Vidyasagar University

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

Semester-IV

Course	Course Code	Name of the Subjects	Course Type/ Nature	Teaching Scheme in hour per week			Credit	Marks
				L	T	P		
CC-8		**C8T:** Metamorphic Petrology	Core Course - 8	4	0	0	6	75
		C8P: Metamorphic Paleontology **Lab**		0	0	4		
CC-9		**C9T:** Principles of Stratigraphy and Precambrian Stratigraphy of India	Core Course - 9	4	0	0	6	75
		C9P: Stratigraphic Principles and Indian Stratigraphy **Lab**		0	0	4		
CC-10		**C10T:**Phanerozoic Stratigraphy of India	Core Course - 10	4	0	0	6	75
		C10P: Phanerozoic Stratigraphy of India **Lab**		0	0	4		
GE-4		TBD	Generic Elective-4				6	75
SEC-2			Skill Enhancement Course-2	0	0	4	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 [**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-IV

Core Course (CC)

CC-8: Metamorphic Petrology — Credits 06

C8T: Metamorphic Petrology — Credits 04

Course Contents:

Unit I: Metamorphism: controls and types.

1. Definition of metamorphism. Factors controlling metamorphism, Types of metamorphism– contact, regional, fault zone metamorphism, impact metamorphism
2. Causes of metamorphism and concept of metamorphic P-T-t paths

Unit 2: Metamorphic Facies and Grades. Metamorphic Structures and Textures

1. Index minerals, metamorphic zones and isograds. Structure and textures of metamorphic rocks
2. Concept of metamorphic facies and grade
3. Mineralogical phase rule of closed and open system
4. Composition-paragenesis diagrams. ACF, AKF and AFM diagrams
5. Metamorphic products of pelitic, carbonate and mafic igneous rocks

Unit 3: Metamorphic reactions. Metamorphism and deformation.

1. Progressive and retrogressive metamorphism
2. Prograde and retrograde metamorphic minerals reactions.
3. Relationship between metamorphism and deformation.

Unit 4: Migmatites and their origin

1. Metasomatism and role of fluids in metamorphism.
2. Brief idea of crustal anatexis. Migmatites and its origin.

Unit 5: Metamorphic rock associations and plate tectonic settings

Regional occurrence and tectonic significance of metamorphic rocks: Metamorphism along convergent plate margins, in continent-continent collisions, in rifting terrains and sea floor metamorphism.

Suggested Readings:

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. Yardley, B. W. D. (1989). An introduction to metamorphic petrology. Longman Scientific and Technical, London.
6. Spear F. S. 1993. Metamorphic phase equilibria and Pressure-Temperature-Time paths.
7. Mineralogical Society of America. Monograph. 799 p.

C8P: Metamorphic Paleontology Lab **Credits 02**

List of Practical

1. Hand specimen study of following metamorphic rocks: Slate, Phyllite, Schist, Gneiss, Amphibolite, Charnockite, Khondalite, Mafic granulite, Marble

2. Textural and mineralogical study of following metamorphic rocks in thin sections: slate, varieties of schists, gneiss, amphibolite, charnockite, khondalite, mafic granulite, eclogite, marble, high Mg-Al granulites

3. Graphical plots of metamorphic mineral assemblages using chemographic diagrams

CC-9: Principles of Stratigraphy and Precambrian Stratigraphy of India

Credits 06

C9T: Principles of Stratigraphy and Precambrian Stratigraphy of India **Credits 04**

Course Contents:

Unit 1: Principles of stratigraphy

1. Fundamentals of lithostratigraphy, biostratigraphy and chronostratigraphy.
2. Introduction to concepts of dynamic stratigraphy (chemostratigraphy, seismic stratigraphy, sequence stratigraphy).
3. Relevance of Type section.
4. Principles of stratigraphic correlation.

Unit 2: Code of stratigraphic nomenclature

1. International Stratigraphic Code – development of a standardized stratigraphic nomenclature

2. Concepts of Stratotypes. Global Stratotype Section and Point (GSSP)

3. Brief introduction to the concepts of lithostratigraphy, biostratigraphy, chronostratigraphy, seismic stratigraphy, chemostratigraphy, magnetostratigraphy, sequence stratigraphy and their subdivisions with Indian examples

Unit 3: Principles of stratigraphic analysis Facies concept in stratigraphy

1. Walther's Law of Facies.
2. Concept of paleogeographic reconstruction

Unit 4: Stratigraphic boundaries in India

1. Archaean-Proterozoic boundary.
2. Precambrian-Cambrian boundary and their status in global perspective.

Unit 5: Physiographic and tectonic subdivisions of India

1. Brief introduction to the physiographic and tectonic subdivisions of India
2. Introduction to Indian Shield, Craton
3. Introduction to Indian Precambrian belts.
4. Introduction to Proterozoic basins of India

Unit 6: Geologic evolution Important Precambrian terrains

1. Geologic evolution with emphasis on sedimetation, lithology, magmatism, structure, metamorphism and geochronology of: Singhbhum, Dharwar, Rajasthan, Central India and Eastern Ghats.
2. Vindhyan and Cudappah basins of India.

Suggested Readings:

1. Krishnan, M. S. (1982) Geology of India and Burma, CBS Publishers, Delhi
2. Doyle, P. & Bennett, M. R. (1996) Unlocking the Stratigraphic Record. John Wiley
3. Ramakrishnan, M. &Vaidyanadhan, R. (2008) Geology of India Volumes 1 & 2, Geological society of India, Bangalore.
4. Valdiya, K. S. (2010). The making of India, Macmillan India Pvt. Ltd.

C9P: Stratigraphic Principles and Indian Stratigraphy Lab Credits 02

List of Practical

1. Study of geological map of India and identification of major stratigraphic units
2. Major features of paleogeographic maps – Precambrian

CC-10: Phanerozoic Stratigraphy of India — Credits 06

C10T: Phanerozoic Stratigraphy of India — Credits 04

Course Contents:

Unit 1: Introduction

1. Definition.
2. Important Stratigraphic boundaries during Phanerozoic time in India - a. Precambrian-Cambrian boundary, b. Permian-Triassic boundary, and c. Cretaceous-Tertiary boundary.

Unit 2: Important Palaeozoic successions in India

Important Palaeozoic successions in India with emphasis on succession, lithology, flora and fauna, correlation and palaeoenvironment of the following:

1. Paleozoic Succession of Kashmir
2. Stratigraphy Structure of Gondwana basins.
3. Mesozoic stratigraphy of India:
    a. Triassic successions of Spiti,
    b. Jurassic of Kutch,
    c. Triassic and Jurassic non marine successions of peninsular India (Upper Gondwana formations, relevant Formations of Rajasthan basin)
    d. Cretaceous, successions of Cauvery basins
    e. Lameta and Jabalpur Formations
4. Cenozoic stratigraphy of India:
    a. Kutch basin,
    b. Siwalik successions,
    c. Assam, Andaman and Arakan basins.
5. Stratigraphy and structure of Krishna-Godavari basin, Cauvery basin, Bombay offshore basin, Kutch and Saurashtra basins and their potential for hydrocarbon exploration

Unit 3: Stratigraphy of the intertrappeans

1. Deccan,
2. Rajmahal,
3. Sylhet Trap

Unit 4: Quaternary Geology

1. Definition
2. Principles of subdivision of Quaternary succession in India.

C10P: Phanerozoic Stratigraphy of India Lab **Credits 02**

List of Practical

1. Study of geological map of India and identification of major Phanerozoic stratigraphic units.
2. Stratigraphic correlation of Phanerozoic stratigraphic units in geological map of India
3. Proterozoic supercontinent reconstructions

Skill Enhancement Course (SEC)

SEC-2: Field Geology **Credits 02**

SEC2P: Field Geology

Course Contents:

A. Field Geology : Stratigraphy and structure related field

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

Or

B. Field Geology : Stratigraphy Sedimentology - related field

List of Trainings to be covered

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

C. Field Geology : Himalayan Geology Field

1. Preparation of a geological transect map in the Himalayas

Or

D. Field Geology : Economic Geology Field

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

Or

E. Field Geology :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.

Generic Elective (GE)

[Interdisciplinary for other department]

GE-4: Earth Resources — Credits 06

GE-4T Earth Resources — **Credits 04**

Course Contents:

Unit 1

1. Resource reserve definitions; mineral, energy and water resources
2. A brief overview of classification of mineral deposits with respect to processes of formation

Unit 2

1. Difference between Energy, Power and Electricity
2. Renewable and Non- Renewable Sources of Energy
3. The concept and significance of Renewability: Social, Economic, Political andEnvironmental Dimension of Energy

Unit 3

1. Resources of Natural Oil and Gas
2. Coal and Nuclear Minerals
3. Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass Based powerand Energy

Unit 4

1.Ground water resources in India and its role in economic development of the country
2. Current Scenario and Future Prospects of Solar Power, Hydrogen Power and Fuel Cells.

Suggested Readings:

1. Energy and the Environment by Fowler, J.M 1984. McGraw-Hill

2. Global Energy Perspectives by Nebojsa Nakicenovic 1998, Cambridge University Press.
3. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M. A. Prelas. 2009, Springer
4. Introduction to Wind Energy Systems: Hermann-Josef Wagner and Jyotirmay Mathur. 2009, Springer.
5. Renewable Energy Conversion, Transmission and Storage. Bent Sorensen, 2007

GE4P: Earth Resources Lab **Credits 02**

List of Practical:

1. Study of coal ain Hand specimen
2. Plotting of major Indian oil fields on map of India
3. Problems related to assessment of possible oil exploration site from geological maps andsections.
4. Construction of cross section of mineral deposits from maps and drill hole data.
5. Estimation of reserves.
6. Preparation and interpretation of depth to water level maps and water level contourmaps

OR

GE-4: Nuclear Waste Management Credits 06

GE4T: Nuclear Waste Management **Credits 04**

Course Contents:

Nuclear Waste Management

Theory and Concepts

Nuclear reactors and generation of nuclear waste, nuclear fuel cycle, basic concepts about nuclear waste management. Classification, composition and types of nuclear waste, their sources and characteristics. Introduction to immobilization and vitrification processes. Nuclear waste forms and containments. Immobilization of nuclear waste in synthetic (AVS, BBS, SON 68 and R7T7) glasses and natural glass/rocks (acidic: obsidian, rhyolite and basic: nephiliniite and basaltic). Glass/rock characterization and its long-term performance assessment. Geochemistry of glass/rock-water interaction- solution and neo formed mineral chemistry.

Glass/rock alteration studies by mathematical modeling using EQ3/6 and GWB. Nuclear waste confinement and safe disposal in deep geological repository. Application of clays as natural barrier.

Suggested Readings:

1. Saling, J. (2001). Radioactive waste management. CRC Press.
2. Ojovan, M. I., & Lee, W. E. (2013). An introduction to nuclear waste immobilisation. Newnes.
3. T.G. Wolery: reaction path modeling of aqueous geochemical systems.
4. Bethke, C. M. (2007). Geochemical and biogeochemical reaction modeling. Cambridge University Press.

GE4P: Nuclear Waste Management Lab **Credits 02**

List of Practical

1. Determination of physical properties such as hardness, durability, melting and pouring temperatures
2. Chemical characterization of synthetic and natural glass
3. Mathematical modeling and extrapolation of synthetic glass alterations
4. Mathematical modelling and extrapolation of natural acidic (obsidian, rhyolite) and basic (nephilinite and basaltic) glasses
5. Determination of rate of alteration and recognition of neo-formed minerals
6. Calculation of retention coefficient for glass residue