elements of Geochemistry DSC-6	4	3	0	1	B.Sc. Hons. Geology students only	Completion of Semester 1 in Geology

Learning Objectives

The Learning Objectives of this course are as follows:

- To develop an understanding of the chemical nature of the earth and other planetary material and relate mineralogy, geochemistry and bulk chemistry.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Students will be able to appreciate the field of geochemistry and understand the properties of the elements - Nucleosynthesis; Cosmochemistry; Principles of isotope geochemistry; Solid earth geochemistry: Core, Mantle, Crust. Near-surface geochemical environment, Chemical weathering of minerals and rocks. Examples of instrumentation, data collection and analyses

SYLLABUS OF DSC-6

UNIT – I (3 Weeks)

Detailed contents

The abundance of elements in the cosmos, solar system and earth. Meteorites, distribution of elements in core, mantle, crust.

UNIT – II (4 Weeks)

Detailed contents

Introduction to properties of elements: periodic table, chemical bonding, states of matter and atomic environment of elements, geochemical classification of elements, the concept of elemental fractionation.

UNIT – III (4 Weeks)

Detailed contents

Geochemistry of igneous rocks: geochemical variability of magma and its products. Near-surface geochemical environment: Chemical weathering of minerals and rocks.

UNIT – IV (4 Weeks)

Detailed contents

Introduction to isotope geology: use of stable and radiogenic isotopes in earth science.

Practical component:

- Geochemical analysis of geological materials (analytical methods, concept of normalization)
- Geochemical variation diagrams, common geochemical plots, and their interpretations.
- Basic idea about handling and interpretation of isotope data.

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Essential/recommended readings

Mason, B (1986). Principles of Geochemistry. 3rd Edition, Wiley New York.
Faure, G., 1986. Principle of Isotope Geology, J. Wiley & Sons.

Suggestive readings

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 John, V., 2009 Essentials of geochemistry, student edition. Jones and Bartlett Publishers
Albarede, F, 2003. An introduction to geochemistry. Cambridge University Press.
Faure, G., 1986. Principle of Isotope Geology, J. Wiley & Sons.
Geochemistry by William M White, Wiley-Blackwell (2013).

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

(For all the Generic Elective courses offered by your Department, please put it in the format provided below)

GENERIC ELECTIVES (GE-2): Physics & Chemistry of Earth

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	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Physics & Chemistry of Earth (GE-2)	**4**	**3**	**1**	**0**	**Class-XII**	**Class-XII**	**Geology**

Learning Objectives

To develop an understanding of the surface and internal structure of the Earth and its mineralogy and chemistry; To equip the students about the present and past processes operative in shaping the physical and chemical make-up of the planet Earth

Learning outcomes

After completion of this course students will learn about:

- Physical, mineralogical and chemical structure of the earth
- Major surface features and their evolution through time
- Concept of geological time and its determination
- Earth's magneitc field, its short term and long term variation and its application
- Physical and chemical evolution of earth through time

SYLLABUS OF GE-2

UNIT – I (2 Weeks)

Detailed contents

Earth: surface features: Continents, continental margins, oceans

Earth's materials: Rocks and Minerals

UNIT – II (3 Weeks)

Detailed contents

Earth's interior - variation of physical parameters and seismic wave velocity inside the earth, major sub divisions and discontinuities. Depth-wise mineralogical variation in the Earth. Concepts of Isostasy; Airy and Pratt Model. Core and Mantle: Seismological and other geophysical constraints. The geodynamo - Convection in the mantle. Plate Tectonics. Types of plate margins and their Dynamics.

UNIT – III (2 Weeks)

Detailed contents

Elements of Earth's magnetism: Secular variation and westward drift. Solar activity and magnetic disturbance. Paleomagnetism

UNIT – IV (3 Weeks)

Detailed contents

Elements: Origin of elements/nucleosynthesis. Abundance of the elements in the solar system/planet Earth. Geochemical classification of elements. Earth accretion and early differentiation. Isotopes and their applications in understanding Earth processes.

UNIT – V (2 Weeks)

Detailed contents

Isotopes: Radiogenic and Stable. Radiogenic isotopes and their applications
Stable isotope fractionation. Oxygen isotopes. Sublithospheric Mantle (Mineralogy/phase transitions) Concept of mantle heterogeneity

UNIT – VI (2 Weeks)

Detailed contents

Low-temperature geochemistry; surface and near-surface processes

Essential/recommended readings

- Holmes, A. (1992). Principles of Physical Geology, 1992, Chapman and Hall.
- Anderson, G. M. (1996). Thermodynamics of natural systems. John Wiley & Sons Inc.
- Condie, K.C. (2016) Earth as an evolving planetary system (3rd Edn.) Elsevier

Suggestive readings

- 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.
- Condie, K.C. (2016) Earth as an evolving planetary system (3rd Edn.) Elsevier