Since 1919

NATIONAL COLLEGE (AUTONOMOUS)

(Nationally Re-accredited at "A" Level by NAAC)

(Recognized as a College with Potential for Excellence by UGC)

Tiruchirappalli - 620001

B. Sc. Geology

Programme Structure & Syllabus

Outcome Based Education System (OBES)

(Applicable to the Candidates Admitted from the Academic Year 2025-2026 Onwards)

Since 1961

POST GRADUATE AND RESEARCH DEPARTMENT OF GEOLOGY

POST GRADUATE AND RESEARCH DEPARTMENT OF GEOLOGY
NATIONAL COLLEGE (AUTONOMOUS)

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Vision

- To transform the Department into one of the best learning centres for Geology in the State and the country

Mission

- To ignite the young minds with lofty ideals and inspire them to achieve excellence in the field of Geology
- To provide an understanding of the Earth System and apply these to the needs of society
- To prepare the next generation of Geologists to use latest technologies in the exploration of resources especially rocks and minerals, water and hydrocarbons

Programme Structure

Category	No. of Courses	Total Credits
Core Course (T+P)	13	68
Elective Course	03	12
Allied Course (T+P)	06	18
Language /English Course	08	24
Non Major Elective Course	02	04
Skill Based Elective Course	03	06
Soft Skills Course	01	02
Value Education Course	01	02
Environmental Studies Course	01	02
Gender Studies Course	01	01
Extension Activities	01	01
Total	**40**	**140**

Programme Structure for B.Sc. Geology

Sl. No.	Course Code	Part	Hours / Week	Credit	Course Type	Course Title	Course Kind	Hours of Exam		IE Marks (for 25)		EE Marks (for 75)	
								T	P	T	P	T	P
Semester - I													
1	U25T1 / U25H1/ U25S1	I	6	3	T		L	3	-	25	-	75	-
2	U25E1	II	6	3	T		E	3	-	25	-	75	-
3	U25GY1	III	5	5	T	The Dynamic Earth	CC	3	-	25	-	75	-
4	U25GY2P	III	3	-	P	Practical I – Toposheet Reading, Surveying and Palaeontology	CC	-	-	-	-	-	-
5	U25AMS1/ U25ACH1	III	5	3	T		AC	3	-	25	-	75	-
6	U25AMS2/ U25ACH2P	III	3	-	P		AC	-	3	-	25	-	75
7	U25ES	IV	2	2	T	Environmental Studies	ES	3	-	25	-	75	-
Semester - II													
8	U25T2 / U25H2 / U25S2	I	6	3	T		L	3	-	25	-	75	-
9	U25E2	II	6	3	T		E	3	-	25	-	75	-
10	U25GY2P	III	3	5	P	Practical I – Toposheet Reading, Surveying and Palaeontology	CC	-	3	-	25	-	75
11	U25GY3	III	5	5	T	Palaeontology	CC	3	-	25	-	75	-
12	U25AMS2/ U25ACH2P	III	3	3	T/P		AC	3	-	25	-	75	-
13	U25AMS3/ U25ACH3	III	5	3	T		AC	3	-	25	-	75	-
14	U25GYSBE1	IV	2	2	T	Basic Computer Studies	SBE	3	-	25	-	75	-

(Contd…)

Semester - III														
15	U25T3 / U25H3 / U25S3	I	6	3	T		L	3	-	25	-	75	-
16	U25E3	II	6	3	T		E	3	-	25	-	75	-
17	U25GY4	III	4	4	T	Mineralogy	CC	3	-	25	-	75	-
18	U25GY5P	III	3	-	P	Practical II – Mineralogy and Crystallography	CC	-	3	-	25	-	75
19	U25APH1	III	4	3	T		AC	3	-	25	-	75	-
20	U25 APH2P	III	3	-	P		AC	-	3	-	25	-	75
21	U25GYSBE2	IV	2	2	T	Statistics	SBE	3	-	25	-	75	-
22	U25GYSBE3P	IV	2	2	T	Basic Computer Studies and Statistics	SBE	-	3	-	25	-	75
Semester - IV														
23	U25T4 / U25H4 / U25S4	I	6	3	T		L	3	-	25	-	75	-
24	U25E4	II	6	3	T		E	3	-	25	-	75	-
25	U25GY5P	III	2	5	P	Practical II – Mineralogy and Crystallography	CC	-	3	-	25	-	75
26	U25GY6	III	4	4	T	Crystallography and Gemology	CC	3	-	25	-	75	-
27	U25APH2P	III	3	3	P		AC	-	3	-	25	-	75
28	U25APH3	III	5	3	T		AC	3	-	25	-	75	-
29	U25GYNME1	IV	2	2	T	Elements of Geology	NME	3	-	25	-	75	-
30	U25VE	IV	2	2	T	Value Education	VE	3	-	25	-	75	-
Semester - V														
31	U25GY7	III	5	5	T	Igneous and Metamorphic Petrology	CC	3	-	25	-	75	-
32	U25GY8	III	5	5	T	Sedimentary Petrology and Structural Geology	CC	3	-	25	-	75	-
33	U25GY9P	III	6	6	P	Practical III – Petrology and Structural Geology	CC	-	3	-	25	-	75
34	U25GY10E1 / U25GY10E2	III	5	4	T	Environmental Geology and Marine Geology / Natural Disasters	CC-E	3	-	25	-	75	-
35	U25GY11E1 / U25GY11E2	III	5	4	T	Remote Sensing and Field Geology / GIS and GNSS	CC-E	3	-	25	-	75	-
36	U25GYNME2	III	2	2	T	Geology and Environment	NME	3	-	25	-	75	-
37	U25SS	IV	2	2	T	Soft Skills	SS	3	-	25	-	75	-

Sl. No.	Course Code	Part	Hours / Week	Credit	Course Type	Course Title	Course Kind	Hours of Exam		IE Marks (for 25)		EE Marks (for 75)	
								T	P	T	P	T	P
Semester - VI													
38	U25GY12	III	6	6	T	Stratigraphy	CC	3	-	25	-	75	-
39	U25GY13	III	6	6	T	Economic Geology	CC	3	-	25	-	75	-
40	U25GY14	III	6	6	T	Mineral Prospecting and Mining Geology	CC	3	-	25	-	75	-
41	U25GY15P	III	6	6	P	Practical IV – Economic Geology, Mining Geology and Hydrogeology	CC	-	3	-	25	-	75
42	U25GY16E1	III	5	4	T	Hydrogeology and Engineering Geology	CC-E	3	-	25	-	75	-
	U25GY16E2					Geoexploration							
43	U25GS	V	1	1	T	Gender Studies	GS	3	-	25	-	75	-
44	Extn. Activity	V		1			EA	-	-	-	-	-	-
	Total Credits			140									

Note: Geological field instructional tour is mandatory for all the students of B.Sc. Geology Programme.
Students should submit the tour report which will be considered for evaluating the internal marks of the practical examinations.

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY1	Core	THE DYNAMIC EARTH	Theory	5	5

Course Description

The course provides a comprehensive introduction to geology, exploring the Earth's structure, composition, and dynamic processes. It covers key topics such as the origin of the Earth, plate tectonics, geological phenomena like earthquakes and volcanoes, and the formation of various landforms due to natural processes. The course integrates theoretical concepts with real-world applications, emphasizing the relationship between geology, people, and the environment.

Course Objectives: To impart knowledge on the

1. Branches of geology and their connection to the Earth system.
2. Earth's internal structure, isostasy theories, continental drift, seafloor spreading and plate tectonics
3. Geological hazards like earthquakes and volcanoes, and their impacts.
4. Processes and landforms due to weathering, river action and groundwater
5. Processes and landforms due to glacial, aeolian, coastal and marine processes

Unit 1: Geology: Branches and outline on the relationships between Geology, people and environment – Solar System: components, important theories of its origin – Formation of Earth's layered structure: primary geochemical differentiation, formation of atmosphere and oceans – Salient features of the Earth's spheres: atmosphere, hydrosphere, biosphere and Geosphere – Outline on the concept of Earth system – Earth's shape and size – Abundant elements in the Earth as a whole and in the crust – Outline of the geological history of the Earth.

Unit 2: Earth's internal structure and composition – Isostasy: Airy's and Pratt's theories – Outline on Earth's internal temperature, geothermal gradient, heat flow variations – Outline of Earth's gravitational field – Outline of Earth's magnetic field – Continental drift: Wegener's hypothesis, evidences and objections – Sea floor spreading: Hess's concept and evidences – Plate tectonics: types of plate boundaries, evidences for plate movement, characteristic features of plate boundaries, driving forces of plate motion.

Unit 3: Earthquakes: causes, types of seismic waves, earthquake belts and their relation to plate tectonics, expression of earthquake strength and, hazards – Volcanism: causes, types of eruption, products, global volcanic belts and effects – Outline on orogeny, orogenic cycles, epeirogeny – Mountains: types and, important mountain belts of the world and India – Principles used for the determination of relative and absolute time.

Unit 4: Weathering: types, products, factors affecting rates of weathering and landforms formed – Fluvial processes and landforms – Drainage patterns – Landforms formed due to the action of groundwater – Lakes: types of lakes and lake deposits.

Unit 5: Glaciers: distribution, types, glacial processes and landforms – Aeolian processes and landforms – Coastal processes and landforms – Coral reefs: origin, types, distribution and importance – Marine processes and landforms – Major landforms of India.

Course Outcomes: On completion of the course the student would have gained knowledge on the

1. Branches of geology and their connection to the Earth system.
2. Earth's internal structure, isostasy theories, continental drift, seafloor spreading and plate tectonics
3. Geological hazards like earthquakes and volcanoes, and their impacts.
4. Processes and landforms due to weathering, river action and groundwater
5. Processes and landforms due to glacial, aeolian, coastal and marine processes
6. Coral reefs and major landforms of India

Text Books

1. **Arthur Holmes (1965).** Principles of Physical Geology (II Revised Edition), Thomson Learning.
2. **Dayal, P (2010).** A Text Book of Geomorphology, Rajesh Publications.
3. **Kale, V and A. Gupta (2010).** Introduction to Geomorphology, Universities Press.
4. **Mahapatra, G.B (2016).** Text Book of Physical Geology, CBS Publishers & Distributors.
5. **Patwardhan, A.M (2010).** The Dynamic Earth System (II edition), PHI Learning Private Ltd.
6. **Roy, A.B (2010).** Fundamentals of Geology, Narosa Publishing House Pvt. Ltd.
7. **Tarbuck, E.J., Lutgens, F.K., & D Tasa (2017).** Earth Science. Pearson.
8. **Thompson, G.R and J. Turk (1997).** Introduction to Physical Geology (II Ed.), Brooks Cole Publishers.
9. **Savindra Singh (2018).** Geomorphology, Pravalika Publications.

Reference Books

1. **Carlson D.H and C.C. Plummer (2009).** Physical Geology: Earth Revealed, McGraw-Hill.
2. **Chernicoff, S and H.A. Fox (2000).** Essentials of Geology, Houghton Mifflin Company.
3. **Christiansen, E.H and W. K. Hamblin (2014).** The Dynamic Earth, Jones & Bartlett Publishers, Inc.
4. **Plummer, C.C., Carlson, D.H and L.Hammersley (2016).** Physical Geology (XV Ed.), McGraw-Hill.
5. **Reynolds (2017).** Exploring Geology. McGraw Hill.
6. **Sreepat Jain (2014).** Fundamentals of Physical Geology, Springer India.

Web Resources:

1. Geological Society of America (GSA) - https://www.geosociety.org/
2. United States Geological Survey (USGS) - https://www.usgs.gov/

Course Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total Weightage	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **THE DYNAMIC EARTH** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY2P	Core	PRACTICAL I – TOPOSHEET READING, SURVEYING AND PALAEONTOLOGY	Practical	3	5

Course Description

This practical course introduces students to three foundational components of Geology: topographic map reading, field surveying techniques, and palaeontology. Through hands-on exercises, students learn to interpret toposheets, conduct basic field surveys using standard instruments, and identify fossil specimens. The course strengthens field-based skills and observational abilities essential for careers and advanced studies in geology.

Course Objectives: To impart knowledge on

1. The ability to read and analyze topographic maps to analyse the terrain features
2. The analysis of drainage morphometric parameters
3. Gaining proficiency in basic surveying techniques using instruments like chain, compass, dumpy level, auto level, and plane table.
4. The description of the morphological characters of invertebrate fossils and their identification.

1. Toposheet Reading

Exercises relating to

- Location of sites using geographic coordinates. Finding the geographic coordinates of the given feature.
- Identification of natural and man-made features from the symbols, colours, etc. given in toposheets
- Determination of elevation of a point and, elevation differences between two points
- Identification of landforms such as hills, valleys, plateaus, plains, etc. from the contours
- Identification of water bodies, interpreting their nature and the direction of flow of rivers
- Estimation of distance between any two points using map scale
- Estimation of areal extent of features such as cities, tanks, forests, etc.
- Drawing profile along a line between two points on a map to interpret the elevation changes
- Estimation of drainage morphometric parameters

2. Surveying

- Determination of linear distance between the given features using chain / tape by triangulation method and plotting on a paper.
- Determination of elevation of different points and distance between the points of elevation using dumpy level and chain/tape.
- Determination of elevations of different points and distance between the points of elevation using Auto level and chain/tape.
- Determination of angle between two points, or bearings of points using prismatic compass and chain/tape and plotting on a paper.
- Determination of angles between two points, or bearings of points using Brunton compass and chain/tape and plotting on a paper.
- Plotting of field features on a paper by simultaneous observation using plane table and chain/tape.

3. Palaeontology

a. <u>Identification of Selected Fossils from their Morphological Characters</u>

- **Corals:** Calceola, Zaphrenits, Favosites, Halysites and Lithostrotion

- **Brachiopoda:** Spirifer, Productus, Terebratula, Rhynconella, Atrypa and Athyris
- **Echinodermata :** Pentrimites, Cidaris, Hemicidaris, Stygmatophygus, Micraster and Holaster
- **Mollusca :** Pelecypoda: Arca, Cardium, Meretrix, Cardita, Pecten, Trigonia, Gryphea, Exogyra and Ostea
- **Gastropoda :** Natica, Turbo, Trochus, Turritella, Cerethium, Conus, Voluta, Fusus, Murex, Physa & Bellerophon
- **Cephalopoda :** Nautilus, Goniatites, Ceratites, Acanthoceras, Scholenbachia, Perispinctus, Scaphites, Baculites, Turrilites and Belemnites
- **Arthropoda :** Trilobita - Paradoxides, Calymene, Phacops and Trinucleus
- **Graptolites :** Tetragraptus, Didymograptus and Monograptus
- **Plant fossils :** Glossopteris, Gangamopteris, Ptillophyllum, Lepidodentron, Sigillaria and Calamites

b. <u>Diagrams of Morphology of Selected Fossils</u>

- Calymene, Paradoxides, Pentrimites, Arca, Meretrix, Murex, Turritella, Nautilus, Spirifer and Ptillophyllum

Course Outcomes: On completion of the course the student would have gained practical knowledge on

1. The ability to read and analyze topographic maps to analyse the terrain features
2. The analysis of drainage morphometric parameters
3. Gaining proficiency in basic surveying techniques using instruments like chain and compass
4. Gaining proficiency in using instruments dumpy level, auto level, and plane table.
5. The description of the morphological characters of invertebrate fossils and their identification.
6. Plant fossils

Text Books:

1. **Ramachandran, V. (2022).** Topographic Map Reading and Surveying. Himalaya Publishing House.
2. **Woods, H. (2020).** Palaeontology: Invertebrate. CBS Publishers.
3. **Subramani, K and V. Manivanan (2014).** Palaeontology: Practical Manual. Vishal Publication Co.

Reference Books:

1. **Clarkson, E.N.K. (2013).** Invertebrate Palaeontology and Evolution. Wiley-Blackwell.
2. **Mathur, S.M. (2001).** Guide to Field Geology. Prentice Hall of India.
3. **Punmia, B.C. (2016).** Surveying Vol. 1. Laxmi Publications.

Web Resources:

1. **https://www.usgs.gov –** U.S. Geological Survey educational materials.
2. **https://paleobiodb.org –** Paleobiology Database for fossil identification.
3. **https://nptel.ac.in** – Courses on surveying and palaeontology.

Course Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

The Cos and Pos for the **PRACTICAL I – TOPOSHEET READING, SURVEYING AND PALAEONTOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U22GY3	Core	PALAEONTOLOGY	Theory	5	5

Course Description

This course focuses on the study of fossils and their significance in interpreting Earth's history. It explores fossil formation, classification, major fossil groups, evolutionary trends, and the application of fossils in stratigraphy, paleoenvironmental reconstructions, and resource exploration. Emphasis is placed on fossil evidence from Indian stratigraphy, enabling students to connect global evolutionary patterns with regional geological history.

Course Objectives: To impart knowledge on

- Origin of life and its evolution, fossilization processes, types of fossils, and their applications.
- Morphology, classification, evolution, and stratigraphic importance of trilobites, graptolites, and corals.
- Morphology, classification, evolution, and stratigraphic importance of molluscan groups such as Pelecypoda, Gastropoda, and Cephalopoda with their geological importance.
- Fossil plants, echinoderms, Gondwana flora, their geological significance, and an outline on Palynology
- Vertebrate fossils such as Devonian fishes, Mesozoic reptiles, Cenozoic mammals and, evolutionary trends in Hominidae, Equidae and Proboscidae along with important vertebrate, invertebrate and plant fossils in Indian Stratigraphy.

Unit 1: Palaeontology and its branches – Classification of living organism: hierarchy of the classification, binomial nomenclature – Origin of life and major steps in the evolution of life through geological time – Fossils: Conditions for the formation of fossils – Modes of preservation of fossils: Body fossils, unaltered hard parts, and altered hard parts (petrifaction, permineralisation, carbonisation, recrystallisation, impression, moulds and casts) and trace fossils - Microfossils and their types – Uses of fossils in stratigraphy, correlation, evolution studies, paleoenvironment, paleoclimate, paleogeography, palaeooceanography, and exploring hydrocarbons and other economic resources

Unit 2: Trilobites: general morphology, classification, geological history, evolutionary trend and stratigraphic importance – Graptolites: general morphology, classification, geological history and stratigraphic importance – Anthozoa (Corals): general morphology, classification, geological history and stratigraphic importance.

Unit 3: Pelecypoda: general morphology, classification, evolutionary trend and geological history – Types of dentition in Pelecypoda – Gastropoda: General morphology, classification and geological history – Different forms of gastropod shell – Cephalopoda: general morphology, classification and geological history – Types of suture patterns in Cephalopoda and stratigraphic importance of ammonoides.

Unit 4: Brachiopods: general morphology, geological history, evolutionary trend and stratigraphic importance, differences between Articulata and Inarticulata – Echinodermata: general morphology and geological history of Echinoidea, Crinoidea and Blastoidea – Short account on the following plant fossils: Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepidodendron and Sigillaria – Gondwana flora and their stratigraphic significance – Outline on Palynology.

Unit 5: Outline of the following vertebrate fossils: Devonian fishes, Mesozoic reptiles and Cenozoic mammals – Evolutionary trends in Hominidae (Humans), Equidae (Horses) and Proboscidae (Elephants) – Outline on Indian Dinosaurs – Important vertebrate, invertebrate and plant fossils in Indian Stratigraphy.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

- Origin of life and its evolution, fossilization processes, types of fossils, and their applications.
- Morphology, classification, evolution, and stratigraphic importance of trilobites, graptolites, and corals.
- Morphology, classification, evolution, and stratigraphic importance of molluscan groups such as Pelecypoda, Gastropoda, and Cephalopoda with their geological importance.
- Fossil plants, echinoderms, Gondwana flora, their geological significance, and an outline on Palynology
- Vertebrate fossils such as Devonian fishes, Mesozoic reptiles, Cenozoic mammals and, evolutionary trends in Hominidae, Equidae and Proboscidae along with important vertebrate, invertebrate and plant fossils in Indian Stratigraphy.

Text Books

1. **Benton, M.J. (2005).** Vertebrate Palaeontology. Blackwell Publishing.
2. **Clarkson, E.N.K. (1998).** Invertebrate Palaeontology and Evolution. Blackwell Science.
3. **Euan, C and N.K. Clarkson (1998).** Invertebrate Palaeontology and Evolution, Wiley-Blackwell.
4. **Jain P.C and M.S. Anantharaman (2018).** An Introduction to Paleontology, Vishal Publications.
5. **Peter, D (1996).** Understanding Fossils: An Introduction to Invertebrate Palaeontology, John Wiley & Sons
6. **Raup, D.M and S.M. Stanley (1985).** Principles of Paleontology, CBS Publications.
7. **Sreepat Jain (2017).** Fundamentals of Invertebrate Palaeontology, Springer.
8. **Woods, H (1959).** Invertebrate Palaeontology, Cambridge.

Reference Books

1. **Arnold, C.A (1947).** An Introduction to Palaeobotany, McGraw-Hill Book Company, Inc.
2. **Benton, M. J (2015).**Vertebrate Palaeontology and Evolution (IV Edition), Wiley-Blackwell.
3. **Easton W. H (1960).** Invertebrate Paleontology, Harper's Geoscience Series.
4. **Gupta, V.P. (2005).** Paleobotany. Agrobios
5. **Hag, B.U and A. Boersma (1978).** Introduction to Marine Micropalaeontology, Elsevier
6. **Moore R.C., Lalieker, C.D and A.G. Fischer (1952).** Invertebrate Fossils, McGraw Hill.
7. **Romer A.S (1960).** Vertebrate Palaeontology, Chicago Press.
8. **Shrock, R.R and W.H. Twenhofel (1953).** Principles of Invertebrate Palaeontology, Arnold Publication.

Web Resources

1. Fossil works Gateway – https://fossilworks.org
2. Palaeontological Association – https://www.palass.org
3. Paleobiology Database – https://paleobiodb.org
4. Smithsonian National Museum of Natural History – https://naturalhistory.si.edu

Course Articulation Matrix (COs vs POs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	9	9	9	3	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	3	3
Total	54	54	54	54	18	18
Weightage %	21.42	21.42	21.42	21.42	7.14	7.14

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	9	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	3
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **PALAEONTOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GYSBE1	Skill Based Elective	BASIC COMPUTER STUDIES	Theory	2	2

Course Description:

This is a skill-based elective course designed to provide foundational knowledge and hands-on experience in essential computer applications. The course covers operating systems, Microsoft Office tools (Word, Excel, PowerPoint, Access, Outlook), graphic design software like Photoshop and CorelDRAW. It equips students with practical digital skills applicable in academic, professional, and personal contexts.

Course Objectives: To impart knowledge on

1. Basic computer operations, Windows OS, and core features of MS Word.
2. Spreadsheet creation and data analysis tools using MS Excel and database management in MS Access.
3. Creating multimedia presentations using MS PowerPoint and managing email communication in Outlook.
4. Basic graphic editing and design using Adobe Photoshop.
5. Vector-based design and illustration techniques using CorelDRAW.

Unit 1: Introduction to computers: hardware and software – Operating System: short account on Windows – Accessories in Windows – MS office and its core applications – MS Word: creating, editing and formatting document – Page layout: margins, column, water mark, page border, Indent – Inserting of page break, illustrations, tables, header and footer, text box, Word art – Creating Envelops and Labels – Short account on Mail merge.

Unit 2: MS Excel: creating and Navigating workbooks – Formatting rows, columns, and cells – Creating database – Sorting and filtering of data – Creating charts and graphs – Insert functions and formulas: statistical and financial – Short account on pivot tables and pivot charts – MS Access: creation of table, import and export of data, queries.

Unit 3: MS Power Point: creating, editing, navigating and formatting presentation – Applying design templates – Applying transition and animation effects – Adding video and audio to presentation – Viewing and setting up a slide show – MS Outlook: sending and receiving emails, managing contacts.

Unit 4: Photoshop: page set up and file format – Layers: new layer, duplicate layer and merge layers – Layer styles: drop shadow, inner shadow, outer glow and inner glow, bevel and emboss, gradient overlay, stroke – Photoshop tools : move, type, marquee, lasso, crop, shapes, healing, brush, patch, cloning stamp, eraser, gradient, blur, smudge, dodge, pen, eye dropper, patch selection and zoom tool.

Unit 5: Coreldraw: Drawing tools – pick, shape, knife, eraser, smudge, roughen brush, free transform, artistic pen, poly line, point, spiral tool – Colour tool: paint bucket tool, eye dropper, fill tools – Fill options, stroke options – Special effects: 3D effects, add perspective, blend, contour, artistic media, lens, and power clip – Shaping options: weld, trim and Intersect.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. Basic computer operations, Windows OS, and core features of MS Word.
2. Spreadsheet creation and data analysis tools using MS Excel
3. Database management using MS Access.
4. Creating multimedia presentations using MS PowerPoint and managing email communication in Outlook.
5. Basic graphic editing and design using Adobe Photoshop.
6. Vector-based design and illustration techniques using CorelDRAW.

Text books

1. **Anita Goel. (2010).** Computer Fundamentals. Pearson Education India.
2. **Sanjay Saxena. (2007).** MS Office 2007 in a Nutshell. Vikas Publishing House.

Reference Books

1. **Carla, R (2000).** Teach Yourself Adobe Photoshop, Sams publisher.
2. **Gupta, S (2008).** Corel Draw in Simple Steps, Dreamtech Press India Pvt. Ltd.
3. **Hinkle, D (2003).** Microsoft Office 2003 PowerPoint: A Professional Approach, Comprehensive Student CD, McGraw-Hill/Irwin.
4. **Jill Murphy (2003).** Microsoft Office Word- Comprehensive Course, Labyrinth Publications.
5. **Miller, D (1998).** Corel Draw, John Wiley & Sons.
6. **Nellai Kannan, C (2002).** MS-Office, Nels Publications.
7. **Sinha, PK, Sinha P (2007).** Foundations of Computing. BPB Publications.

Web Resources

1. https://www.gcflearnfree.org – Free tutorials on MS Office and basic computer skills
2. https://www.microsoft.com/en-us/learning – Microsoft official training resources
3. https://www.adobe.com/creativecloud.html – Official Adobe Photoshop tutorials
4. https://coreldraw.com – CorelDRAW training and resources

Course Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome Attainment Assessment Tools & Evaluation

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **BASIC COMPUTER STUDIES** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY4	Core	MINERALOGY	Theory	4	4

Course Description:

This course provides a comprehensive understanding of minerals, including their formation, classification, physical and optical properties, and industrial applications. The course emphasizes the crystallographic, chemical, and optical principles governing mineral structures and behaviour, and fosters skills in identifying and analyzing various mineral groups, using petrological microscope.

Course Objectives: To impart knowledge on

1. Atomic bonding in minerals, structure and classification of minerals
2. Physical properties of minerals
3. Behaviour of light, optical principles, functioning of a petrological microscope and optical accessories.
4. Optical properties of minerals, including birefringence, pleochroism, interference colors, and extinction
5. Mineralogy, chemistry, and industrial importance of quartz, feldspars, micas, and zeolites.
6. Structure, chemistry, mode of occurrence and industrial uses of ferromagnesian and non-silicate minerals including pyroxenes, amphiboles, and accessory minerals.

Unit 1: Definition of minerals – Atomic bonding in minerals – Structure and classification of silicates – Isomorphism, polymorphism and pseudomorphism in minerals – Physical properties of minerals depending upon cohesion and elasticity, specific gravity, light, heat, electricity, magnetism and the senses – Determination of specific gravity of minerals: Joly balance method.

Unit 2: Nature of light, wave nomenclature, phase, perception of colour – Reflection, critical angle and total internal reflection – Isotropic and anisotropic media – Dispersion – Ordinary and polarized light – Methods of polarization: by selective absorption, by double refraction, Brewster's angle and Snell's law, polarisation by reflection – Petrological microscope and its parts – Optical accessories, their construction and uses: quartz wedge, gypsum plate, mica plate, and Bereck's compensator.

Unit 3: Optical properties of isotropic and anisotropic minerals – Definition of optic axis, optically uniaxial and biaxial minerals, fast ray and slow ray, birefringence, uniaxial and biaxial indicatrix, retardation – Interference phenomena, orders of interference colours – Extinction: types of extinction, extinction angle and procedure for its determination – Sign of elongation and its determination – Pleochroism and dichroism – Characters of uniaxial and biaxial minerals – Optic axial angle – Acute and obtuse bisectrix – Optic sign of uniaxial and biaxial minerals – Optical anomalies.

Unit 4: Mineralogy, structure, chemistry, optical and physical properties, mode of occurrences and industrial uses of the following groups of minerals: quartz group, feldspar group, feldspathoids, mica, zeolites and alumina-silicates.

Unit 5: Mineralogy, structure, chemistry, optical and physical properties, mode of occurrences and industrial uses of the following groups of minerals: pyroxenes, amphiboles, olivine and garnet – Physical and optical properties, chemical composition, uses and modes of occurrence of the following minerals: Epidote, Chlorite, Cordierite, Talc, Serpentine, Steatite, Calcite, Dolomite, Topaz, Staurolite, Beryl, Tourmaline, Fluorite, Apatite, Zircon, Rutile and Corundum.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. Atomic bonding in minerals, structure and classification of minerals
2. Physical properties of minerals
3. Behaviour of light, optical principles, functioning of a petrological microscope and optical accessories.
4. Optical properties of minerals, including birefringence, pleochroism, interference colors, and extinction
5. Mineralogy, chemistry, and industrial importance of quartz, feldspars, micas, and zeolites.
6. Structure, chemistry, mode of occurrence and industrial uses of ferromagnesian and non-silicate minerals including pyroxenes, amphiboles, and accessory minerals.

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Text Books:

1. **Dana, F.S (1955).** A Text Book of Mineralogy, Asia Publishing House, Wiley.
2. **Mason, B and L.G. Berry (2004).** Elements of Mineralogy (II Edition), CBS Publishers.
3. **Read, H.H (1974).** Rutley's Elements of Mineralogy, Thomas Murby & Co.
4. **Winchell, A.N (1968).** Elements of Optical Mineralogy, Wiley Eastern Pvt. Ltd.

Reference Books:

1. **Cornelis Klen and Cornelius S. Hurlbut (1985).** Manual of Mineralogy, John Wiley &Sons.
2. **Deer, W.A., Howoe, R.A & J. Zuessman (1966).** An Introduction of the Rock Forming Minerals, Longman
3. **Dyar, M and M.E. Gunter (2007).** Mineralogy and Optical Mineralogy, Mineralogical Society of America.
4. **Gribble, C.D and A.J. Hall (1985).** A Practical Introduction to Optical Mineralogy, Springer.
5. **Kerr, P.F (1959).** Optical Mineralogy, McGraw Hill, New York.
6. **Nesse, W.D (1991).** Introduction to Optical Mineralogy, Oxford University Press, Oxford.

Web Resources

1. www.mindat.org – Mineral database and reference
2. www.webmineral.com – Mineral data and optical properties
3. https://www.minerals.net – Educational resource on minerals
4. https://www.geology.com – General geology and mineral information
5. YouTube channels like "Earth Explorers" and "GeologyHub" for optical mineralogy tutorials

Course Articulation Matrix (COs vs POs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **MINERALOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GYSBE2	Skill Based Elective	STATISTICS	Theory	2	2

Course Description:

This course introduces students to the foundational concepts of statistics with a special emphasis on data analysis techniques relevant to the geosciences. It covers data collection methods, presentation and organization of data, central tendency and dispersion measures, correlation and regression, and basic probability theory. Additionally, it familiarizes students with widely used statistical software to enhance analytical skills and prepare them for research and industry applications.

Course Objectives: To impart knowledge on

1. Concepts and classifications of statistics, and various methods of data collection and sampling techniques.
2. Organising of data using appropriate tables
3. Presentation of data
4. Computing and interpreting measures of central tendency, dispersion, and variability.
5. Exploring relationships between variables using correlation and regression techniques.
6. Understanding fundamental probability rules and gain awareness of key statistical software tools used in scientific analysis.

Unit 1: Statistics: concepts, merits and limitation – Descriptive and inferential statistics – Data analysis process – Collection of data: primary data and secondary data – Sampling techniques: Random, stratified random, cluster and systematic sampling.

Unit 2: Organization of data: tabulation, continuous and discrete frequency – Presentation of data: Bar diagram, pie diagram, histogram, line graph, frequency polygon.

Unit 3: Measures of central tendency: arithmetic mean, median and mode – Measures of Dispersion: standard deviation, skewness, kurtosis – Measures of variability: range, inter-quartile range, variance.

Unit 4: Correlation: auto correlation, rank correlation and cross correlation, scatter diagrams – Regression: linear regression and lines of regression, multiple regressions.

Unit 5: Probability: concepts, addition and multiplication theorems – Short account on following statistical Software: SPSS, PAST, GSTAT, GRADISTAT, SURFER, GRAPHER.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. Concepts and classifications of statistics, and various methods of data collection and sampling techniques.
2. Organising and visually presenting data using appropriate tables and graphical representations.
3. Computing and interpreting measures of central tendency, dispersion, and variability.
4. Exploring relationships between variables using correlation and regression techniques.
5. Understanding fundamental probability rules.
6. Important statistical software tools used in scientific analysis.

Text Books:

1. **Gupta, S.C. (2020).** Fundamentals of Statistics. Himalaya Publishing House.
2. **Goon, A.M., Gupta, M.K and B. Dasgupta (2021).** Basic Statistics. World Press.

Reference Books:

1. **Davis, J.C (1962).** Statistics and Data Analysis in Geology, Third Edition, John Wiley & Sons.
2. **Lane, D.M (1999).** Introduction to Statistics, University of Houston, Open Text Book, Online Edition.
3. **Miller, R.L and J. Stevenkahn (1962).** Statistical analysis in the Geological Sciences, John Wiley & Sons.
4. **Moore, D.S., George, P., McCabe and B. A. Craig (2017).** Introduction to the Practice of Statistics, W. H. Freeman and Company.
5. **Spiegel, M.R and L.J. Stephens (2018).** Schaum's Outline of Statistics. McGraw Hill.

Web Resources:

1. https://nptel.ac.in – Online video lectures on statistics
2. https://www.khanacademy.org – Free tutorials on statistics and probability
3. https://www.statsoft.com – Resources on statistical methods and software
4. https://www.spss-tutorials.com – SPSS resources and guides
5. https://folk.uib.no/nglhe/gradistat.html – GRADISTAT tutorials

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **STATISTICS** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GYSBE3P	Skill Based Elective	BASIC COMPUTER STUDIES AND STATISTICS	Practical	2	2

Course Description:

This practical course introduces students to fundamental digital tools and statistical techniques relevant to Geology. Students gain hands-on experience in word processing, spreadsheets, graphic design, and basic photo editing, along with essential geostatistical methods such as data presentation, measures of central tendency and dispersion, and correlation analysis. The course equips students with the necessary technical and analytical skills to manage data and present scientific information effectively using digital tools.

Course Objectives: To impart knowledge on

1. Text editing, formatting, and creating professional documents such as invitations and mail merge.
2. Applying statistical & mathematical functions and represent data visually using different types of charts.
3. Basics of image editing, combining multiple images, and working with layers.
4. Designing simple vector-based graphics and logos for academic or professional use.
5. Understanding and applying statistical concepts including data presentation, central tendency and dispersion
6. Correlation using real-world datasets.

Exercises Relating to

1. MS Word: Text formatting
2. MS Word: Mail merge
3. MS Word: Preparing an invitation for an event
4. Ms Excel: Basic Statistical & Mathematical Functions
5. Ms Excel: Preparing different types of chart for the given data
6. Photoshop: Create a single image from multiple images
7. Photoshop: Creating an image with multilayers
8. Coral draw: Creating logo
9. Statistics: Presentation of data
10. Statistics: Measures of tendency
11. Statistics: Measures of dispersion
12. Statistics: Correlation and scatter diagram

Outcomes (COs): On completion of the course the student would have gained knowledge on

1. Text editing, formatting, and creating professional documents such as invitations and mail merge.
2. Applying statistical & mathematical functions and represent data visually using different types of charts.
3. Basics of image editing, combining multiple images, and working with layers.
4. Designing simple vector-based graphics and logos for academic or professional use.
5. Understanding and applying statistical concepts including data presentation, central tendency and dispersion
6. Correlation using real-world datasets.

Text Books:

1. **Sinha, P.K. (2010).** Computer Fundamentals. BPB Publications.
2. **Gupta, S.C. (2020).** Fundamentals of Statistics. Himalaya Publishing House.

Reference Books:

1. **Gopal, K. (2012).** Microsoft Office 2010 Training Guide. Prentice Hall India.
2. **Adobe Creative Team. (2020).** Adobe Photoshop Classroom in a Book. Adobe Press.
3. **Goon, A.M., Gupta, M.K and B.Dasgupta (2021).** Basic Statistics. World Press.

Web Resources:

1. https://www.office.com – MS Word and Excel tutorials
2. https://www.adobe.com/creativecloud – Photoshop learning resources
3. https://www.statisticshowto.com – Statistics concepts and tools
4. https://www.khanacademy.org – Free courses on statistics and software basics
5. https://nptel.ac.in – Free Indian academic content on computer applications and data analysis

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

The Cos and Pos for the **BASIC COMPUTER STUDIES AND STATISTICS** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY5P	Core	PRACTICAL - II MINERALOGY AND CRYSTALLOGRAPHY	Practical	3	5

Course Description:

This practical course provides hands-on training in the identification and characterization of minerals and crystal models. Through megascopic, optical, and crystallographic analyses, students learn to identify minerals and twin crystal models. The course reinforces theoretical knowledge and fosters practical skills for advanced geological and gemmological applications.

Course Objectives: To impart knowledge on

1. The identification of common rock-forming minerals using their physical properties.
2. The identification of economic minerals based on their physical properties.
3. The identification of minerals using their optical properties.
4. The morphology and symmetry of crystals.
5. To understand the crystallographic features and laws of twinning through twin crystal models.

1. Mineralogy

a) Identification of the following minerals by the study of their megascopic characters:

Quartz, Amethyst, Chalcedony, Agate, Jasper, Chert, Opal. Orthoclase, Microcline, Albite, Anorthite, Oligoclase, Labradorite, Nepheline, Sodalite, Enstatite, Bronzite, Hypersthene, Diopside, Augite, Spodumene, Acmite, Rhodonite, Wollastonite, Anthophyllite, Tremolite, Actinolite, Hornblende, Glaucophane, Olivine, Serpentine, Muscovite, Biotite, Vermiculite, Chlorite, Epidote, Garnet, Natrolite, Stilbite, Apophyllite, Talc, Steatite, Andalusite, Kyanite, Sillimanite, Staurolite, Cordierite, Apatite, Beryl, Topaz, Calcite, Tourmaline, Fluorite.

b) Identification of the following minerals by the study of their optical characters:

Quartz, Orthoclase, Microcline, Perthite, Albite, Labradorite, Nepheline, Enstatite, Hypersthene, Diopside, Augite, Aegirine, Anthophyllite, Hornblende, Glaucophane, Tremolite, Biotite, Muscovite, Olivine, Epidote, Garnet, Apatite, Zircon, Sphene, Tourmaline, Calcite, Andalusite, Kyanite, Sillimanite, Staurolite, and Cordierite.

2. Crystallography

a) Description of crystallographic characters and identification of the following crystal models:

Galena, Garnet, Fluorite, Pyrite, Tetrahedrite, Boracite, Sphalerite, Cuprite, Zircon, Cassiterite, Rutile, Apophyllite, Vesuvianite, Scheelite, Meonite, Wulfenite, Chalcopyrite, Beryl, Zincite, Apatite, Calcite, Corundum, Tourmaline, Quartz, Olivine, Topaz, Barite, Andalusite, Cordierite, Sulphur, Staurolite, Hypersthene, Calamine, Struvite, Epsomite, Gypsum, Orthoclase, Augite, Hornblende, Epidote, Sphene, Axinite, Albite, Kyanite and Rhodonite.

b. Description of twinning characters and identification of the following twin crystal models:

Galena, Fluorite, Pyrite, Rutile, Calcite, Quartz, Staurolite, Gypsum, Augite, Orthoclase, Albite.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. The identification of common rock-forming minerals using their physical properties.
2. The identification of economic minerals based on their physical properties.
3. The identification of minerals using their optical properties.
4. The morphology and symmetry of crystals.
5. To understand the crystallographic features and laws of twinning through twin crystal models.
6. Characters and identification of selected twin models.

Text Books:

1. **Dana, E. S. (2021).** Manual of Mineralogy. Wiley.
2. **Deer, W. A., Howie, R. A & J. Zussman (2021).** An Introduction to the Rock-Forming Minerals. Longman.
3. **Kerr, P. F. (2022).** Optical Mineralogy. McGraw-Hill.

Reference Books:

1. **Klein, C and B. Dutrow (2007).** Manual of Mineral Science. Wiley.
2. **Nesse, W. D. (2012).** Introduction to Optical Mineralogy. Oxford University Press.
3. **Phillips, F. C. (1971).** An Introduction to Crystallography. Longman.

Web Resources:

1. Mindat.org – Mineral Database
2. Mineralogy Database – Webmineral.com

Course Articulation Matrix (CO-PO Mapping)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

COs Mapped with Knowledge Levels

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

The Cos and Pos for the **MINERALOGY AND CRYSTALLOGRAPHY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY6	Core	CRYSTALLOGRAPHY AND GEMMOLOGY	Theory	4	4

Course Description:

This course provides a comprehensive understanding of Crystallography and Gemmology, focusing on the morphological, geometrical, and symmetrical properties of crystals, crystal systems, and twin laws. It also introduces the science of gemstones, including their classification, identification, grading, and enhancement techniques. The course bridges theoretical crystallographic knowledge with practical gemmological applications relevant to both academic and industrial contexts.

Course Objectives: To impart knowledge on

1. Morphological characters, laws, and classification systems of crystals and forms of cubic system.
2. Identification and analysis of symmetry elements and crystal classes of tetragonal, hexagonal, and orthorhombic systems.
3. Identification and analysis of symmetry elements and crystal classes of monoclinic and triclinic systems and develop an in-depth understanding of crystal twinning and its significance.
4. Types, formation, enhancement, and global occurrence of gemstones.
5. Physical, chemical & optical properties of gemstones and methods for their identification and evaluation.

Unit 1: Definition of crystal – Morphological characters of crystals: faces, forms, edges, solid angles, interfacial angle – Contact Goniameter and its use – Symmetry elements, crystallographic axes, axial ratio – Crystal notation: parameter system of Weiss and Miller indices – Laws of Crystallography: law of constancy of symmetry, law of constancy of interfacial angles and the law of rational indices – Classification of crystals into systems and classes – holohedral, hemihedral, hemimorphic and enantiomorphic forms in crystals – Study of the symmetry elements, and forms of the normal, pyritohedral, tetrahedral and plagiohedral classes of cubic system with special reference to well-developed crystals of Galena, Spinel, Garnet, Fluorite, Diamond, Pyrite, Tetrahedrite, Boracite and cuprite.

Unit 2: Study of symmetry elements and forms of Normal, Hemimorphic, Tripyramidal, Pyramidal Hemimorphic, Sphenoidal and Trapezphedral classes of Tetragonal system with special reference to well-developed crystals of zircon, Rutile, Cassiterite, Vesuvianite, Apophyllite, Scheelite, Meionite, Wulfenite and Chalcopyrite – Study of the symmetry elements and forms of Normal, Hemimorphic Tripyramidal, pyramidal Hemimorphic, Trapezohedral, Rhombohedral, Rhombohedral Hemimorphic, Trirhombohedral and Trapezohedral classes of Hexagonal system with special reference to well-developed crystals of Beryl, Zincite, Apatite, Calcite, Corundum, Tourmaline, Phenacite and Quartz – Study of the symmetry elements and forms of the Normal, Hemimorphic and Sphenoidal classes of Orthorhombic system with special reference to well-developed crystals of Barite, Olivine Topaz, Staurolite, Sulphur, Calamine, Struvite and Epsomite.

Unit 3: Study of the symmetry elements and forms of the Normal classes of the Monoclinic and Triclinic systems with special reference to well-developed crystals of Gypsum, Orthoclase, Albite, Augite, Axinite and Kyanite – Twin crystals: Effects of twinning – laws of twinning – composition plane, twinning plane and twinning axis, indices of twins – Simple and repeated (polysynthetic twins), contact and penetration twins, secondary twins – Study of twin laws pertaining to the following crystals – Fluorite (spinel law), Pyrite (iron-cross twin), Rutile (geniculate), Calcite, Quartz (Brazil laws), Aragonite (mimetic twin), Staurolite (cruciform), Gypsum, Augite and Feldspars (Carlsbad, Baveno, Manebach, Albite and Pericline).

Unit 4: Gemstones: minerals used as gemstones, their chemical composition, origin and occurrence – Types of gemstones: inorganic, organic and synthetic – Quality, grading, and evaluation of gemstones – Weighing of gemstones – Gemstone cutting techniques – Enhancement and fashioning of gemstones – Mining of gemstones – Global and Indian occurrences of gemstones – Gemstone belts of Tamil Nadu.

Unit 5: Gemstone identification properties: crystallography, cleavage, parting, fracture, hardness, specific gravity, density, colour, lustre, sheen, reflection, refraction, dispersion, pleochroism, spectroscopy, luminescence, electrical and thermal properties – Gemstone identification instruments – Gemstone identification flow chart – Properties of the following gemstones: Alexandrite, aquamarine, diamond, emerald, ruby, sapphire, pearl and coral.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. Morphological characters, laws, and classification systems of crystals and forms of cubic system.
2. Identification and analysis of symmetry elements and crystal classes of tetragonal, hexagonal, and orthorhombic systems.
3. Identification and analysis of symmetry elements and crystal classes of monoclinic and triclinic systems/
4. Crystal twinning and its significance.
5. Types, formation, enhancement, and global occurrence of gemstones.
6. Physical, chemical & optical properties of gemstones and methods for their identification and evaluation.

Text Books:

1. **Berry, L.G and B. Mason (2019).** Elements of Mineralogy, CBS Publishers and Distributors.
2. **Dana, F.S (1955).** A Text Book of Mineralogy, Asia publishing House, Wiley.
3. **GIA. (2020).** Gem Identification Lab Manual. Gemological Institute of America.
4. **Phillips, P.C (1956).** An Introduction to Crystallography, Longmans Green & Co.
5. **Read, H.H (1974).** Rutley's Elements of Mineralogy, Thomas Murby & Co.
6. **Read, P.G (1988).** Beginner's Guide to Gemology,Newnes Publishers.

Reference Books:

1. **Karnath K.V (1989).** Gem and Gem Industry in India, Geo. Soc. India Pub.
2. **Read, P.G (2005).** Gemmology (III Edition), Elsevier Butterworth-Heinemann.
3. **Schumann, W (2013).** Gemstones of the World (V Edition), Sterling Publishers.
4. **Wenk, H. R and A. Bulakh (2004).** Minerals: Their Constitution and Origin. Cambridge University Press.

Web Resources:

1. https://www.gia.edu – Gemological Institute of America
2. https://webmineral.com – Mineral database with crystallographic data
3. https://www.mindat.org – Mineralogy database and locality information
4. https://crystallography.net – Crystallography Open Database (COD)
5. https://www.gemdat.org – Gemstone information and images

Course Articulation Matrix (CO-PO Mapping):

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

COs Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **CRYSTALLOGRAPHY AND GEMMOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GYNME1	Non-Major Elective	Non-Major Based Elective Course I ELEMENTS OF GEOLOGY	Theory	2	2

Course Description:

This course introduces fundamental concepts in geology, covering its branches, the solar system, Earth's structure, physical geology, structural geology, stratigraphy, paleontology, mineralogy, and petrology. It provides an understanding of Earth's processes, rock formations, and the geological time scale.

Course Objectives: To impart knowledge on

1. Scope and branches of geology, the solar system, and Earth's internal structure.
2. Processes and landforms formed due to weathering, running water, wind and sea waves.
3. Geological structures such as faults, folds, joints, unconformities and, an overview of plate tectonics.
4. Geologic time scale, Indian stratigraphic divisions, and fossil preservation and applications.
5. Classification and physical properties of minerals and
6. Various rock types.

Unit 1: Geology and its Branches, Solar System and Earth: Scope and branches of Geology – Solar System: components and their important features, outline of hypotheses relating to its origin – Interior of the Earth – Seas and oceans.

Unit 2: Physical Geology: Weathering: types and products – Processes and landforms produced by running water – Processes and landforms produced by wind – Landforms produced by coastal processes.

Unit 3: Structural Geology: Faults: definition, causes and types – Folds: causes and types – Joints: definition, causes and types – Unconformities: definition and types – Bedding in sedimentary rocks, dip and strike of beds – Outline of plate tectonics.

Unit 4: Stratigraphy and Palaeontology: Geologic Time Scale – Indian Stratigraphic Divisions – Fossils: types, their modes of preservation and applications – Outline of important fossils of India and their geological ages.

Unit 5: Mineralogy and Petrology: Definition of minerals, their classification and physical properties – Brief account of quartz and feldspars – Rocks: definition and types – Igneous rocks: outline of the forms, description of granite, pegmatite and basalt – Sedimentary rocks: description of sandstone, shale and limestone – Metamorphic rocks: schist, gneiss, charnockite.

Course Outcomes: On completion of the course the student would have gained knowledge on

1. Scope and branches of geology, the solar system, and Earth's internal structure.
2. Processes and landforms formed due to weathering, running water, wind and sea waves.
3. Geological structures such as faults, folds, joints, unconformities and, an overview of plate tectonics.
4. Geologic time scale, Indian stratigraphic divisions, and fossil preservation and applications.
5. Classification and physical properties of minerals and
6. Various rock types.

Text Books:

1. **Mahapatra, G.B (2016).** Text Book of Physical Geology,CBS Publishers and Distributors Pvt. Ltd.
2. **Mukherjee, P.K (1981).** A Text Book of Geology. World Press.
3. **Radhakrishnan, V (1987).** General Geology, VVP Press.
4. **Roy, A.B (2010).** Fundamentals of Geology,Narosa Publishing House Pvt. Ltd.
5. **Tyrrell, G.W (2019).** Principles of Petrology,Surjit Publications.

Reference Books:

1. **Billings, M.P. (2016).** Structural Geology (IIII Edition), Pearson Publishers.
2. **Dana, F.S (1955).** A Text Book of Mineralogy, Asia Publishing House, Wiley.
3. **Krishnan, M. S (2003).** Geology of India and Burma (VI Edition), CBS Publishers and Distributors.
4. **Patwardhan, A.M (2010).** The Dynamic Earth System (II Edition), PHI Learning Private Ltd.
5. **Savindra Singh (2018).** Geomorphology, Pravalika Publications.
6. **Thornbury, W.D (1969).** Principles of Geomorphology (Revised II Edition), 2015 Reprint, New Age International Pvt. Ltd.
7. **Woods, H (1959).** Invertebrate Palaeontology, Cambridge.

Web Resources:

1. https://www.iugs.org/
2. https://geo.libretexts.org/
3. https://www.usgs.gov/

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **ELEMENTS OF GEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY7	Core	IGNEOUS AND METAMORPHIC PETROLOGY	Theory	5	5

Course Description:

The course provides an in-depth understanding of the composition, formation, classification, and characteristics of igneous and metamorphic rocks. It encompasses evolution of magma, igneous rock classification, textures, mineralogy and, metamorphic processes.

Course Objectives: To impart knowledge on

1. The composition, evolution, and crystallization processes of magma.
2. The forms, structures, and classification systems of igneous rocks.
3. Mineralogical and petrographical characteristics of plutonic and volcanic rocks.
4. Petrographic characters and origin of selected rocks of Tamil Nadu
5. The processes and agents of metamorphism and their products.
6. The structures, textures, and petrography of key metamorphic rocks.

Unit 1: Composition and constitution of magma – Processes of evolution and diversification of magma – Bowen's reaction principle – Crystallization of unitary magma: SiO_2 System – Crystallization of binary magma: Diopside-Anorthite eutectic system, Albite-Anorthite solid-solution system, Forsterite-Silica incongruent melting system – Short notes on magmatic differentiation, fractional crystallization, liquid immiscibility and assimilation – Short notes on variation diagrams and petrographic provinces.

Unit 2: Forms of igneous rocks: extrusive and intrusive – Structures of igneous rocks – Textures of igneous rocks – Classification of igneous rocks: classification based on colour index, silica saturation, silica contents, alumina saturation – CIPW Normative classification – Tyrrell's tabular classification – IUGS Modal classification for plutonic and volcanic rocks.

Unit 3: Texture, mineralogy, classification, modes of occurrence of plutonic rocks and their hypabyssal and volcanic equivalents of Granite, Syenite, Diorite, Gabbro, Ultramafics, Dunites, Peridotites, Pyroxenites and Anorthosites – Petrographic characters and origin of the following rocks: Anorthosites of Sittampundi and Ottanchatram, Syenites of Sivanmalai and Dunites of Salem.

Unit 4: Metamorphism: definition and agents – Types of metamorphism and their products: thermal metamorphism, dynamic metamorphism dynamothermal metamorphism, plutonic metamorphism, regional metamorphism, contact metasomatism – Metamorphism of partial melting, anataxis and palingenesis – Metamorphic zones – Metamorphic grades – Metamorphic facies – Characteristic mineral assemblages of pelites in the Barrovian zones and mafic rocks in common facies – Outline of Gibb's Phase rule and its applications– Outline of ACF, AKF and AFM diagrams.

Unit 5: Metamorphic structures – Metamorphic textures – Petrography and origin of the following metamorphic rocks: Phyllite, Slate, Schist, Gneiss, Granulite, Khondalite, Marble, Quartzite, Charnockite, Amphibolite and Pyroxenites.

Course Outcomes: On completion of the course the student would have gained knowledge on

1. The composition, evolution, and crystallization processes of magma.
2. The forms, structures, and classification systems of igneous rocks.
3. Mineralogical and petrographical characteristics of plutonic and volcanic rocks.
4. Petrographic characters and origin of selected rocks of Tamil Nadu
5. The processes and agents of metamorphism and their products.
6. The structures, textures, and petrography of key metamorphic rocks.

Text Books:

1. **Best, M.G (1993).** Igneous and Sedimentary Petrology, CBS Publishers and Distributors.
2. **Hatch, R.H and A.K. Wells (2003).** Petrology of the Igneous Rocks, CBS Publishers and Distributors.
3. **Turner, F.J and J. Verhoogen (1960).** Igneous and Metamorphic Petrology, McGraw Hill.
4. **Tyrrell, G.W (1963).** Principles of Petrology, Asia Publishing House
5. **Winter J.D (2014).** Igneous and Metamorphic Petrology, Prentice Hall.

Reference Books:

1. **Frost, B.R & D.C. Frost (2014).** Essentials of Igneous & Metamorphic Petrology, Cambridge Univ. Press.
2. **Gautham Sen (2014).** Petrology, Springer Publications.
3. **McBirney A.R (1994).** Igneous Petrology, CBS Publishers and Distributors.
4. **Phillipots R. Anthony and Cornelis Klein (2017).** Earth Materials: Introduction to Mineralogy and Petrology, Cambridge University Press.
5. **Raymond, L. A (2001).** Petrology: The Study of Igneous, Sedimentary and Metamorphic Rocks, McGraw Hill.

Web Resources:

1. https://www.geokniga.org/bookfiles/geokniga
2. https://www.geokniga.org/bookfiles/geokniga-
3. https://geology.com/rocks/igneous-rocks.shtml
4. https://opengeology.org/
5. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsyFCoiPyJlPmzHDxg==
6. https://egyankosh.ac.in/handle/123456789/66681

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **IGNEOUS AND METAMORPHIC PETROLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY8	Core	SEDIMENTARY PETROLOGY AND STRUCTURAL GEOLOGY	Theory	5	5

Course Description:

The course provides fundamental knowledge of sedimentary processes, classification, structures, textures, descriptive study of important sedimentary rocks and sedimentary basins of India. It also focuses on the principles of structural geology, rock deformation, stress-strain relationships, and structural features such as folds, faults, joints, and unconformities.

Course Objectives: To impart knowledge on

1. Sedimentary processes, lithification, diagenesis, and sedimentary rock structures.
2. Classification of sedimentary rocks and, sedimentary basins.
3. The concepts of structural geology, including rock deformation and stress-strain relationships.
4. Ductile structures such as folds, foliation, lineation, and unconformities in the field and maps.
5. Brittle structures such as faults, shear zones, joints, and stereographic projections.
6. Petrofabric diagrams and their interpretation.

Unit 1: Sedimentary process: disintegration and decomposition of rocks, transportation, deposition, lithification and diagenesis – Structures of sedimentary rocks: mechanical, chemical and organic – Textures of sedimentary rocks: clastic and non-clastic – Elements of sedimentary environments.

Unit 2: Classification of sedimentary rocks: Residual deposits: terra rossa, clay, laterite, bauxite and soils – Mechanical deposits: rudaceous, arenaceous and argillaceous – Heavy minerals and their applications – A descriptive study of conglomerate, breccia, sandstone and shale – Chemical deposits: siliceous, calcareous (limestone) and ferruginous – Organic deposits – calcareous, siliceous, phosphatic, ferruginous and carbonaceous deposits – A brief study of flint, chert, siderite, gypsum, rocksalt, caliche, guano and kiesellgher – Sedimentary basins of India.

Unit 3: Structural Geology: Beds and their attitudes: strike, true dip and apparent dip, relation between strike and dip – Outcrops and trends of outcrop: Rule of V of outcrops, width of outcrops, true thickness, vertical thickness and their mutual relations – Basic concepts of deformation:force, stress, strain and deformation – Stress and strain, and their types – Behaviour of rocks under deformation: brittle and ductile deformation.

Unit 4: Ductile Structures: Folds: geometry, description, classification of folds, recognition of folds in the field and map – Foliation and lineation: cleavage and its types, lineation and its types – Unconformities: types, significance, recognition of unconformities in field and map – Outline on overlap, offlap, inlier and outlier.

Unit 5: Brittle Structures: Faults: nomenclature, genetic and geometric classification, recognition of fault in field and map – Distinction between faults and unconformities – Shear zone: origin and types – Short account of rift valleys – Joints: geometric and genetic classification and uses of joints – Outline on stereographic and equal area projections – Petrofabric diagrams.

Course Outcomes: On completion of the course the student would have gained knowledge on

1. Sedimentary processes, lithification, diagenesis, and sedimentary rock structures.
2. Classification of sedimentary rocks and, sedimentary basins.
3. The concepts of structural geology, including rock deformation and stress-strain relationships.
4. Ductile structures such as folds, foliation, lineation, and unconformities in the field and maps.
5. Brittle structures such as faults, shear zones, joints, and stereographic projections.
6. Petrofabric diagrams and their interpretation.

Text Books:

1. **Billings, M.P. (2016).** Structural Geology (IIII Edition) Pearson Publishers.
2. **Ghosh, S. K (1993).** Structural Geology: Fundamental and Modern Developments, Pergamon Press.
3. **Gokhale, N.W (1996).** Theory of Structural Geology, CBS Publishers.
4. **Pettijohn, F.J (2002).** Sedimentary Rocks (III Edition), CBS Publishers & Distributors.
5. **Prothero, D. R and Schwab, F (2003).** Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy, W. H. Freeman.

Reference Books:

1. **Fossen, H (2010).** Structural Geology, Cambridge University Press.
2. **Michael McLane (1995).** Sedimentology, Oxford University Press.
3. **Park, P.G (1994).** Fundamentals of Structural Geology, John Willey & Sons.
4. **Pollard, D. D and R.C Fletcher (2005).** Fundamentals of Structural Geology, Cambridge University Press.
5. **Ragan, D. M (2009).** Structural Geology - An Introduction to Geometrical Techniques, Cambridge University Press.
6. **Rowland, S. M., Duebendorfer, E. M and I.M. Schiefelbein (2007).** Structural Analysis and Synthesis: Laboratory Course in Structural Geology (III Edition), Wiley-Blackwell.
7. **Sam Boggs (2000).** Principles of Sedimentology and Stratigraphy, Pearson.
8. **Tucker, M.E (2001).** Sedimentary Petrology, Blackwell Science.

Web Resources:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsyFCoiPyJlPmzHDxg==
2. https://egyankosh.ac.in/handle/123456789/66693
3. https://egyankosh.ac.in/handle/123456789/53276
4. https://geo.libretexts.org/Courses/California_State_University_Los_Angeles/Book%3A_An_Introduction_to_Geology_(Johnson_Affolter_Inkenbrandt_and_Mosher)/08%3A_Crustal_Deformation_(Geological_Structure)

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **SEDIMENTARY PETROLOGY AND STRUCTURAL GEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY9P	Core	PRACTICAL III – PETROLOGY AND STRUCTURAL GEOLOGY	Practical	6	6

Course Description:

This practical course provides hands-on experience in petrology and structural geology. Students will develop skills in identifying rocks through megascopic and microscopic studies, analyzing geological structures through contour maps, and solving structural geology problems using stereographic projections.

Course Objectives: To impart knowledge on

1. Identification of rocks by studying their megascopic characters.
2. Identification of rocks by studying their microscopic characters.
3. Interpreting and analysing geological structures from contour maps and solid geological maps.
4. Developing skills towards solving structural geology problems.
5. Determination of true and apparent thickness and vertical and true thickness
6. Using stereographic projection techniques for analyzing planar and linear geological structures.

1. Petrology:

1.1 Identification of rocks from the study of their megascopic characters

a) **Igneous rocks:** Granite, Graphic granite, Pegmatite, Aplite, Schorl rock, Syenite, Syenite porphyry, Diorite, Gabbro, Anorthosite, Dunite, Pyroxenite, Dolerite, Diabase Porphyry, Basalt, Trachyte, Rhyolite, Pumice and Scoria.

b) **Sedimentary rocks:** Sandstone, Arkose, Breccia, Conglomerate, Shale, Shell limestone

c) **Metamorphic rocks:** Slate, Phyllite, Schists, Gneisses, Quartzite, Marble, Amphibolite, Ecologite, Leptynite, Charnockite and Khondalite.

1.2 Identification of rocks from the study of their optical properties

a) **Igneous rocks:** Granite, Aplite, Graphic Granite, Syenite, Nepheline syenite, Diorite, Gabbro, Norite, Dunite, Peridotite, Anorthosite, Dolerite, Trachyte, Andesite, Basalt and Obsidian.

b) **Sedimentary rocks:** Sandstone, Conglomerate, Breccia, Arkose, Shale, Shell limestone.

c) **Metamorphic rocks:** Garnet mica schist, Hornblende schist, Hornblende gneiss, Charnockite, Amphibolite, Quartzite and Marble.

2. Structural Geology:

2.1 Interpretation of contour maps for solving problems relating to geological structures

- Exercises to predict trends of the outcrop of horizontal, vertical and inclined beds with respect to topography
- Reading of solid conformable maps
- Deciphering dip and strike of outcrops

- Construction of map when three points over a bedding plane are given
- Construction of vertical sections, thickness and order of superposition
- Reading of solid fold and fault maps
- Construction of vertical sections
- Determination of throw of vertical faults
- Reading of unconformable solid maps and construction of sections
- Reading of solid maps of areas when more than one structure is involved
- Determination of comparative ages of structures and intrusions
- Deciphering geological history.

2.1 Structural Geology problems relating to the determination of

a) true dip & apparent dip b) Vertical and true thickness

2.2 Stereographic projection of linear and planar structures

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. Identification of rocks by studying their megascopic characters.
2. Identification of rocks by studying their microscopic characters.
3. Interpreting and analysing geological structures from contour maps and solid geological maps.
4. Developing skills towards solving structural geology problems.
5. Determination of true and apparent thickness and vertical and true thickness
6. Using stereographic projection techniques for analyzing planar and linear geological structures.

Mapping Course Outcomes (COs) with Program Outcomes (POs):

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	54	48	48	54	30	18
Weightage %	21.95	17.07	19.51	21.95	12.19	7.31

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

The Cos and Pos for the **PRACTICAL III – PETROLOGY AND STRUCTURAL GEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY10E1	Core Course Elective	Elective Course – I ENVIRONMENTAL GEOLOGY AND MARINE GEOLOGY	Theory	5	4

Course Description:

This course focuses on the fundamental concepts of Environmental Geology, provides an in-depth knowledge about the various natural hazards such as river flooding, mass movements, coastal erosion, earthquakes, volcanic eruption, and the role of Geology in mitigating the impacts of these hazards. It also deals with the understanding of the impacts of mining activities, surface, groundwater and marine pollution, urbanisation, desertification and EIA.

Course Objectives: To impart knowledge on

1. The fundamental concepts of Environmental Geology
2. The hazards of river flooding, mass movement, coastal erosion, earthquakes, volcanic eruption and global climate change.
3. Impacts of mining activities, surface, groundwater and marine pollution, urbanisation and desertification
4. Solid and liquid waste disposal, EIA procedure and an account on Environmental laws of India
5. Dimensions of oceans, oceanographic exploration, techniques for mapping ocean basins, provinces of ocean basins, features of active and passive continental margins, ocean basins and, shorelines
6. Oceanic processes including waves, tides, currents, oceanic circulation, marine mineral resources, marine pollution, and the legal aspects governing seas and oceans.

Unit 1: Basic concepts of Environmental Geology – River flooding: causes and impacts, mitigation measures and the role of geology in flood mitigation planning – Mass movement: types, causes and impacts, mitigation measures and the role of geology in mass movement mitigation planning – Coastal erosion: causes, impacts, coastal erosion mitigation planning – Global climatic change: outline of influencing factors and impacts.

Unit 2: Earthquakes: Elastic rebound theory, earthquake distribution, expression of earthquake strength, earthquake hazards and their mitigation planning and, the role of Geology – Volcanic activity: types, distribution, hazards, strategies for reducing hazards of volcanic activity and the role of Geology – Environmental impacts of mining activities – Outline of the environmental laws in India.

Unit 3: Man as an agent of environmental modification – Surface water, groundwater and marine pollution: causes, hazards and strategies for their reduction – Urbanization and Groundwater problems – Desertification: causes, consequences, mitigation planning and role of Geology – Solid and liquid waste disposal – Environmental Impact Assessment: objectives and procedures.

Unit 4: Marine Geology: Oceans and their dimensions – Oceanographic exploration and important milestones – Origin and evolution of ocean basins – Mapping of ocean basins: modern techniques (Echo sounder, side scan sonar, multi beam sonar, radar altimeter) and sea floor chart – Provinces of ocean floor: continental margins, ocean basin, oceanic ridges – Features of active and passive continental margins: continental shelf, continental slope, continental rise – Features of ocean basin: deep ocean trenches, abyssal plains, guyots, oceanic plateaus, seamounts and volcanic Islands – Mid-oceanic ridges and sea floor spreading – Shorelines and their types.

Unit 5: Brief account on waves, tides, oceanic currents, storm surges and tsunami – Factors affecting general oceanic circulation of water – Coriolis effect and Ekman spiral and, their impacts – Physical and chemical properties of ocean water – Ocean sediments and their types – Marine mineral resources – Marine pollution: causes, hazards, their preventive and remedial measures – Laws of Seas and Oceans – Sea level changes: causes and effects – El Nino and La Nina and their effects.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. The fundamental concepts of Environmental Geology
2. The hazards of river flooding, mass movement, coastal erosion, earthquakes, volcanic eruption and global climate change.
3. Impacts of mining activities, surface, groundwater and marine pollution, urbanisation and desertification
4. Solid and liquid waste disposal, EIA procedure and an account on Environmental laws of India
5. Dimensions of oceans, oceanographic exploration, techniques for mapping ocean basins, provinces of ocean basins, features of active and passive continental margins, ocean basins and, shorelines
6. Oceanic processes including waves, tides, currents, oceanic circulation, marine mineral resources, marine pollution, and the legal aspects governing seas and oceans.

Text Books:

1. **Keller, E.A (2012).** Introduction to Environmental Geology (V Edition), Pearson Prentice Hall.
2. **Kind, A.H (1979).** Introduction to Marine Geology and Geomorphology, Edward ArnoldPub.
3. **Montgomery, C.W (2011).** Environmental Geology (IX Edition), McGraw-Hill Pub.
4. **Shepard, F.P (1973).** Submarine Geology, Harper and RowPub.

Reference Books:

1. **Erickson, J., Timothy and Kusky (2002).** Marine Geology: Exploring the New Frontiers of the Ocean, Facts on file, Inc.
2. **Eugen Seibold and Wolfgang Berger (2017).** Sea Floor: An Introduction to Marine Geology, Springer.
3. **McConnell, R.L and D.C. Abel (2015).** Environmental Geology Today, Jones and Bartlett Learning.
4. **Menard, H.W (1977).** Ocean Sciences – Readings from Scientific American, Freeman
5. **Reichard, J.S (2011).** Environmental Geology, McGraw Hill.
6. **Valdiya, K.S (1987).** Environmental Geology – Indian Context, Tata McGraw Hill Publications.

Web Resources:

1. https://moef.gov.in/
2. https://geo.libretexts.org/Bookshelves/Oceanography/Introduction_to_Oceanography_(Webb)
3. https://geo.libretexts.org/Bookshelves/Geology/Environmental_Geology_(Earle)
4. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=0Xvq9yUM2ILDrJ07FvlArQ==

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **ENVIRONMENTAL GEOLOGY AND MARINE GEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY10E2	Core Course Elective	Elective Course – I NATURAL DISASTERS	Theory	5	4

Course Description:

This course provides an in-depth study of natural disasters, their causes, distribution, associated hazards, and mitigation strategies. It covers disasters triggered by geological, hydrological, meteorological, and climatic factors, as well as their impacts on human society and the environment. The course emphasizes disaster risk reduction, preparedness, and management at local, national, and global levels.

Course Objectives: To impart knowledge on

1. The classification of natural disasters, energy sources driving disasters, global trends, and risk assessment.
2. The role of disaster management organizations.
3. Earthquakes, volcanic eruptions, and mass movements, their causes, impacts, and mitigation strategies.
4. Floods, cyclones, and global climate change, their contributing factors, hazards, and reduction strategies.
5. Droughts, heat waves, and forest fires, their characteristics, severity factors, hazards, and mitigation measures.
6. Desertification, dust storms, pandemics, lightning strikes, and meteorite impacts, their hazards, and strategies for impact reduction.

Unit 1: Natural disasters: Natural disasters and their classification – Internal and external energy sources of disasters – Major natural disasters since 1900 – Natural disasters and their trends – Outline on natural disaster hazard, vulnerability and, risk assessment, integrated management, community awareness and participation – UNDRR, India's NDMA and Government of Tamil Nadu's SDMA and their role in disaster management.

Unit 2: Earthquakes: distribution and its relation to plate tectonics, major earthquakes of the world and the Indian subcontinent, earthquake related hazards and their mitigation – Volcanic eruption: distribution of active volcanoes and their relation to plate tectonics, major volcanic eruptions of the world, hazards relating to volcanic eruption and their mitigation – Mass movements: factors influencing mass movements, hazards relating to mass movements and their mitigation.

Unit 3: Floods: types of floods, factors governing flood severity, characteristics of floods, hazards relating to floods and strategies for their reduction – Cyclones: types, factors governing severity of cyclones, hazards relating to cyclones and strategies for their reduction – Global climatic change: factors governing its severity, related hazards and strategies for their reduction.

Unit 4: Droughts: types of droughts, factors governing severity of droughts, hazards relating to droughts and strategies for their reduction – Heat waves: factors governing its severity, characteristics of heat waves, hazards relating to heat waves and strategies for their reduction – Forest fires: factors governing its severity, characteristics of forest fires, hazards relating to forest fires and strategies for their reduction.

Unit 5: Desertification: factors governing its severity, related hazards and strategies for their reduction – Dust storms and sand storms: factors governing their severity, their characteristics, hazards relating to them and strategies for their reduction – Pandemics and epidemics: Important events and their impacts – Lightning strikes and meteoritic impacts: their hazards.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. The classification of natural disasters, energy sources driving disasters, global trends, and risk assessment.
2. The role of disaster management organizations.
3. Earthquakes, volcanic eruptions, and mass movements, their causes, impacts, and mitigation strategies.
4. Floods, cyclones, and global climate change, their contributing factors, hazards, and reduction strategies.
5. Droughts, heat waves, and forest fires, their characteristics, severity factors, hazards, and mitigation measures.
6. Desertification, dust storms, pandemics, lightning strikes, and meteorite impacts, their hazards, and strategies for impact reduction.

Text Books:

1. **Abbott, P.L (2020).** Natural Disasters (XI Edition), McGraw Hill Publishers.
2. **Cheval, S (2012).** Natural Disasters, InTech free online edition.
3. **Ebert, C.H.V (2000).** Disasters: An Analysis of Natural and Human Induced Hazards (IV Edition), Kendall/Hunt Pub.

Reference Books:

1. **Claire Watts (2006).** Natural Disasters, DK Publishing Inc., London, 76p.
2. **Lee Davis (2008).** Natural Disasters, Facts on File, Inc., New York, 464p.
3. **Marlene Bradford (2007).** Notable Natural Disasters, Salem Press Inc., 1050p.
4. **The World Bank and the United Nations (2010).** Natural Hazards, Unnatural Disasters: The Economics of Effective Prevention, 279p.

Web Resources:

1. https://geo.libretexts.org/Bookshelves/Geology/Environmental_Geology_(Earle)
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=bsA+3rVcyoJ6GW6UkeQmhw==
3. https://ndma.gov.in/

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **NATURAL DISASTERS** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY11E1	Core Course Elective	Elective Course – II REMOTE SENSING AND FIELD GEOLOGY	Theory	5	4

Course Description:

This course provides a comprehensive account on Remote Sensing, both aerial and satellite Remote Sensing, their applications in geosciences, along with fundamental principles of field geology, geological mapping, and data interpretation essential for geological investigations.

Course Objectives: To impart knowledge on

1. To understand the processes and elements involved in electromagnetic remote sensing, electromagnetic spectrum.
2. Electromagnetic energy interaction with Earth's atmosphere and surface features, spectral reflectance curves and applications of Remote Sensing.
3. Various important aspects of Aerial Remote Sensing
4. Various important aspects of Satellite Remote Sensing.
5. Field geology techniques, measurement of geological structures, and use of field instruments.
6. Geological mapping techniques, interpretation of topographic maps, and preparation of geological reports.

Unit 1: Introduction to Remote Sensing: Processes and elements involved in electromagnetic remote sensing – Electromagnetic spectrum: basic characteristics and components – Electromagnetic energy interaction with Earth's atmosphere – Electromagnetic energy interaction with Earth's surface features – Spectral reflectance curve of healthy vegetation, bare soil and clear water – Data recording and interpretation – Outline of thermal, microwave, hyperspectral and lidar sensing – Applications of Remote Sensing with special reference to Geosciences.

Unit 2: Aerial Remote Sensing: Types of aerial photographs – Photoscale and causes for its variation – Flight planning procedures – Stereoscopes: pocket and mirror stereoscopes – Marginal information of aerial photographs – Photointerpretation elements.

Unit 3: Satellite Remote Sensing: Types of satellites – Scanning systems and detectors – Outline of satellite data products – Types of sensor resolution – Sensor characteristics of Landsat, Spot, IRS series of satellites – Outline of high resolution satellites – Elements of satellite image interpretation – Outline of digital image processing techniques – Outline of GNSS, GPS and their applications.

Unit 4: Field Geology: Importance of field geology – Tasks of field geologist – Preparation for and planning of field trip – Field equipments: Clinometer Compass and Brunton Compass: working principle and uses – Elements of geological field diary – Places of importance for the field geologist – where to look for outcrops, fossils and other geological features – Detailed study of contouring, dip (true dip and apparent dip) and their relationship with strike – Influence of dip and ground slope on outcrops – True thickness and vertical thickness of beds: their measurement in the field, their relationships, their calculation from field data – Conditions that bring about repetition of outcrops.

Unit 5: Topographic features, methods of representing topography on maps – Topographic map – Marginal information of toposheets: details printed on the map, cardinal points (directions) conventional signs, scale of map, map references (indexing), orienting the map – Locating the position of outcrops on a map, plotting attitude of beds, symbols used for rock types and various structural features – Different types of field mapping techniques: quarry mapping, structural mapping and lithologic mapping – Geological maps: symbols used for various geological features – Outline on the preparation of geological map and geological field report.

Course Outcomes: On completion of the course the student would have gained knowledge on

1. To understand the processes and elements involved in electromagnetic remote sensing, electromagnetic spectrum.
2. Electromagnetic energy interaction with Earth's atmosphere and surface features, spectral reflectance curves and applications of Remote Sensing.
3. Various important aspects of Aerial Remote Sensing
4. Various important aspects of Satellite Remote Sensing.
5. Field geology techniques, measurement of geological structures, and use of field instruments.
6. Geological mapping techniques, interpretation of topographic maps, and preparation of geological reports.

Text Books:

1. **Compton, R. R (1962).** Field Geology, Wiley Publishers.
2. **Gupta, R.P (2008).** Remote Sensing Geology (II Edition), Springer Pub.
3. **Lahee, F. H (2002).** Field Geology (VI Edition), McGraw Hill Publishers.
4. **Lillesand, T.M., Keifer, R.W and J.W. Chipman (2015).** Remote Sensing and Image Interpretation, John Wiley & Sons, Inc.
5. **Pandey, S.N (1987).** Principles and Applications of Photogeology, New Age International.

Reference Books:

1. **Chuvieca, E and A. Huete (2016).** Fundamentals of Satellite Remote Sensing, Taylor & Francis Inc.
2. **Mathur, S. M (2001).** Guide to Field Geology, Prentice Hall.
3. **Sabins, F.F (2007).** Remote Sensing Principles and Interpretation (III Edition), Waveland Pr Inc.

Web Resources:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=8zYwEsyFCoiPyJlPmzHDxg==
2. Indian Space Research Organisation (ISRO) Bhuvan: https://bhuvan.nrsc.gov.in
3. NASA Earth Observatory: https://earthobservatory.nasa.gov
4. US Geological Survey (USGS) Remote Sensing: https://www.usgs.gov

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	9	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	30	18
Weightage %	20	17.5	20	22.5	12.5	7.5

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **REMOTE SENSING AND FIELD GEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY11E2	Core Course Elective	Elective Course – II GIS AND GNSS	Theory	5	4

Course Description:

This course provides an in-depth understanding of Geographic Information Systems (GIS) and Global Navigation Satellite Systems (GNSS). It covers GIS components, spatial data models, data processing, GIS analysis, and GNSS technologies, including GPS, DGPS, and their applications in geological and environmental studies.

Course Objectives: To impart knowledge on

1. The fundamentals of GIS, including its history, components, and geospatial data handling.
2. Various data models and management techniques in GIS.
3. GIS modelling, spatial interpolation, and terrain mapping techniques.
4. Applications of GIS in the field of Geosciences.
5. GNSS, its components and augmentation systems.
6. Applications of GNSS in geospatial science.

Unit 1: Introduction: History and development of GIS – Components of GIS – Coordinate systems: Geographical coordinate system and Projected coordinate system – Map projections – Geospatial data – Data input: existing GIS data, creating new data – Data query: attribute data query, spatial data query, raster data query.

Unit 2: Data Models and Management: Data format: Raster and vector data formats – Spatial data models: vector and raster data models, non-spatial data models, spaghetti model and topology models, grid model, TIN model and network model – Data collection, capture and geoprocessing: sources, input methods, editing, re-projection, geometric transformation, map scale, precision and accuracy.

Unit 3: GIS Modelling and Analysis: Basic elements of GIS modelling – Spatial interpolation: global methods, local methods, krigging method – Comparison of spatial interpolation methods – Vector data analysis: buffering and overlay – Raster data analysis: local operations, neighbourhood operations and zonal operations – Terrain mapping and analysis: DEM and TIN, contour, hill shading, slope and aspect.

Unit 4: Application of GIS: GIS for mineral exploration – GIS for hydrocarbon exploration – GIS for groundwater potential mapping – GIS for water quality evaluation – GIS for flood risk analysis – GIS for seismic zonation – GIS applications in urban planning – GIS for environmental impact analysis.

Unit 5: GPS, DGPS and GNSS: History, components, types and applications of GPS, GLONASS, GALILEO, COMPASS – System segmentation: control segment, user segment, space segment, types of receivers – DGPS: differential corrections, accuracy in DGPS – GNSS: different GNSS, GNSS augmentation – RNSS: IRNSS, WAAS, EGNOS, MSAS, QZSS, SNAS, SDCM WAGE and their advantages and disadvantages.

Course Outcomes: On completion of the course the student would have gained knowledge on

1. The fundamentals of GIS, including its history, components, and geospatial data handling.
2. Various data models and management techniques in GIS.
3. GIS modelling, spatial interpolation, and terrain mapping techniques.
4. Applications of GIS in the field of Geosciences.
5. GNSS, its components and augmentation systems.
6. Applications of GNSS in geospatial science.

Text Books:

1. **Burrough, P.A., McDonnell, R.A and C.D Lloyd (2016).** Principles of Geographical Information Systems, Oxford University Press.
2. **Heywood (2009).** An Introduction to Geographical Information Systems, Pearson Education.
3. **Hofmann-Wellenhof, B., Lichtenegger, H and J. Collins (2012).** GPS: Theory and Practice (V Revised Edition), Springer Verlag.
4. **Kang-Tsung Chang (2017).** Introduction to Geographic Information Systems, McGraw Hill Education.

Reference Books:

1. **Demers, M.N (2012).** Fundamentals of Geographic Information Systems (IV Edition), John Wiley.
2. **Kaplan, E and C. Hegarty (2006).** Understanding GPS: Principles and Applications, Artech House Inc.,
3. **Lo, C.P and A.K.W. Yeung (2016).** Concepts and Techniques of Geographic Information Systems, Pearson
4. **Rahman, A and Shahab Fazal (2017).** Global Positioning System, New Age Publishers.
5. **Tasha Wade and Shelly Sommer (2006).** A to Z GIS: An Illustrated Dictionary of GIS (II Edition), ESRI Press.
6. **Tian, B (2017).** GIS Technology Applications in Environmental and Earth Sciences, Taylor & Francis Group.

Web Resources:

1. ESRI GIS Resources: https://www.esri.com/en-us/home
2. International GNSS Service (IGS): https://www.igs.org
3. NASA GIS & Remote Sensing: https://earthdata.nasa.gov
4. National Remote Sensing Centre (NRSC), India: https://www.nrsc.gov.in
5. USGS GIS and Remote Sensing: https://www.usgs.gov/products/maps/gis-data

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	3	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	54	48	48	54	24	18
Weightage %	21.95	19.51	19.51	21.95	9.75	7.31

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	9	9	9	9	3
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **GIS AND GNSS** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GYNME2	Non-Major Elective	Non-Major Based Elective Course II GEOLOGY AND ENVIRONMENT	Theory	2	2

Course Description:

This course explores the relationship between geology and the environment, covering ecosystems, natural resources, and pollution. It examines environmental impacts due to soil erosion, landslides, earthquakes, and coastal degradation, along with human-induced environmental problems such as mining and urbanization.

Course Objectives: To impart knowledge on

1. Fundamental concepts of environment, ecosystems, and natural resources and their classification.
2. Environmental problems caused by surface geological processes such as soil erosion, landslides, and floods, along with their hazards and remediation.
3. The influence of deep-seated geological processes like earthquakes, tsunamis, and volcanic eruptions and their mitigation strategies.
4. Degradation of coastal environments, marine pollution, and conservation measures for coral reefs and mangroves.
5. Environmental impacts caused by mining activities
6. Environmental impacts of desertification, emphasizing human roles in environmental degradation.

Unit 1: Definition of environment, ecosystem and ecology – Different ecosystems – Classification of natural resources – A short account of renewable and non-renewable resources – Environmental pollution: causes and consequences with special reference to surface and groundwater – Solid waste and radioactive waste disposal.

Unit 2: Environment problems due to surface geological processes: Soil erosion: causes, hazards and remedial measures – Landslides: causes, hazards and remedial measures – Floods: causes, hazards and remedial measures

Unit 3: Influence of deep seated geological processes: Earthquake – origin, distribution, hazards and their mitigation measures – Outline of Tsunamis – Volcanoes: types, products, distribution, hazards, and their mitigation measures of volcanic eruption.

Unit 4: Degradation of coastal environment and measures for coastal protection – Marine pollution: causes, hazards and remedial measures – Environmental problems relating to coral reefs and mangroves and their conservation measures.

Unit 5: Environmental impacts associated with mining and mineral processing – Urbanisation: causes and impacts – Desertification: causes and impacts – Man as an agent for environmental degradation.

Course Outcomes: On completion of the course the student would have gained knowledge on

1. Fundamental concepts of environment, ecosystems, and natural resources and their classification.
2. Environmental problems caused by surface geological processes such as soil erosion, landslides, and floods, along with their hazards and remediation.
3. The influence of deep-seated geological processes like earthquakes, tsunamis, and volcanic eruptions and their mitigation strategies.
4. Degradation of coastal environments, marine pollution, and conservation measures for coral reefs and mangroves.
5. Environmental impacts caused by mining activities
6. Environmental impacts of desertification, emphasizing human roles in environmental degradation.

Text Books:

1. **Keller, E.A (2012).** Introduction to Environmental Geology (V Edition), Pearson Prentice Hall.
2. **Montgomery, C.W (2011).** Environmental Geology (IX Edition), McGraw-Hill Pub.

Reference Books:

1. **McConnell, R.L and D.C. Abel (2015).** Environmental Geology Today, Jones and Bartlett Learning.
2. **Reichard, J.S (2011).** Environmental Geology, McGraw Hill.
3. **Valdiya, K.S (1987).** Environmental Geology – Indian Context, Tata McGraw Hill Publications.

Web Resources:

1. https://opengeology.org/textbook/
2. https://openpress.usask.ca/physicalgeology/
3. https://www.britannica.com/science/geomorpholgy

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	3	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	54	48	48	54	24	18
Weightage %	21.95	19.51	19.51	21.95	9.75	7.31

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	3	9	9	9	3
CO5	9	9	3	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **GEOLOGY AND ENVIRONMENT** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY12	Core	STRATIGRAPHY	Theory	6	6

Course Description:

This course explores the fundamental principles of stratigraphy and its applications in understanding Earth's geological history. It covers topics such as stratigraphic classification, correlation methods, and the geological time scale. The course also delves into the stratigraphy of India, including Precambrian, Phanerozoic, Mesozoic, and Cenozoic formations, highlighting their economic significance.

Course Objectives: To impart knowledge on

1. The principles and methods of stratigraphic correlation.
2. Classification and significance of different stratigraphic sequences.
3. Physiographic and tectonic framework of India.
4. Precambrian of Tamil Nadu
5. Geological history & economic importance of Precambrian, Phanerozoic & Cenozoic formations in India.
6. Key geological events and boundary problems in Earth's history.

Unit 1: Stratigraphy – Introduction: Principles of Stratigraphy – Correlation: modern methods of stratigraphic correlation – Physical and biological criteria of correlation – Fossiliferous and unfossiliferous rocks – Classification of stratigraphic sequences/units: lithostratigraphic, biostratigraphic, chronostratigraphic, sequence stratigraphic and magneto-stratigraphic sequences/units, and their interrelationships – Physiographic divisions and tectonic framework of India: Peninsular India, Indo-gangetic alluvial plains, Extra-peninsular India – Geologic Time Scale with special reference to India.

Unit 2: Precambrian Stratigraphy: An outline on cratons, shield areas, mobile belts and platforms – Distribution and classification of Precambrian rocks of India – Dharwar Province – Eastern Ghat belt – Sausar and Sakoli Series – Archaeans of Singhbhum – Iron Ore Series and Gangpur Series – Descriptive Stratigraphy and economic importance of the Archaean and Dharwar rocks of the Peninsular India – Descriptive Stratigraphy of Aravalli and Delhi Supergroup–Descriptive Stratigraphy of Proterozoic rocks: Cuddapah and Vindhyan Super Groups – Economic importance of Precambrians – Precambrian of Tamil Nadu – Life during Precambrian – Eparchaean Unconformity.

Unit 3: Phanerozoic Stratigraphy (Palaeozoic, Mesozoic and Cenozoic): Study of stratigraphic distribution and lithology of Phanerozoic rocks of India with reference to fauna, flora and economic importance – Palaeozoic Stratigraphy: Distribution of Palaeozoic rocks in India – Cambrian of Salt Range – Age of Saline Series – Upper Carboniferous and Permian rocks of Salt Range – Haimantha system of Spiti and Kashmir – Permocarboniferous of Kashmir Valley and its equivalents from Spiti Valley and Zanskar – Umaria marine beds.

Unit 4: Mesozoic Stratigraphy: Distribution, structure, climate, the depositional environment (conditions of sedimentation), life and economic importance of Gondwana formations of India – Gondwana formations of Tamil Nadu – Mesozoic of Kashmir: Triassic of Spiti and Lilang System– Jurassic of Kutch – Cretaceous of Tiruchirappalli and Pondicherry Bagh– beds and Lameta beds – Deccan traps: distribution and structure, infratrappean and intertrappean beds and age.

Unit 5: Cenozoic Stratigraphy: Geological events of Cenozoic Era in India: Rise of Himalayas and Pleistocene glaciation – Stratigraphy, conditions of deposition, fauna and flora of Siwalik System – Tertiary and Quaternary sequences of Bengal – Tertiary formations of Assam – Karewa Series – Important Tertiary formations of South India: Cuddalore sandstone, Rajahmundry sandstone, Varkala beds and Quilon beds – Major boundary problems – Cambrian/ Precambrian and Cretaceous/ Tertiary – Mineral wealth of Tertiary formations.

Course Outcomes: On completion of the course the student would have gained knowledge on

1. The principles and methods of stratigraphic correlation.
2. Classification and significance of different stratigraphic sequences.
3. Physiographic and tectonic framework of India.
4. Precambrian of Tamil Nadu
5. Geological history & economic importance of Precambrian, Phanerozoic & Cenozoic formations in India.
6. Key geological events and boundary problems in Earth's history.

Text Books:

1. **Krishnan, M. S (2003).** Geology of India and Burma (VI Edition), CBS Publishers and Distributors.
2. **Lemon, R. Y (1990).** Principles of Stratigraphy, Merrill Publishing Co.
3. **Ramakrishnan, M and R. Vaidyanadhan (2008).** Geology of India (Vols. 1 & 2), Geological Society of India.
4. **Ravindrakumar, K. R (2018).** Fundamentals of Historical Geology and Stratigraphy of India, New Age Publishers.
5. **Selvam, T. A and K.S. Subramanian (2002).** Geology of Tamil Nadu and Pondicherry, Geol. Soc. India Publ.
6. **Wadia, D. N (1953).** Geology of India, Tata McGraw Hill Publishing Co.

Reference Books:

1. **Doyle, P and M.R. Bennett (1996).** Unlocking the Stratigraphic Record, John Wiley India Publ.
2. **Dunbar, C. O and J. Rodgers (1960).** Principles of Stratigraphy, McGraw Hill.
3. **Geological Society of India (1990).** Stratigraphic Boundary Problems in India, Memoir 16.
4. **Lemon, R. Y (1990).** Principles of Stratigraphy, Merrill Publishing Co.
5. **Naqvi, S. M and J.J.W. Rogers (1987).** Precambrian Geology of India, Oxford University Press.
6. **Valdiya, K. S (2010).** The Making of India, Macmillan India Publications.

Web Resources:

1. http://www.qsc.uh.edu/pdf/courses/Janok_AAPG_Short_Course_Notes.pdf.
2. https://www.scribd.com/doc/315335009/Geology-of-India-and-Burma-by-M-S-krishnan#.

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	3	3	3	9	3	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	24	18
Weightage %	20.51	17.94	20.51	23.07	10.25	7.69

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	3	9	9	9	3
CO5	9	9	3	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **STRATIGRAPHY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY13	Core	ECONOMIC GEOLOGY	Theory	6	6

Course Description:

This course provides an in-depth understanding of ore genesis, classification, controls of ore localisation, ore forming processes such as magmatic process, sublimation, metasomatism, hydrothermal processes, Oxidation and supergene sulphide enrichment, Metamorphic processes, Sedimentary processes and cycles, Mechanical concentration, fossil fuels, Important ores, their composition, mode of occurrences, uses and distribution in India of metalliferous deposits, industrial minerals and mineral resources of Tamil Nadu.

Course Objectives: To impart knowledge on

1. Classification of mineral deposits, controls of ore localization, metallogenetic epochs and provinces
2. Ore forming processes such as magmatic process, sublimation, metasomatism, hydrothermal processes, Oxidation and supergene sulphide enrichment, Metamorphic processes, Sedimentary processes and cycles, Mechanical concentration
3. Salient features of coal, petroleum, and nuclear minerals.
4. Important metalliferous ore deposits in India, their composition, mode of occurrence, and uses.
5. Important industrial minerals, building stones
6. Tamil Nadu's mineral wealth.

Unit 1: Definition of ore, tenor, grade and gangue – Classification of mineral deposits: outline of Lindgren's and Bateman's classification – Controls of ore localization: structural, stratigraphic, physical and chemical controls – Outline of metallogenetic epochs and provinces, geothermometry and geobarometry – Ore forming processes: Magmatic concentration: early magmatic and late magmatic processes and deposits – Sublimation – Contact metasomatic processes: process, effects and resulting mineral deposits.

Unit 2: Hydrothermal processes: principles, factors affecting deposition, wall rock alteration, minerals sequence – Cavity filling deposits: fissure veins, shear zone, stock-work, saddle reef, ladder vein, fold cracks, breccia filling, solution cavities, pore space and vesicular filling – replacement deposits, the process and deposits – criteria of replacement – Oxidation and supergene sulphide enrichment: solution and deposition in the zone of oxidation, secondary sulphide enrichments, gossans and capping – Metamorphic processes: formation of graphite, asbestos, talc, soapstone and alumino silicate group of minerals.

Unit 3: Sedimentary processes and cycles: principles involved in sedimentation, cycles of iron and manganese – Residual concentration process and deposits – Mechanical concentration process and deposits: elluvial, alluvial, beach and aeolian placers, paystreak and bonanza – Coal: classification, origin, uses and distribution of coal in India – Petroleum: composition, theories of origin and uses – Oil traps – Oil fields of India with special reference to Assam, Cambay and Cauvery basins – Outline of nuclear minerals and their distribution in India.

Unit 4: Important ores, their composition, mode of occurrences, uses and distribution in India of the following metalliferous deposits: iron, manganese, aluminium, gold, copper, chromium, lead and zinc.

Unit 5: Mineralogy, mode of occurrences, uses and distribution in India of the minerals required for the following industries: abrasives, fertilizer, paint, refractory, glass, ceramic and cement – Building stones: mode of occurrences, uses and distribution in India – Mineral wealth of Tamil Nadu.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. Classification of mineral deposits, controls of ore localization, metallogenetic epochs and provinces
2. Ore forming processes such as magmatic process, sublimation, metasomatism, hydrothermal processes, Oxidation and supergene sulphide enrichment, Metamorphic processes, Sedimentary processes and cycles, Mechanical concentration
3. Salient features of coal, petroleum, and nuclear minerals.
4. Important metalliferous ore deposits in India, their composition, mode of occurrence, and uses.
5. Important industrial minerals, building stones
6. Tamil Nadu's mineral wealth.

Text Books:

1. **Bateman Allan, M (1962).** Economic Mineral Deposits (II Edition), Asian Publishing House.
2. **Deb, S (1980).** Industrial Minerals and Rocks of India, Allied.
3. **Krishnaswamy, S (1979).** India's Mineral Resources, Oxford and IBH.
4. **Lindgren, W (1933).** Mineral Deposits, MCGraw Hill.
5. **Umeshwar Prasad (2019).** Economic Geology (II Edition), CBS Publishers.

Reference Books:

1. **Coggin, B and A.K. Dey (1955).** India's Mineral Wealth, Oxford Publishing House.
2. **Gokhale, K.V.G.K. and T.C. Rao (1978).** Ore Deposits of India, their Distribution and Processing, Thomson.
3. **Park, C.F and R.A. Macdiarmid (1970).** Ore Deposits, Freeman.

Web Resources:

1. https://www.southalabama.edu/geology/haywick/GY111/111-8.pdf
2. https://science.asu.edu.eg/ResearchGroup/storage/uploads/mediacenter/2022/t0zMG76YLufW55bJ.pdf
3. https://www.geokniga.org/bookfiles/geokniga-economic-geology-principles-and-practice-metalsminerals-coal-and-hydrocarb.pdf

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	3	3	3	9	3	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	24	18
Weightage %	20.51	17.94	20.51	23.07	10.25	7.69

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	3	9	9	9	3
CO5	9	9	3	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **ECONOMIC GEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY14	Core	MINERAL PROSPECTING AND MINING GEOLOGY	Theory	6	6

Course Description:

This course covers the fundamental principles and methodologies of geological, geophysical, and geochemical exploration, along with mining geology and underground mining techniques. It provides a comprehensive understanding of geological prospecting, mineral exploration methods, mining techniques, and their applications in the industry. The course also introduces various sampling and drilling methods, ore reserve estimation, geochemical cycles, geophysical exploration methods, and mining equipment.

Course Objectives: To impart knowledge on

1. The criteria and methodologies used in geological exploration
2. Sampling techniques and ore reserve estimation.
3. The principles and applications of geophysical exploration methods in mineral prospecting.
4. Geochemical principles, geochemical dispersion, and their application in mineral exploration.
5. Mining geology, mining terminologies, and surface mining methods.
6. Underground mining methods, stoping techniques, and coal mining processes.

Unit 1: Geological Exploration: Criteria controlling the choice of sites for geological prospecting – Geological Guides – physiographic, lithologic, structural and stratigraphic guides – Sampling methods: channel sampling, bulk sampling, pitting, trenching and core sampling – Coning and Quartering – Drilling: types of drilling methods, their applications and limitations – Ore reserve estimation.

Unit 2: Geophysical Exploration: Basic concepts of Geophysics – Principles, outline on instruments and field procedure, applications and limitations of various geophysical exploration methods: electrical (Resistivity and self-potential method) – magnetic – seismic – gravity and electromagnetic methods

Unit 3: Geochemical Exploration: Basic concepts of geochemistry – Geochemical cycle – General principles of geochemical prospecting – Geochemical dispersion – Background and threshold values – Geochemical anomalies – Path finder elements – Application of geochemistry in mineral exploration – Brief introduction to pedo-geochemical, hydro-geochemical, litho-geochemical and bio-geochemical methods – Outline on geobotanical indicators.

Unit 4: Mining Geology: Role of geologist in mining – Mining terminologies: shaft, adit, roof, drive, crosscut, tunnel, raise, winze and stope – Mining methods: surface methods, alluvial mining – pan andbetea, sluicing, hydraulicking and dredging – Opencast mining – benches, explosives, and working slope – Mining equipments: dragline, power showels, bucket wheel excavators, conveyor and overburden.

Unit 5: Underground mining: advantages and limitations – Stoping: open stoping, supported stoping (pillar-supported, square-supported and timber-supported stoping), filled stopes, shrinkage stopes, shaft sinking, caving, top slicing, sublevel caving and block caving – Coal mining: Surface mining (strip mining and augering), Underground mining (room and pillar method, longwall method).

Course Outcomes: On completion of the course the student would have gained knowledge on

1. The criteria and methodologies used in geological exploration
2. Sampling techniques and ore reserve estimation.
3. The principles and applications of geophysical exploration methods in mineral prospecting.

4. Geochemical principles, geochemical dispersion, and their application in mineral exploration.
5. Mining geology, mining terminologies, and surface mining methods.
6. Underground mining methods, stoping techniques, and coal mining processes.

Text Books:

1. **Arogyaswamy, R.N.P (1986).** Courses in Mining Geology, Oxford & IBH Publishing Co.
2. **Hawkes, H.E and J.S. Webb (1980).** Geochemistry in Mineral Exploration, Harper & Row.
3. **Lowrie, W (1997).** Fundamentals of Geophysics, Cambridge.
4. **Mason, B (1966).** Principles of Geochemistry, Willey Toppan.
5. **McKinstry, H. E (2000).** Mining Geology, Asia Publishing House.
6. **Ramachandra Rao, M. B (1975).** Outlines of Geophysical Prospecting - A manual for Geologist, English Book Depot.

References Books:

1. **Dobrin, M.B (1981).** Introduction to Geophysical Prospecting, McGraw Hill International Book Company.
2. **Kearey, P and M. Brooks (1984).** An Introduction to Geophysical Exploration, ELBS.
3. **Mathur, S.M (2001).** Guide to Field Geology, Prentice Hall of India.
4. **Robinson, E. Sand C. Coruh (2002).** Basic Exploration Geophysics, John Wiley.
5. **Sinha, R.K (2000).** Mineral Economics, Oxford & IBH Publishing Co.
6. **Thamus, P.J (1979).** An Introduction to Mining, Methun.

Web Resources:

1. https://www.usgs.gov/
2. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/geophysical-exploration
3. https://www.elsevier.com/books/geochemistry-in-mineral-exploration/rose/978-0-12-596251-0

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	3	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	24	18
Weightage %	20.51	17.94	20.51	23.07	10.25	7.69

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	3	9	9	9	0
CO5	9	9	3	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **MINERAL PROSPECTING AND MINING GEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY15P	Core	PRACTICAL IV ECONOMIC GEOLOGY, MINING GEOLOGY AND HYDROGEOLOGY	Theory	6	6

Course Description:

This practical course provides an in-depth understanding of economic geology, mining geology, and hydrogeology. It covers the identification of ore and industrial minerals based on megascopic properties, blowpipe tests, ore reserve calculation using the included area method, and interpretation of hydrogeological data. The course is designed to impart practical skills necessary for the exploration, evaluation, and sustainable management of mineral and water resources.

Course Objectives: To impart knowledge on

1. The megascopic characters of ore minerals
2. The megascopic characters of
3. Identification of mineral powder using simple blow pipe tests
4. Estimation of ore reserves
5. Interpreting rainfall data and hydrogeological data
6. Interpretation of hydrochemical, recharge, and discharge data.

1. Economic Geology:

1.1 Identification of the following ore and industrial minerals from the study of their megascopic properties.

Realgar, Orphiment, Stibnite, Molybdenite, Galena, Sphalerite, Cinnabar, Covelite, Bornite, Chalcophyrite, Pyrite, Arsenopyrite, Marcasite. Barite, Celestite, Gypsum. Cuprite, Zincite, Corundum, Hematite, Ilmenite, Magnetite, Chromite, Franklinite, Cassiterite, Pyrolusite, Psilomelane, Limonite, Bauxite, Calcite, Magnesite, Siderite, Witherite, Strontionite, Cerussite, Azurite, Malachite, Chrysocolla, Columbite, Fluorite, Phosphatic Nodule, Graphite, Lignite, Bituminous and Anthracite.

1.2 Identification of minerals using simple blow pipe tests of the respective powder

Apatite, Barite, Calcite, Celestite, Cerusite, Chalcopyrite, Galena, Gypsum, Haematite, Magnetite, Magnesite, Psilomelane, Pyrolusite, Siderite, Sphalerite, Strontianite and Witherite.

2. **Mining Geology:** Calculation of ore reserves – Included area method.

3. **Hydrogeology:**

Simple problems relating to interpretation of rainfall data, hydrogeological data, hydrochemistry, recharge and discharge.

Course Outcomes

1. The megascopic characters of ore minerals
2. The megascopic characters of
3. Identification of mineral powder using simple blow pipe tests
4. Estimation of ore reserves
5. Interpreting rainfall data and hydrogeological data
6. Interpretation of hydrochemical, recharge, and discharge data.

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	3	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	24	18
Weightage %	20.51	17.94	20.51	23.07	10.25	7.69

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	9	3	9	9	9	3
CO5	9	9	3	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

The Cos and Pos for the **PRACTICAL IV ECONOMIC GEOLOGY, MINING GEOLOGY AND HYDROGEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY16E1	Core Course Elective	Elective Course – III HYDROGEOLOGY AND ENGINEERING GEOLOGY	Theory	5	4

Course Description:

This course provides a comprehensive study of groundwater, its origin, movement, occurrence, and quality. It also explores engineering geology principles, geological investigations, and geotechnical applications in civil engineering projects such as dams, tunnels, and coastal protection structures.

Course Objectives: To impart knowledge on

1. Hydrologic cycle, groundwater origin, movement, and measurement of permeability.
2. About aquifers, groundwater distribution, quality, and exploration methods.
3. Natural and artificial discharge, and well hydraulics
4. Groundwater recharge, and saltwater intrusion.
5. The Principles of Engineering Geology, rock and soil properties, and geological considerations in construction.
6. Gain insights into geological investigations for dams, tunnels, and mass-movement mitigation strategies.

Unit 1: Hydrologic cycle – Origin of groundwater: meteoric water; connate water and juvenile water – Hydrological properties of geological formations: porosity, permeability, hydraulic conductivity, transmissivity, specific retention, specific yield, specific capacity – Porosity: primary and secondary porosities, void ratio, effective porosity – Water flow: laminar flow and turbulent flow – Forces causing groundwater movement: Potential energy and hydraulic head, direction of ground water flow – Darcy's law – Measurement of permeability: laboratory methods and field methods.

Unit 2: Definition of aquifers, aquitards, aquifuges and aquicludes – Vertical distribution of groundwater: zone of aeration, zone of saturation, water table and peizometric surface – Types of aquifers: unconfined, confined, and perched aquifers – Occurrence of groundwater in commonly occurring rocks – Groundwater quality: physical, chemical and biological qualities – Latest WHO & BIS Drinking water standards – Groundwater exploration: Outline of surface methods and subsurface methods, principles and methods of electrical resistivity for ground water exploration.

Unit 3: Natural discharge of ground water: springs, hot springs, geysers, artesian wells and seepage – Geological conditions favouring development of springs – Artificial discharge of ground water: Water wells and types of water wells – Pumping from wells and cone of depression – Outline on pumping test parameters – Well hydrographs – Groundwater recharge: natural and artificial recharge – Rain water harvesting – Fluctuations in Groundwater levels: causes and effects of fluctuations – Salt water intrusion: causes, effects and control.

Unit 4: Principles of Engineering Geology – Role of Geologists in Civil Engineering – Engineering properties of rocks and soils – Strength and elastic properties – Geologic considerations and physical characteristics of building stones, concrete aggregates and rail road ballasts – Rock as construction material – Geological investigations pertaining to the foundation and development of roads/highways, Railways (rail tracks), bridges and buildings.

Unit 5: Types of Dams – Geological investigations for dam sites and reservoirs – Problems relating to spillways and sluiceways – Geological investigations preceding tunneling in hard and soft grounds – Geological investigations pertaining to coastal protection structures for control or preventive measures of coastal erosion – Geological and geotechnical investigations for the mitigation strategies of mass-movements with special emphasis on landslides – Outline on geosynthetics.

Course Outcomes: On completion of the course the student would have gained knowledge on

1. Hydrologic cycle, groundwater origin, movement, and measurement of permeability.
2. About aquifers, groundwater distribution, quality, and exploration methods.
3. Natural and artificial discharge, and well hydraulics
4. Groundwater recharge, and saltwater intrusion.
5. The Principles of Engineering Geology, rock and soil properties, and geological considerations in construction.
6. Gain insights into geological investigations for dams, tunnels, and mass-movement mitigation strategies.

Text Books

1. **Bell, F. G (1983).** Fundamentals of Engineering Geology, Butterworths.
2. **Blyth, F. G. H and M.H. De Freitas (1984).** Geology for Engineers (VII Edition), Butterworth-Heinemann.
3. **D.K. Todd (2005).** Groundwater Hydrology, Wiley India Pvt. Ltd.
4. **Parbin Singh (2003).** Engineering Geology and General Geology, S. K. Kataria& Sons.
5. **Raghunath, H.M (2007).** Groundwater, Wiley Eastern Limited.
6. **Ramakrishnan S (1998).** Groundwater, KJ Graphs Arts.
7. **Sathyanarayanaswami, B. S (2000).** Engineering Geology, DhanpatRai& Co.
8. **Venkat Reddy, D (2010).** Engineering Geology, Vikas PublishingHouse Pvt. Ltd.

Reference Books

1. **Fetter C.W (2007).** Applied Hydrogeology, CBS Publishers.
2. **Gokhale N.W (2009).** All about Water, CBS Publishers.
3. **Gokhale, K.V.G.K and D.M. Rao (1981).** Experiments in Engineering Geology, McGraw Hill.
4. **Krynine, D.P and W.R. Judd (1957).** Principles of Engineering Geology and Geotechniques, McGraw Hill.
5. **Legget, R F (1962).** Geology and Engineering, McGraw Hill.
6. **Maslov, N.N (1987).** Basic Engineering Geology and Soil Mechanics, Mir Publishers.
7. **Murthy, V.N.S (2018).** Soil Mechanics and Foundation Engineering, CBS Publishers and Distributors Ltd.
8. **Pandey, V.K and A. Mishra (2017).** Handbook of Engineering Geology, CBS Publishers & Distributors Pvt. Ltd.
9. **Ries, H and T.L Watson (2016).** Elements of Engineering Geology. Wentworth Press.

Web Resources

1. http://opac.vimaru.edu.vn/edata/EBookManual_of_applied_Field_Hydrogeology.pdfhttps://water.usgs.gov/ogw/pubs/TWRI3-B2/TWRI3-B2-with-links.pdf
2. http://unesdoc.unesco.org/images/0013/001344/134432e.pdf
3. http://www.basichydrogeology.com/HydrogeologyLectureNotes-v2.3-LR.pdf

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	9	9	3	3
CO2	9	9	9	9	3	3
CO3	9	9	9	9	3	3
CO4	9	3	3	9	3	3
CO5	9	9	9	9	3	3
CO6	9	9	9	9	9	3
Total	48	42	48	54	24	18
Weightage %	20.51	17.94	20.51	23.07	10.25	7.69

Course Outcomes Mapped with Knowledge Levels:

CO / K-Level	K1	K2	K3	K4	K5	K6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	3	9	9	9	3	3
CO5	9	9	3	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
K1	2	1	1	1	5	-	5	20%
K2	1	2	1	1	5	-	5	20%
K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **HYDROGEOLOGY AND ENGINEERING GEOLOGY** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**

Programme Code	Course Code	Course Type	Course Title	Category	Hrs / Week	Credits
GEOUG1961	U25GY16E2	Core Course Elective	Elective Course – III GEOEXPLORATION	Theory	5	4

Course Description:

This course provides an in-depth study of geological, geophysical, and geochemical exploration techniques used in mineral prospecting. It covers site selection, sampling methods, drilling techniques, geophysical anomalies, geochemical dispersion, and interpretation of anomalies. The course also explores various field and laboratory techniques essential for resource exploration.

Course Objectives: To impart knowledge on

1. Guides to ore search, various sampling and drilling methods
2. The fundamental concepts and applications of geophysical exploration methods.
3. Various geophysical exploration techniques, instruments, and their applications.
4. The principles of geochemical exploration
5. Geochemical cycles and anomalies.
6. Interpreting geochemical anomalies and understand different geochemical methods.

Unit 1: Geological Exploration: Criteria controlling the choice of sites for geological prospecting – Guides to ore search – Sampling: definition of a sample – sample requirement as to the size, purity, contamination, packing – Types of samples: chip samples, muck samples, car samples, channel samples, grid samples – Sampling methods: channel sampling, bulk sampling, pitting and trenching the ore bodies, drill-hole or core sampling – Coning and quartering – Drilling: Various types of drilling methods, their applications and limitations – Applications of sampling.

Unit 2: Geophysical Exploration: Basic philosophy of the methods of geophysical prospecting – Natural and artificial fields – Physical, Electrical, Magnetic and Radioactive properties of rocks and minerals related to geophysics – Geophysical anomalies: regional and local anomalies.

Unit 3: Geophysical Exploration: Principles, instruments, field procedures, applications and limitations of electrical, magnetic, seismic, gravity and radioactive methods of geophysical exploration.

Unit 4: Geochemical Exploration: Principles of geochemical prospecting – Origin and abundance of elements in the earth's crust – Geochemical cycle – Geochemical dispersion: Primary dispersion and secondary dispersion – Background values, threshold values and geochemical anomalies

Unit 5: Geochemical Exploration: Interpretation of geochemical anomalies – Key and path finder elements – Geothermometry and geothermobarometry – Introduction to pedogeochemical, hydrogeochemical, lithogeochemical and biogeochemical methods – Geobotanical indicators.

Course Outcomes (COs): On completion of the course the student would have gained knowledge on

1. Guides to ore search, various sampling and drilling methods
2. The fundamental concepts and applications of geophysical exploration methods.
3. Various geophysical exploration techniques, instruments, and their applications.
4. The principles of geochemical exploration
5. Geochemical cycles and anomalies.
6. Interpreting geochemical anomalies and understand different geochemical methods.

Text Books:

1. **Dhanaraju, R (2009).** Handbook of Mineral Exploration and Ore Petrology: Techniques and Applications, Geological Society of India.
2. **Mason, B and C.B. Moore (1991).** Introduction to Geochemistry, Wiley Eastern.
3. **Misra, K. C (2012).** Introduction to Geochemistry: Principles and Applications, Wiley-Blackwell.
4. **Ramachandra Rao, M. B (1975).** Outlines of Geophysical Prospecting - A Manual for Geologist, English Book Depot.
5. **Solovov, A. P (1987).** Geochemical Prospecting, Mir Publishers, Moscow.

References Books:

1. **Dobrin, M. B (2001).** Introduction to Geophysical Prospecting, McGraw Hill Inc.
2. **Faure, G (1998).** Principles and Applications of Geochemistry, Prentice Hall.
3. **Kovalevskll, A. L (1987).** Biogeochemical Exploration for Mineral Deposits, VSP Publishers.
4. **Krauskauf, B. K (1988).** Introduction to Geochemistry (II Edition), McGraw-Hill Book Company.
5. **Kreiter, V. M (2004).** Geological Prospecting and Exploration, University Press of the Pacific.
6. **Lowrie, W (1997).** Fundamentals of Geophysics, Cambridge.
7. **Marjoribanks, R (2010).** Geological Methods in Mineral Exploration and Mining (II Edition), Springer.
8. **Moon, C. J., Whateley, M. K. G. and A. M.Evans (2006).** Introduction to Mineral Exploration (II Ed.).

Web Resources:

1. https://ocw.mit.edu/courses/12-201-essentials-of-geophysics-fall-2004/pages/lecture-notes/
2. https://ocw.mit.edu/courses/12-201-essentials-of-geophysics-fall-2004/
3. https://www.freebookcentre.net/physics-books-download/Introduction-to-Geophysics-LectureNotes.html

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
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CO2	9	9	9	9	3	3
CO3	9	9	9	9	9	3
CO4	3	9	3	9	9	0
CO5	9	9	9	9	9	9
CO6	9	9	9	9	9	9

Legend: 1 – Low, 3 – Medium, 9 – High, 0 – No Correlation

Course Outcome (CO) Attainment Assessment Tools & Evaluation:

K Levels	T1	T2	Assignment	Seminar	Total Scholastic Marks	Non Scholastic Marks	CIA Total	% of Assessment
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K3	1	1	1	1	4	-	4	16%
K4	1	1	1	1	4	-	4	16%
K5	-	1	-	1	2	-	2	8%
K6	-	-	-	-	-	-	-	-
Non Scholastic	-	-	-	-	-	5	5	20%
Total	**5**	**6**	**4**	**5**	**20**	**5**	**25**	**100%**

The Cos and Pos for the **GEOEXPLORATION** course in the B.Sc. Geology Programme is effectively matched by the Course In-charge.

Signature of the Course In-charge **Signature of the HoD**