B. Sc. Geology

Syllabus

AFFILIATED COLLEGES

Program Code:

2021 – 2022 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A" Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking: Times -801-1000,Shanghai -901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **B.Sc. Geology students program educational objectives are as follows**	
PEO1	Provide basic knowledge of different branches of Geology at graduate level.
PEO2	Understand the Earth and its various processes, both external and internal that shape it.
PEO3	Assess the Earth as source of natural resources such as water, minerals, rocks, ores, coal and oil and devise ways and means to extract these for benefit of mankind.
PEO4	Realize the threat of natural disasters and and work out ways to mitigate its effects.
PEO5	Recognize the Earth as an environmental realm and chalk out plans for conserving its resources.

Program Specific Outcomes (POs)	
On successful completion of the B Sc. Geology program	
PSO1	The student gains insight into both subjects by combining theory with practical observation.
PSO2	This expertise may be used in field geology and laboratory studies of minerals The student gains insight into the principles of Stratigraphy and Indian Geology.
PSO3	This knowledge is useful for field geology, mineral exploration, oil exploration, and tectonics
PSO4	The student gains useful insight into the methods of mineral identification..

Program Outcomes (POs)	
After the successful completion of B.Sc. Geology program, the students are expected to	
PO1	To familiarize students with the concepts of physical geology and also to learn about various processes operational in and on the earth
PO2	The student gains useful insight and understanding of the earth's surface and the structures it contains through geomorphology and structural geology.
PO3	The student is introduced to the basic knowledge relevant to geological maps. Practical exercises emphasize the use of compasses
PO4	The student gains insight and an informed awareness of natural disasters for future safety measures and preparedness
PO5	The student gains insight into the basic principles of hydrogeology
PO6	Map drawing exercises emphasize the use of completed geological maps to decipher the underlying structure and different methods of solving them.
PO7	The student gains knowledge in Palaeontology ,
PO8	The student gains insight into the methods of gemstone identification and exploration. This expertise may be useful in the particular field of gemmology the student wishes to pursue for employment.
PO9	The student gains insight into the basic principles of economic geology and mineral economics and gains insight into the basic principles of mining geologyThe student gains insight into the basic principles of exploration and mineral fuels.
PO10	The student gains insight into the basic principles of engineering geology, computer application in geology, and geostatisticsMegascopic Identification of rock forming silicate on the basis of their physical propertie

BHARATHIAR UNIVERSITY::COIMBATORE 641 046
B. Sc. GEOLOGY Course Title (CBCS PATTERN)
(*For the students admitted from the academic year **2021-2022** and onwards*)
Scheme of Examination

Part	Title of the Course	Hours/ Week	Examination				Credits
			Duration in Hours	Maximum Marks			
				CIA	CEE	Total	
	Semester I						
I	Language - I	6	3	50	50	100	4
II	English - I	6	3	50	50	100	4
III	Core Paper I Physical Geology	6	3	50	50	100	4
III	Core Practical I Structural Geology and Surveying	3	-	--	--	--	--
III	Allied A: Paper I Chemistry	5	3	50	50	100	4
III	Allied Practical I Chemistry (Practical)	2	--	--	--	--	--
IV	Environmental Studies*	2	3	--	50	50	2
	Total	**30**		**200**	**250**	**450**	**18**
	Semester II						
I	Language – II	6	3	50	50	100	4
II	English – II	6	3	50	50	100	4
III	Core Paper II Geomorphology and Structural Geology	6	3	50	50	100	4
III	Core Practical I Structural Geology and Surveying	3	3	50	50	100	4
III	Allied A: Paper I Chemistry	5	3	30	45	75	3
III	Allied Practical I Chemistry (Practical)	2	3	30	45	75	3
IV	Value Education – Human Rights*	2	3	--	50	50	2
	Total	**30**		**260**	**340**	**600**	**24**
	Semester III						
I	Language – III	6	3	50	50	100	4
II	English – III	6	3	50	50	100	4
III	Core Paper III Palaeontology	5	3	50	50	100	4
III	Core Practical II Palaeontology and crystallography	2	--	-	--	--	--
III	Allied B: Paper I Physics	4	3	30	45	75	3
III	Allied Practical I Physics (Practical)	2	--	--	--	--	--
IV	Skill based Subject: Field Geology	3	3	30	45	75	3
IV	Tamil** / Advanced Tamil* (OR) Non-major elective - I (Yoga for Human Excellence)* / Women's Rights*	2	3	--	50	50	2
	Total	**30**		**210**	**290**	**500**	**20**
	Semester IV						
I	Language – IV	6	3	50	50	100	4
II	English – IV	6	3	50	50	100	4
III	Core Paper IV Crystallography and optical mineralogy	5	3	50	50	100	4
III	Core Practical II Palaeontology and crystallography	2	3	50	50	100	4

III	Allied B: Paper I Physics	4	3	30	45	75	3
III	Allied Practical Physics	2	3	30	45	75	3
IV	Skill based Subject 2:Natural Disaster management	3	3	30	45	75	3
IV	Tamil**/Advanced Tamil* (OR) Non-major elective -II (General Awareness*)	2	3	--	50	50	2
	Total	**30**		**290**	**385**	**675**	**27**
	Semester V						
III	Core Paper V Mineralogy	5	3	50	50	100	4
III	Core Paper VI Stratigraphy and Indian Geology	5	3	50	50	100	4
III	Core Paper VII Igneous and metamorphic petrology	5	3	50	50	100	4
III	Core Paper VIII Hydrogeology	5	3	50	50	100	4
III	Core Practical III Mineralogy and Petrology	3	--	--	--	--	--
III	Elective I Remote Sensing	4	3	50	50	100	4
IV	Skill based Subject 3: Gemmology	3	3	30	45	75	3
	Total	**30**		**280**	**295**	**575**	**23**
	Semester VI						
III	Core Paper IX Sedimentary petrology and environmental geology	4	3	50	50	100	4
III	Core Paper X Economic geology	5	3	50	50	100	4
III	Core Practical III Mineralogy and Petrology	3	3	50	50	100	4
III	Elective II Mining Geology and Ore Dressing	5	3	50	50	100	4
III	Elective III Exploration geology and mineral fuels	5	3	50	50	100	4
III	Core Practical -economic minerals and field geology practials	3	3	30	45	75	3
IV	Skill Based Subject 4 Engineering Geology, Computer applications in Geology and Geostatistics	5	3	30	45	75	3
V	Extension Activities**	--	--	50	--	50	2
	Total	**30**		**360**	**340**	**700**	**28**
	Grand Total			**1600**	**1900**	**3500**	**140**

Note

* No Continuous Internal Assessment (CIA). Only University Examinations.
** No University Examinations. Only Continuous Internal Assessment (CIA).

First Semester

Course code		TITLE OF THE COURSE	L	T	P	C
Core		PHYSICAL GEOLOGY	80	75	5	0
Pre-requisite		Basic scientific knowledge in the +2 level	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Geology is the study of the Earth as a whole.
2. Physical Geology introduces different topics which define geology as a branch of Physical Geology.
3. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To familiarize students with the concepts of physical geology	K1
2	Learn about various processes operational in and on the earth	K2
3	The student will have an understanding about the age of the Earth	K3
4	The student will be able to identify the causes of Earthquake and about it forecasting	K2
5	The student will have understanding about Volcanoes	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction to Geology	15 hours

– Branches and applications of Geology.

Solar System: Definition – A brief outline of: Planets – Satellites – Comets – Asteroid belt and asteroids – Meteorites. Kepler's Laws of Planetary Motion – Bode's Law.Origin of the Solar System: Planetesimal Model – Tidal Model – Nebular and Gas Cloud Models.

Age of the Earth- Direct Methods: Introduction to radioactivity – Radioactive minerals - Radioactive decay and isotopes-Concept of half life - Parent and Daughter elements. Outline and application of:U - Pb method; K - Ar method; Rb - Sr method and C^{14} method. Relative dating methods: - Cross cutting relations - Unconformable surfaces - Changes in lithology - Superposition of beds. **Indirect Methods:** - Short outline of glacial and lacustrine varves - tree rings - ocean salinity.

Short account of Earth parameters: Size, shape, rotation, revolution – Milankovitch cycle - perigee and apogee positions.

Unit:2	Interior of the Earth and Earth quakes	15 hours

Interior of the Earth: Internal structure of the Earth: Crust - Mantle - Core. Brief account of seismic boundaries and discontinuities - shadow zones.

Earthquakes: Definition of Earthquake – Seismic waves: types – basic properties - generation of seismic waves in the earth. Location of EQs: focus (hypocentre) - epicentre. Magnitude and intensity of EQs –A brief introduction to seismogram and seismograph. The causes of EQs. The prediction of EQs and remedial measures. A brief introduction of Seismic zones and Indian EQs. - **Tsunamis & Seiche Waves:**Definition - Types - Generation - Remedial measures. A brief outline of Indian Tsunamis.

Unit:3	PLATE TECTONICS AND CONTINENTAL DRIFT	15 hours

Continental Drift: Definition - Evidences - Mechanisms - Wegener's and Taylor's idea of continental drift. - **Sea floor spreading:**Definition - mechanism - evidences.

Plate Tectonics: Concept of plate tectonics - Types of plates - Major and Minor plates - plate movement and their causes - plate boundaries: convergent,divergent,& transform. Brief account of features related to plate tectonics: Island Arcs - Folded Mountain chains - Subduction zones - Trenches - Rift and ramp valleys - Ring of Fire. A Short account of volcanic and earthquake belts as related to plate tectonics.

Unit:4	VOLCANOES AND MOUNTAINS	15 hours

Unit IV

Volcanoes: Definition of volcano and lava – Types of volcanoes – Volcanic products – Causes of Volcanism – Styles of volcanic eruption – Types of volcanic eruption – Prediction of volcanic eruptions. Volcanic landforms: craters - lava flows – pillow lava – domes – columnar lava structures. Distribution of volcanoes - Examples of Indian volcanoes.
Atmosphere: Definition - vertical extent - layers - composition - temperature variation - generation of wind on earth's surface.
Mountains: Definition of Mountain – Types and classification of Mountains – Origin of Mountains – Distribution of mountains in Indian sub continent.**Isostasy:**Concept of Isostasy - Models of Isostasy: Airy's model - Pratt's model.

Unit:5	PLATEAUS, PLAINS RIVERS AND LAKES	15 hours

Plateaus and plains : Definition - characteristics and types of plateaus and plains – Short account of Deccan Plateau. **Weathering:** Definition - processes: erosion - transport - deposition. Agents of weathering. Types of weathering: physical - chemical - biological. Factors affecting weathering. O17ine of products of weathering: sediments - soil - regolith.
Rivers: Definition – origin – types of streams – stages of rivers – deltas and alluvial fans.
Lakes: Definition – Types of Lakes – Formation of Lakes – deltas and deposits.

Unit:6	Contemporary Issues	5hours

Suggested Group Work/Tasks: Field excursion is suggested under proper supervision and with the submission of a field report.

	Total Lecture hours	80 hours

Text Book(s)

1 **1. Holmes,A&P.L.Duff.**(1996). Principles of Physical Geology, 4 th revised edition,ELBS,London
2. Radhakrishnan,V. (1996). General Geology, V.V.P. Publishers,Tuticorin.
3. Mahapatra,G.P. (1994). Physical Geology,CBS Publishers,New Delhi.
4. Mahapatra,G.P. (1992). Textbook of Geology,CBS Publishers,New Delhi.
14. Earth Materials 2010 by Kevin Hefferan and John O′Brien

Reference Books

1
1. **Emiliani,C.(1992).** Planet Earth, Cambridge University Press, Delhi.
2. **Porter,S.C. &B.J. SkinnerJ.** (1995). The Dynamic Earth, John Wiley & Sons, New York.
3. **Leet,D& Judson,S** (1987). Physical Geology,McGraw Hill. New Jersey.
4. **Zumberge,J.(**1980). Physical Geology, Freeman, New York.
5. **Patwardhan,A.M.** (1999). Dynamic Earth System,Prentice Hall, New Delhi.
6. **Dasguptha,A.B.** (1978). Physical Geography,CBS Publishers,Delhi.
7. **Mukherjee,A.K.** (1990). Principles of Geology,EW Press,Kolkata.
8. **Reed,J.S. & T.H. Wicander.**(2005). Essentials of Geology, McGraw Hill., New York.
9. **Skinner, B.J., Porter, S.C., Park, J.J. and Levin, H.L., 2004**. Dynamic Earth: An introduction
to physical geology.

Related Online Contents.]

1 https://opentextbc.ca/geology/
https://geo.libretexts.org/Bookshelves/Geology/Book%3A_Physical_Geology_(Earle)
Assignments: Any two assignments (within the five units) may be suggested by the Teacher.
Suggested Group Work/Tasks: Field excursion is suggested under proper supervision and with the submission of a field report

Course Designed By: Dr. J. Ebanasar

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	M	M	L	L	L	L
CO2	S	S	M	M	M	M	L	L	L	L
CO3	S	S	M	M	M	M	L	L	L	L
CO4	S	S	M	M	M	M	L	L	L	L
CO5	S	S	M	M	M	M	L	L	L	L

*S-Strong; M-Medium; L-Low

Second Semester

Course code		PAPER II - GEOMORPHOLOGY AND STRUCTURAL GEOLOGY	L	T	P	C
Core/Elective/Supportive		CORE	80	75	5	0
Pre-requisite		Basic Knowledge on physical geology	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. To understand Geomorphology which is the study of different landforms and their evolution on the earth's surface. Structural Geology is the study of different structures in crustal rocks derived from different forces active on and within the earth's crust.
2. The teaching and learning methodology involves class lectures, practical and laboratory demonstrations with equipment available

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain useful insight and understanding of the earth's surface and the structures it contains through geomorphology and structural geology.	K2
2	Understand Land Forms Created By Glaciers and rivers	K1
3	Able to identify rock joints	K3
4	The student will have an idea about ground water	K2
5	The student will understand about sedimentary beds	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Concept of Geomorphology	15 hours

Concept of Geomorphology: Geomorphic cycles. A brief account of first order, second order, and third order landforms. **Land forms created by Wind:** Erosion and deflation: features produced by erosion and deflation. Abrasion – features produced by abrasion. Attrition: features produced by attrition. Transportation: suspension, saltation, and surface. Deposition: loess, sand deposits. Sand dunes and their types. .

Unit:2	Land Forms Created By Rivers and underground water	15 hours

Land Forms Created By Rivers: Erosion processes, erosional features: Potholes, Waterfalls, River valleys, Gorges, Canyons, Escarpments, Hogback, Cuesta, Mesa, Butte, Peneplain, Pediments, River terraces, Badlands. Transportation – Deposition: Depositional features: Alluvial fans, and cones, Flood plains, Meanders, Ox – bow lakes, Braided rivers, and Delta. Cycle of erosion, River patterns, Drainage patterns. O17ine of Rivers of India with special reference to Tamil Nadu. **Land Forms derived from Underground Water:** Definition of groundwater. Groundwater zones. Factors controlling groundwater movement. Sources of groundwater. Erosional features of groundwater: dolines, sink, caverns, solution valley, stylolite, depositional features: stalactites, stalagmites, siliceous sinter and travertine, geode, and concretionary structures

Unit:3	Land Forms Created By Glaciers and oceans	15 hours

Land Forms Created By Glaciers: Definition of glaciers, formation of glaciers, movement of glaciers. Types: valley glaciers, piedmont glaciers, continental glaciers, Surface features of glaciers. Glacial action: Erosion: plucking, rasping, avalanche, erosional features produced by valley glaciers: cirque, horn, glacial trough, hanging valleys, truncated spurs, glacial boulders, glacial scars, roches

mountonnees, fjords. Depositional Features produced by continental ice sheets: crescentic gorges; drumlins. **Land Forms Created by Ocean:** Shore profile and shoreline development: continental shelf, continental slope, continental rise; Ocean floor-Marine erosion, Features formed by marine reefs – deep sea deposits, abyssal deposits, polygenic sediments, volcanogenic sediments, o17ine of mid oceanic ridges and submarine canyons. Outline of Geomorphology of Tamil Nadu.

Unit:4	**Introduction and scope of Structural Geology**	**15 hours**

Introduction and scope of Structural Geology. Cardinal directions of a compass – whole circle and quadrant. Magnetic and true North. **Rock outcrops**: definition, types: sedimentary, igneous and metamorphic. **Orientation of rock outcrops**: strike – trend. **Tilt of rock outcrops**: Dip, apparent dip and plunge. **Sedimentary beds**: definition and types. Surficial structures of sedimentary beds: ripple marks, mud cracks, and rain imprints. Trends of outcrops – Contours - Topographic and Geological maps. **Concordant bodies**: Sills – Laccoliths – Lopoliths and Phacoliths. **Discordant bodies**: Dykes – Volcanic vents – Batholiths and stocks. Lava flows - Pillow lava structure.

Unit:5	**ROCK JOINTS AND FOLDS**	**15- hours**

Rock Joints: Definition – types – classification – o17ine of genesis. **Foliation and Lineation**: Definition of foliation and lineation - Brief account of common types of foliations and lineations. **Faults**: Definition and parts of a fault. Types – Geometric and genetic classification of faults – Horst and Graben – Criteria for recognition of faults in the field. **Folds**: Definition and parts of a fold - Geometry of folds – Classification – Plunging of folds – Anticlinorium - Synclinorium – o17iers and inliers - recognition of folds in the field and on the map. **Unconformity**: Types and geological significance of unconformities – Recognition of unconformities in the field and on a map

Unit:6	**Contemporary Issues**	**5 hours**

Additional Resources: The student may consult the Class Teacher for additional web resources and related materials. Other related materials are available in CD/DVD format .**Assignments:** Any two assignments may be suggested by the Teacher.

Suggested Group Work/Tasks: Field visit to known areas is suggested under proper supervision and with the submission of a field report.

	Total Lecture hours	**80 hours**

Text Book(s)

1

1. Worcester,P.G.(1960), A Text Book of Geomorphology, East West Press Ltd.Delhi.

2. Radhakrishnan ,V. (1996), General Geology, V.V.P. Publications, Tuticorin.

3. Mahapatra, G.B. (1994), Text book of Physical Geology, CBS publications, Delhi.

4. Singh,S. (2007) Geomorphology. S. Chand & Co.Delhi.

5. Bloom, A. (1985), Principles of Geomorphology, Prentice Hall of India, Delhi.

6. Billings,M.P. (1974) Structural Geology. Prentice Hall of India Ltd. New Delhi.

7. Sathya Narayanaswami,B.S. (1994). Structural Geology. Dhanpat Rai & Sons. New Delhi.

8. Eldridge.M.Moores (2007). Structural Geology, W.H.Freeman and Company, 695p

Reference Books

1

1. **Gokhale,N.W.** (1995), Theory of Structural Geology, CBS, Delhi.
2. **Davis,G.H.** (1985). Structural Geology of Rocks and Regions. Elements of Structural geology, Wiley.
3. **1Hills,E.S.** (1963). Elements of Structural Geology, Chapman & Hall. London.

4. **Ragan, D.M.,**(2000).Structural Geology-An Introduction to Geometrical Techniques.Wiley.New York.
5. **Park,P.G.**(1983).Foundations of Structural Geology,Blackie.London.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://en.wikipedia.org/wiki/Geomorphology
https://www.youtube.com/watch?v=5ieigKikIRY

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	S	S	S	S	L	L	L	L
CO2	M	M	S	S	M	M	L	L	L	L
CO3	M	M	S	S	M	M	L	L	L	L
CO4	M	M	S	S	M	M	L	L	L	L
CO5	M	M	S	S	M	M	L	L	L	L

*S-Strong; M-Medium; L-Low

Course code		TITLE OF THE COURSE	L	T	P	C
Core Practical I		STRUCTURAL GEOLOGY AND SURVEYING (Practical)	85	-	80	5
Pre-requisite		Basic experience in the science lab in the HSc level	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

Broad Objectives & Learning Outcomes

1. The student is introduced to the basic knowledge relevant to geological maps.
2. Map drawing exercises emphasize the use of completed geological maps to decipher the underlying structure and different methods of solving them.
3. Practical exercises emphasize the use of compasses,Clinometer and Brunton. S
4. urvey Practical introduces the student to basic surveying which is relevant to geological mapping and mining geology.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Prepare maps of geological significance	K1
2	Able to conduct surveys and use surveying equipment	K2
3	Use topological maps	K2
4	Can prepare cross sections across the maps	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Topographical maps and other tools	10 hours

Geological Maps:

Study of Topographical maps: Identification of land forms, structures such as fold, fault, unconformities and intrusions.

Field Uses of Clinometer and Brunton Compass.

Unit:2	Laboratory exercises in structural Geology	10 hours

Laboratory exercises in structural Geology maps: Contours – Completion of outcrops.

Three point problems, Fold Maps. Fault Maps, Unconformity maps. Complex maps with two structures such as fold and fault, fault and unconformity, etc

Unit:3	Preparation of cross sections	15 hours

Preparation of cross sections across the geological maps to bring out the structure of the area, interpretation of structures, determining the order of superposition of beds and writing the geological history of the area.

Unit:4	Structural geology problems	15 hours

Exercise on structural geology problems: Graphical Determination of Dip in gradient. Determination of true dip by simple calculation. Determination of thickness of a bed by calculation on a level ground

Unit:5	Surveying methods	25 hours

Chain surveying: Open traverse, closed traverse.

Prismatic Compass surveying: Determination of the distance between two inaccessible stations. Radiation method and Intersection method.

GPS surveying: Determination of the distance between two inaccessible stations. Radiation method and Intersection method.

Area calculation by applying polygone method by applying Arc GIS

Unit:6	FIELD TRAINING PROGRAMME	10 hours
Expert lectures, online seminars - webinars		
In part fulfilment of B.Sc.,Applied Geology Degree course, students should be taken on local field trips to study the geomorphology and structural geology of the area in and around Salem district, for a period of 3 to 4 days. The student should submit a report on the field training along with specimens collected from the field.Internal assessment marks for the practical are		
	Total hours	**85 hours**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://www.photosat.ca/mining-surveying/mining-exploration/capabilities/structural-geology/

Practical Class Attendance = 5 marks; Practical Test= 10 marks; Field Training Report=25 marks; Total=40 Marks.

Course Designed By: Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	L	L	L	L
CO2	S	S	S	M	M	M	L	L	L	L
CO3	S	S	S	M	M	L	L	L	L	L
CO4	S	S	S	M	M	M	L	L	L	L

*S-Strong; M-Medium; L-Low

Third Semester

Course code		PAPER III - PALAEONTOLOGY	L	T	P	C
Core/Elective/Supportive		CORE	72	65	7	0
Pre-requisite		Basic knowledge on fossils and animal diversity	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. **Broad Objectives & Methodology:** Palaeontology is the study of entombed animal and plant remains in rocks. Class lectures and practical, involving the study of representative fossils.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify fossils and describe geological time scale	K2
2	Identify different types of molluscan fossils	K1
3	understand about Hemichordata and their significance	K2
4	Understand about vertebrate fossils and dinosaurs	K2
5	Identify about plant fossils and significance of Paleobotany	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Geological time scale and Fossils	10 hours

Outline of Geological time scale. Definition of Fossils. Modes of preservation of fossils. Uses of fossils. Morphology and geological history of **Foraminifera**. Outline of uses of microfossils. **Phylum Porifera** – Sponges. **Phylum Brachiopoda**: Morphological characters – classification – geological and stratigraphical importance.

Unit:2	Phylum Mollusca	15 hours

Phylum Mollusca: **Pelecypods** - morphological characters – classification – geological and stratigraphical importance. **Gastropods** - morphological characters – classification – geological and stratigraphical importance. **Cephalopods** - morphological characters – classification – geological and stratigraphical importance.

Unit:3	Phylum Hemichordata	12 hours

Phylum Hemichordata: Morphological characters – classification –geological and stratigraphical importance **Phylum Coelenterata:** Class Anthozoa - Corals: Morphological characters – classification – geological and stratigraphical importance

Unit:4	Phylum Echinodermata and Arthropoda	15 hours

Phylum Echinodermata: Morphological characters – classification – geological and stratigraphical importance. Morphological characters, geological and stratigraphical importance of Blastoids and Crinoids. **Phylum Arthropoda**: Morphological characters – classification – geological and stratigraphical importance.

Unit:5	Vertebrate Palaeontology and Paleobotany	15- hours

Vertebrate Palaeontology: A short account on the classification of vertebrates. O17ine of evolution of vertebrates through geological time. Introduction to Dinosaurs. Short account of Indian dinosaurs: Kotasaurus, Rajasaurus, Stegosaurus, and Ankylosaurus. A brief account of Archaeopteryx and Pterosaurs. **Palaeobotany**: Classification of plant fossils – modes of preservation of plant fossils. Short account of Gondwana flora; Glossopteris, Gangamopteris, Calamites, Lepidodendron, Sigillaria and Ptilophyllum.

Unit:6	Contemporary Issues	5 hours

Additional Resources: Palaeontology and Crystallography related materials is available in CD/DVD format

Suggested Group Work/Tasks: Field collection of fossils and crystalline minerals of a known area preferably cretaceous sediments of Ariyalur formation under proper supervision and submission of a field report.

	Total Lecture hours	72hours

Text Book(s)

1. **Black**, **R.M.** (1972). Elements of Palaeontology. Oxford University Press.Oxford.UK.
2. **Clarkson,E.N.K.** (2005). Invertebrate Palaeontology and Evolution. Wiley. New Delhi.
3. **Easton,W.H.** (1960). Invertebrate Palaeontology. Harper & Brothers. New York.
4. **Moore,R.C. et al.** (1952). Invertebrate Fossils. CBS. Delhi.
5. **Agashe,S.N.** (1995). Palaeobotany. Oxford & IBH. Delhi.
6. **Jain,M.L.& P.C.Anantharaman.**(2017).An Introduction to Palaeontology. Vishal Publications. Delhi.

Reference Books

1. **Sahni,A.** (2001). Dinosaurs of India. NBT. Delhi.
2. **Stewart,W.N. & G.W.Rothwell.** (2005). Palaeobotany. Cambridge University Press. Delhi.
3. **Benton, M.J.** (1995). Vertebrate Palaeontology. Wiley. New Delhi.
4. **Colbert,E.H. et al.** (2002). Evolution of the Vertebrates. Wiley. New Delhi.
5. **Richard,C.** (2000). History of Life. Wiley. New Delhi.12. Shrock and Twentoefel 1953, Principles of invertebrate Paleantology, Mc Graw Hill
6. **Woods H.** 1961, Paleantology, Cambridge University Press
7. **David Raup and Steven Stanly** 1975 . Principles of Paleantology.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://en.wikipedia.org/wiki/Paleontology
https://en.wikipedia.org/wiki/Fossil
https://www.thehindu.com/society/history-and-culture/a-trip-through-the-fossil-rich-grounds-of-ariyalur/article26676409.ece
https://www.nationalgeographic.com/science/2018/09/photos-dinosaurs-fossils-t-rex-triceratops-velociraptor-paleontology/
https://www.youtube.com/watch?v=ft419nvVY8o

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	M	S	S	S	L	L	L
CO2	M	M	M	M	M	M	S	L	L	L
CO3	M	M	M	M	M	M	S	L	L	L
CO4	M	M	M	M	M	M	S	L	L	L
CO5	M	M	M	M	M	M	S	L	L	L

*S-Strong; M-Medium; L-Low

Course code		PART – IV SKILL BASED ELECTIVE PAPER – I	L	T	P	C
Supportive		SBE I- FIELD GEOLOGY	45	40	5	0
Pre-requisite		Basic knowledge on field equipment in Geology	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. To introduce the student to: the significance of field training in geology,
2. Explain and demonstrate the different field techniques,
3. Enable the student to prepare a field plan and execute mapping of an area, and to prepare a geological report based on the geological mapping and related field work
4. Introduce proper method of instruments handling and safety,
5. Use of field note book and information on personal safety and camping.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	**Learning Outcomes:** The student gains insight into the methods of geological mapping and can gain expertise by proper practice. This expertise may be useful in the particular field of geology the student wishes to pursue for employment	K6
2	Describe Rock outcrops and their surficial expressions	K1
3	Measure altitude and mapping mines and quarries	K3
4	Acquire knowledge in terrain mapping	K2
5	Prepare field geological reports	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1		**8 hours**

Definition and scope of Field Geology – Prior planning – Basic equipment required for field work – Types of field investigations. Field work objectives and types of data collected. Introduction to topographic maps: parts, symbols, and other information. Basic concepts: relief, contours, slope, gradients, profiles and sections. Interpretation of topographic maps. Base map preparation and map scale.

Unit:2		**8 hours**

Rock outcrops and their surficial expressions. Basic concepts: strike, dip, apparent dip and rock trends. Introduction to the outcrop features used in mapping: foliations, lineations, bedding, and lithological contacts. Geological mapping: Techniques of mapping: Traverse methods: Compass and Contact traverse, Exposure mapping, Variable lithology mapping, Line maps. Preparation of field note based data sheet.

Unit:3	**Field Equipment**	**8 hours**

Field Equipment:

Clinometer compass: different parts and their functions. Measuring attitude of linear structures – determination of bearings – advantages and limitations. Brunton Compass: different parts and their functions - measuring altitude and trends – determination of bearings – adjustments – magnetic declination in topographic sheets - advantages and limitations. Brief account on the utility of Prismatic Compass and Plane Table in mapping open cast mines and quarries.

Unit:4	**Terrains and mapping methods**	**8 hours**

Brief account of the following: Use of Aerial Photographs in geological mapping – Structural

mapping – Stratigraphic mapping methods. outline of mapping methodology for – igneous terrain, sedimentary terrain and metamorphic terrain. Methods of mapping in areas with sparse outcrops. Outcrop structural features common to all rock types. outline of use and applications of GPS in field geology. Sample location techniques in digital base maps.

Unit:5	**Field geological report**	**8- hours**

Field geological report: parts and preparation. Geological and topographic map symbols. Brief introduction of field indicators used in geological mapping: geomorphological, weathering, mineral composition and petrography. Geological materials: types of samples – mineral,ore,fossil,rock. Methods of sampling -care and packing of samples in the field. outline of preparation of thin sections of geological samples.

Unit:6	**Contemporary Issues**	**5 hours**

Additional Resources: The student may consult the Class Teacher for additional web resources and related materials. Other related materials are available in CD/DVD format .**Assignments:** Any two assignments may be suggested by the Teacher.

Suggested Group Work/Tasks: Field visit to known areas is suggested under proper supervision and with the submission of a field report.

	Total Lecture hours	**45 hours**

Text Book(s)

1. **Lahee,F** (1987). Field Geology, CBS Publishers,New Delhi.
2. **Mathur,S.M.** (2001). Guide to Field Geology. Prentice Hall India. New Delhi.
3. **Gokhale,N.W.** (2001). A Guide to Field Geology. CBS Publishers,New Delhi

1	**REFERENCE AND TEXTBOOKS** 1. **Compton, R.R.** (1985). Geology in the Field, John Wiley & Sons Inc., New Delhi. 2. **Compton, R.R.** (1966). Manual of Field Geology. 2nd ed., New York, Wiley. 3. **Freeman,T.** (1999). Procedures in Field Geology. John Wiley & Sons Inc., New Delhi.

Reference Books

1	1. **McClay, K.R.** (2003) The Mapping of Geological Structures, 2nd ed., John Wiley & Sons Ltd, New Delhi. 2. **Coe,A.L.** (ed). (2010). Geological Field Techniques. Open University Press,Milton Keynes,UK. 3. **Barnes,J.W.** (2004). Basic Geological Mapping. John Wiley & Sons Inc., New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	**Additional Resources** Field Geology related animations available in CD/DVD format

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	M	S	M	M	S	L	L	L	L
CO2	L	L	S	M	M	S	L	L	L	L
CO3	M	L	S	M	M	S	L	L	L	L
CO4	M	L	S	M	M	S	L	L	L	L
CO5	M	L	S	M	M	S	L	L	L	L

*S-Strong; M-Medium; L-Low

Fourth Semester

Course code		PAPER IV – CRYSTALLOGRAPHY AND OPTICAL MINERALOGY	L	T	P	C
Core/Elective/Supportive		CORE	72	67	5	0
Pre-requisite		Basic knowledge in crystal structure	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

Study Crystallography which is the foundation of mineralogy,inorganic chemistry and material science.

Optical mineralogy is the method of studying and observing features of minerals in thin sections for identification.

Class lectures and practical, involving the study of representative fossils, crystal models and mineral thin sections.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify Morphological characters of crystals and their types	K2
2	Able to identify symmetry elements and forms of crystals	K1
3	Able to differentiate normal class and twin crystals	K3
4	Understand refractive index of different minerals	K2
5	Understand the role of plane polarized light in finding crystal structure	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	CRYSTALLOGRAPHY	13 hours

Definition of crystal. Morphological characters of crystals: Faces-Forms-Edges-Solid angles-Interface angles. Contact Goniometer and its uses. Symmetry elements in crystals. Crystallographic axes and axial ratio – Parameters - Indices and symbols: Miller system of notation. Laws of Crystallography: Law of constancy of interfacial angles. Law of Rational Indices. Classification of crystal systems. Study of : holohedral, hemihedral, hemimorphic and enantiomorphous forms of crystals.

Unit:2	Symmetry elements and forms of crystals	13 hours

Cubic System: Symmetry elements - forms and representative mineral of the normal, pyritohedral, tetrahedral and plagiohedral classes. **Tetragonal system**: Symmetry element and forms of normal, hemimorphic, tripyramidal, pyramidal hemimorphic, sphenoidal and trapezohedral classes.

Hexagonal system: Symmetry elements and forms. **A. Hexagonal division**: normal, hemimorphic, tripyramidal, and trapezohedral classes with type minerals. **B. Rhombohedral division**: rhombohedral, rhombohedral-hemimorphic, trirhombohedral, and trapezohedral classes. **Orthorhombic system**: study of the symmetry element and forms of the normal, hemimorphic, and sphenoidal classes with type minerals.

Unit:3	Monoclinic, Triclinic systems and twin crystals	12 hours

Monoclinic system: study of the symmetry elements and forms of the normal class. **Triclinic system**: Study of the symmetry elements and forms of the normal class. **Twin crystals**: Definition –evidence of twinning-laws of twinning-compositional plane, twinning plane and twin axis-twins: simple, repeated (polysynthetic twin), contact, and penetration twin

Unit:4	OPTICAL MINERALOGY	12 hours

Light: Corpuscular, electromagnetic and quantum theories. Ordinary light and plane polarized light.

Refractive index and its determination: Relief method, Becke line, Central illumination, and Oblique illumination methods. Isotropism, isotropic minerals and isotropic ray velocity surface. Behaviour of light in isotropic minerals. Petrological Microscope and its parts-optical accessories and their uses: Quartz wedge, Gypsum plate and Mica plate. Study of Isotropic minerals using the petrological microscope: properties of isotropic minerals under parallel Nicol conditions.

Unit:5	**POLARIZED LIGHT AND CRYSTAL STRUCTURE**	**12- hours**

Anisotropism and anisotropic minerals.Behaviour of ordinary light in uniaxial minerals: Double refraction - Indicatrix - Optic axes – Optic sign. Nicol prism and its construction. Behaviour of polarized light in uniaxial minerals. Pleochroism, retardation, birefringence, extinction, and interference colours in uniaxial minerals. Study of Uniaxial minerals using the petrological microscope: under parallel (PN) and crossed Nicol (XN) conditions. Uniaxial interference figure.

Behaviour of ordinary light in biaxial minerals. Behaviour of polarized light in biaxial minerals. Study of Biaxial minerals using the petrological microscope: under PN and XN conditions. Biaxial Indicatrix - optic axes and optical axial angles – biaxial extinction and extinction angles –Trichroism. Biaxial interference figure.Michel Levi interference colour chart and orders of interference colour.

Unit:6	**Contemporary Issues**	**5 hours**

Group discussion

	Total Lecture hours	**72 hours**

Text Book(s)

1. **Ford, W.E.** (1988). Dana's Textbook of Mineralogy. Wiley. New Delhi. (Reprint).
2. **Hota,R.N.** (2011).Practical Approach to Crystallography and Mineralogy. CBS. New Delhi.
3. **Senguptha,S.**(1980).Crystallography and Optical Mineralogy. EW Press. Delhi.
4. **Phillips,F.C.**(1965). Crystallography. ELBS. London
5. **Bishop,A.C**.(1967). An O17ine of Crystal Morphology. Hutchinson. London.

1 **REFERENCE BOOKS:**

1. **Kerr,P.F.** (1977). Optical Mineralogy, 4th ed. McGraw Hill New York.
2. **Gribble,C.D.&A.J. Hall**.(1985).A Practical Introduction to Optical Mineralogy. Springer. London.
3. **MacKenzie,W.S.&C. Guilford**.(1993) Atlas of Rock-Forming Minerals in Thin Section,Longman,UK.
4. **Perkins,D.& K.R.Henke.** (2003). Minerals in Thin Section, Prentice Hall, New Delhi.
5. **Raith,P.M.** (2011). Optical Mineralogy. MSA. Virginia. USA. (e-book)

Additional Resources: Paleontology and Crystallography related materials is available in CD/DVD format.

Assignments: Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks: Field work involving collection of fossils and crystalline minerals of known areas under proper supervision and submission of a field report. Preparation of a thin section of a mineral under proper supervision.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://en.wikipedia.org/wiki/Crystallography
https://www.iucr.org/publ/50yearsofxraydiffraction/full-text/crystallography

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	S	M	M	M	S	M	L	L	L
CO2	L	S	M	M	M	S	M	L	L	L
CO3	M	S	M	M	M	S	M	L	L	L
CO4	M	S	M	M	M	S	M	L	L	L
CO5	M	S	M	M	M	S	M	L	L	L

*S-Strong; M-Medium; L-Low

Course code		PRACTICAL II - PALAEONTOLOGY AND CRYSTALLOGRAPHY	L	T	P	C
Core/Elective/Supportive		CORE practical	80	5	75	0
Pre-requisite		Theoretical knowledge on fossils, crystals and ores	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Identification of fossils
2. Measurements of interfacial angle by using contact goniometer. Stereographic projection exhibiting symmetry elements of normal classes of the six crystal systems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify fossils	K2
2	Determine Biological position and range of time of fossils	K1
3	Determination of system and class of crystals on the basis of symmetry elements	K3
4	Able to measure interfacial angle by using contact goniometer	K2
5	Able to identify ores based on crystal structure in field and in Lab	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1 — **15 hours**

PALAEONTOLOGY:

Identification of fossils on the basis of morphological characters. Fixing the biological position and range in time of the following classes of fossils:

Foraminifera : Textularia, Quinqueloculina, Globigerina, Lagena, Nummulites. **Porifera :** Siphonia and Ventriculites.**Pelecypods**: Meretrix, Arca, Cardium, Cardita, Pecten, Venus, Unio, Pinna, Modiola, Lima, Inoceramous, Alectryonia, Gryphaea, Exogyra, Spondylus,Pectenculus,Radiolites, Trigonia,

Unit:2 — **15 hours**

Ostrea.**Gastropods**:Turritella,Cerithium,Turbo,Trochus,Natica,Conus,Fusus,Physa,Busycon, Voluta, Murex,Bellerophon, Helix,Cyprea,Euomphalus.**Cephalopods**: Orthoceras, Nautilus, Goniatites, Ceratites, Acanthoceras, Schloenbachia, Scaphites, Perisphinctes, Turrilites, Baculites, Belemnites. **Brachiopods**: Lingula, Spirifer, Productus, Terebratula, Rhynchonella, Pentamerus, Atrypa, Athyris. **Corals**: Calceola, Zaphrentis, Thecosmilia, Cyclolites, Favosites, Omphyma, Halysites, Lithostrotion. **Echinoids**: Echinus, Cidaris, Hemicidaris, Micraster, Holaster, Hemiaster, Stigmatophygus.**Crinoidea**:Enchinus Apiocrinus,Pentacrinus.**Blastoidea**:Pentremites.

Unit:3 — **15 hours**

Trilobites: Paradoxides,Calymene,Olenellus,Olenus,Asaphus,Trinucleus,Phacops.**Graptolites**: Monograptus, Rastrites, Diplograptus ,Phyllograptus, Tetragraptus. **Plant fossils**: Glossopteris, Gangamoptris, Ptilophyllum, Lepidodentron, Sigillaria, Stigmaria, Calamites.

Unit:4 — **15 hours**

CRYSTALLOGRAPHY:

Study of Crystal Models: Determination of system and class on the basis of symmetry elements. Description of forms present and determination of Miller indices of the following crystal

models.**Cubic System**: Galena, Garnet, Fluorite, Magnetite, Pyrite, Tetrahedrite, Boracite.**Tetragonal System**: Zircon, Apophyllite, Rutile, Vesuvianite, Cassiterite, Octahedrite, Scheelite, Meionite, Chalcopyrite.**Hexagonal System**: Beryl, Zincite, Apatite, Hematite, Calcite, Corundum, Tourmaline, Phenacite, Alpha Quartz. **Orthorhombic System**: Barite, Olivine, Sulphur, Topaz, Staurolite, Calamine, Epsomite.
Monoclinic System: Gypsum, Augite, Orthoclase, Epidote, Hornblende.**Triclinic System**: Axinite, Albite, Anorthite, Kyanite, Rhodonite.**Study of Twin Crystal Models of the following Crystal Systems:Cubic**: Spinel, Iron Cross twin. **Tetragonal**: Rutile, Zircon, Cassiterite. **Hexagonal**: Brazil law – Calcite, Quartz. **Orthorhombic**: Cruciform, Aragonite – Staurolite. **Monoclinic**: Mica, Orthoclase: Carlsbad, Manebach and Baveno type, Gypsum. **Triclinic**: Albite – Simple Twin.

Unit:5		**15- hours**

CRYSTALLOGRAPHY:
Measurements of interfacial angle by using contact goniometer. Stereographic projection exhibiting symmetry elements of normal classes of the six crystal systems. Study of Crystal Models: Determination of system and class on the basis of symmetry elements. Description of forms present and determination of Miller indices of the following crystal models.**Cubic System**: Galena, Garnet, Fluorite, Magnetite, Pyrite, Tetrahedrite, Boracite.**Tetragonal System**: Zircon, Apophyllite, Rutile, Vesuvianite, Cassiterite, Octahedrite, Scheelite, Meionite, Chalcopyrite.**Hexagonal System**: Beryl, Zincite, Apatite, Hematite, Calcite, Corundum, Tourmaline, Phenacite, Alpha Quartz. **Orthorhombic System**: Barite, Olivine, Sulphur, Topaz, Staurolite, Calamine, Epsomite.
Monoclinic System: Gypsum, Augite, Orthoclase, Epidote, Hornblende.**Triclinic System**: Axinite, Albite, Anorthite, Kyanite, Rhodonite. **Study of Twin Crystal Models of the following Crystal Systems:Cubic**: Spinel, Iron Cross twin. **Tetragonal**: Rutile, Zircon, Cassiterite. **Hexagonal**: Brazil law – Calcite, Quartz. **Orthorhombic**: Cruciform, Aragonite – Staurolite. **Monoclinic**: Mica, Orthoclase: Carlsbad, Manebach and Baveno type, Gypsum. **Triclinic**: Albite – Simple Twin.

Unit:6	**Contemporary Issues**	**5 hours**

FIELD TRAINING PROGRAMME:II Year of the Course.
In part fulfilment of the B.Sc., Geology degree course, the students should be taken to areas with outcrops of fossil bearing rocks for a period of 5 to 7 days, to collect and study modes of preservation of fossils. They should present the collected fossils and submit a report on the field training at the time of the Main Practical Examination.

	Total Lecture hours	**80 hours**

Text Book(s)

1. **Gribble,C.D.&A.J. Hall**.(1985).A Practical Introduction to Optical Mineralogy. Springer. London
2. **Hota,R.N.** (2011).Practical Approach to Crystallography and Mineralogy. CBS. New Delhi . Woods H. 1961, Paleantology, Cambridge University Press
3. **Moore,R.C. et al.** (1952). Invertebrate Fossils. CBS. Delhi **Agashe,S.N.** (1995). Palaeobotany. Oxford & IBH. Delhi.
4. **Benton, M.J.** (1995). Vertebrate Palaeontology. Wiley. New Delhi.
5. **Colbert,E.H. et al.** (2002). Evolution of the Vertebrates. Wiley. New Delhi

Reference Books	
1	Paolo Ardiuni and Giorgio Teruzzi 1986 Simon and Schuster's Guide to fossils , Simon and Schuster's Inc. p.318
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	GEOCHEMISTRY https://onlinecourses.swayam2.ac.in/cec19_mm01/preview
Course Designed By:Dr. J. Ebanasar	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	M	S	M	M	S	S	L	L	L
CO2	L	L	S	M	M	S	S	L	L	L
CO3	M	L	S	M	M	S	S	L	L	L
CO4	M	L	S	M	M	S	S	L	L	L
CO5	M	L	S	M	M	S	S	L	L	L

*S-Strong; M-Medium; L-Low

Course code		PART- IV -SKILL BASED ELECTIVE PAPER – 2 - SBE II - NATURAL DISASTER MANAGEMENT	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	45	40	5	0
Pre-requisite		BASIC KNOWLEDGE IN FIELD GEOLOGY	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. IntroduCE the dangers, problems, effects of natural disasters and their mitigation measures.
2. The methodology of teaching involves class lectures with discussion of case studies relevant to India.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The student gains insight and an informed awareness of natural disasters for future safety measures and preparedness.	K2
2	Identify causes and consequences of Earthquake	K1
3	Identify type of volcanoes	K3
4	Identify Landslides and their impacts	K4
5	Predict causes and consequences of Tsunamis	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	An introduction to Natural disasters	10 hours

An introduction to Natural disasters: floods- cyclones – earthquakes – volcanoes – landslides-tsunamis. Monsoons: North East and South West monsoon – cyclones and storms – surface water flows and river flows. Flooding – flood control measures: check dams. Precautionary measures: warning systems and cyclonic shelters. Failure of monsoons and droughts. Remedial measures and preparedness.

Unit:2	Earthquake	10 hours

Earthquake: Definition – Type of shock waves: Body waves: P waves, S waves. Surface waves: P waves, L waves – Causes of earth quakes. Destructions due to earthquake – Richter scale – Major earthquakes in India. Prediction of Earthquakes and warning systems. Earthquake monitoring and disaster management measures.

Unit:3	Volcanoes:	10 hours

Volcanoes: type of volcanoes – causes of volcanoes – products of volcanoes. Destruction due to volcanic eruptions. Major volcanic eruptions in India. Submarine volcanoes. Prediction of volcanic eruptions and early warning systems. Active volcano monitoring and disaster management measures

Unit:4	Landslides	5 hours

Landslides: definition – terminology – classification. Causes of landslides: slope changes – tectonic activity – rock structures – role of water in landslides – effects of Human activity. Destruction due to landslides – precautionary measures. Glaciers and its avalanches. Major landslides in India. Landslides warning systems and early detection. Landslide disaster management measures

Unit:5	Tsunamis	5- hours

Tsunamis: definition – causes of tsunami: submarine earthquakes and tsunamis – Impact of tsunamis – Major Tsunamis. Advance warning systems for Tsunamis – Tsunamis disaster management measures –

seiche waves in lakes.		
Unit:6	**Contemporary Issues**	**5 hours**
Additional Resources: The student may consult the Class Teacher for additional web resources and related materials. Other related materials are available in CD/DVD format .**Assignments:** Any two assignments may be suggested by the Teacher. **Suggested Group Work/Tasks:** Field visit to land slide zone is suggested under proper supervision and with the submission of a field report.		
	Total Lecture hours	**45 hours**

Text Book(s)

1. **Holmes,A& P.L.Duff.** (1996). Principles of Physical Geology, 4 th revised Edition,ELBS,London
2. **Radhakrishnan,V.** (1996). General Geology, V.V.P. Publishers,Tuticorin.
3. **Mahapatra,G.P.** (1994). Physical Geology,CBS Publishers,New Delhi.
4. **Mahapatra,G.P.** (1992). Textbook of Geology, CBS Publishers,New Delhi.
5. **Emiliani,C.(1992).** Planet Earth, Cambridge University Press, Delhi.

1 **REFERENCES BOOKS**

1. **Porter,S.C. & B.J. SkinnerJ.** (1995). The Dynamic Earth, John Wiley & Sons, New York.
2. **Leet,D& Judson,S** (1987). Physical Geology, McGraw Hill. New Jersey.
3. **Zumberge,J.(**1980). Physical Geology, Freeman, New York.
4. **Patwardhan,A.M.** (1999). Dynamic Earth System, Prentice Hall, New Delhi.
5. **Mukherjee,A.K.** (1990). Principles of Geology,EW Press,Kolkata.
6. **Reed,J.S. & T.H. Wicander.** (2005). Essentials of Geology, McGraw Hill., New York.
7. **Miller,T.G.** (2004). Environmental Science. Wadsworth Publishing. USA

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	M	S	L	L	M	L	L	L
CO2	L	L	M	S	L	L	M	L	L	L
CO3	L	L	M	S	L	L	M	L	L	L
CO4	L	L	M	S	L	L	M	L	L	L
CO5	L	L	M	S	L	L	M	L	L	L

*S-Strong; M-Medium; L-Low

Fifth Semester

Course code		PAPER V - MINERALOGY	L	T	P	C
Core/Elective/Supportive		CORE	72	67	5	0
Pre-requisite		Knowledge in Crystallography and field geology	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

Broad Objectives & Methodology:

1. Mineralogy is the foundation for petrology and field geology.
2. The student is introduced to the different mineral groups emphasizing their properties for megascopic and thin section identification and their distribution in different earth materials.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The student gains useful insight into the methods of mineral identification.	K2
2	This expertise may be used in field geology and laboratory studies of minerals.	K1
3	Identify mode of occurrences and uses of different mineral groups	K3
4	Identify thin sections of earth materials	K1
5	Understand different mineral groups	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Properties of minerals	10 hours

Definition of a mineral. Properties based on external appearance:- Form – Habit and state of aggregation - Colour – Lustre – Diaphaneity. Properties based on crystal structure: Hardness and Tenacity – Cleavage – Fracture – Parting. Properties based on taste – odour – tactile feeling. Specific gravity of minerals. Thermal, magnetic, and electrical properties of minerals. Radioactivity in minerals.

Unit:2	Quartz and Feldspar group	10 hours

Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Quartz Group - Feldspar Group – Feldspathoids Group. Short note on twinning in feldspars.

Unit:3	Pyroxene, amphibole and Chlorite groups	10 hours

Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Pyroxene Group – Amphibole Group – Chlorite Group.

Unit:4	Mica, Garnet and Zeolite groups	7 hours

Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Mica Group – Garnet Group – Zeolite Group

Unit:5		8- hours

Physical, chemical, optical properties, association, mode of occurrences and uses of the following mineral groups: Olivine Group –EpidoteGroup - Spinel Group. Descriptive study of the following minerals: Andalusite, kyanite, sillimanite, scapolite, apatite, tourmaline, cordierite, sphene, beryl, rutile, and fluorite.

Unit:6	**Contemporary Issues**	**5 hours**

Additional Resources: Mineralogy related materials are available in CD/DVD format on written request.
Assignments: Any two assignments (within the five units) may be suggested by the Teacher.
Suggested Group Work/Tasks: Field excursion to a known area under proper supervision and submission of a field report.

	Total Lecture hours **45 hours**

TEXT BOOKS:

1. **Wenk,H.R& A. Bulakh**. (2006). Minerals. Cambridge University Press, New Delhi.
2. **Perkins,D.** (2010). Mineralogy, 3rd ed. Prentice Hall India, New Delhi.
3. **Battey,M.** (1978). Mineralogy for Students,Oxford University Press,UK.
4. **Berry,L.G.,B.Mason & R.V.Dietrich.** (1985). Mineralogy, CBS New Delhi.
5. **Hota,R.N.** (2011). Practical Approach to Crystallography and Mineralogy,CBS,New Delhi.
6. **Haldar,S.K. & J. Tisjlar.** (2014). Introduction to Mineralogy and Petrology, Elsevier, Netherlands.

Reference Books

1. **Kerr,P.F.** (1977). Optical Mineralogy, 4th ed. McGraw Hill New York.
2. **MacKenzie,W.S. & C. Guilford**.(1993) Atlas of Rock-Forming Minerals in Thin Section,Longman,UK.
3. **Heinrich,E.W**.(1965).Microscopic Identification of Minerals.McGraw-Hill. New York.
4. **Gribble,C.D.& A.J. Hall**.(1985).A Practical Introduction to Optical Mineralogy. Springer. London.
5. **Perkins,D.& K.R.Henke.** (2003). Minerals in Thin Section,Prentice Hall,New Delhi

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. **Web resources:** Mineralogical Society of America: http://www.minsocam.org Mineralogy Databases: http://webmineral.com. http://www.mindat.org.

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	M	M	L	S	M	L	S	L
CO3	L	L	M	M	L	S	M	L	S	L
CO3	L	L	M	M	L	S	M	L	S	L
CO4	L	L	M	M	L	S	M	L	S	L
CO5	L	L	M	M	L	S	M	L	S	L

*S-Strong; M-Medium; L-Low

Course code		PAPER VI-STRATIGRAPHY AND INDIAN GEOLOGY	L	T	P	C
Core/Elective/Supportive		CORE	72	67	5	0
Pre-requisite		Knowledge in Geochemistry and paleontology	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. The student is introduced to the basic principles of Stratigraphy and Indian Geology. The methodology of teaching involves class lectures with relevant multimedia materials: digital charts, rocks, and others

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	**Describe** the principles of Stratigraphy	K2
2	This knowledge is useful for field geology, mineral exploration, oil exploration, and tectonics	K1
3	**Describe** the principles of Indian Geology	K3
4	Describe geological formations	K3
5	Understand the distribution of geological formations in India	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	STRATIGRAPHY	15 hours

Definition and scope of Stratigraphy. Principles and laws of Stratigraphy. Methods of Stratigraphic Correlation. Concept of homotaxial and contemporaneous formations. Stratigraphic Nomenclature: Lithostratigraphy – Biostratigraphy – Chronostratigraphy, Geological Time Scale and Standard Geological divisions. Imperfections in the Geological record.

Unit:2	INDIAN GEOLOGY	15hours

Physiographic divisions of India. Structure and Tectonic divisions of India: Peninsular India, Extra-Peninsular India and Indo-Gangetic alluvial plains. -Study of Archaean Group: Dharwar system of Karnataka - mineral riches.

Unit:3	Proterozoic group	10 hours

Study of the following geological formations of India: Proterozoic Group: Cuddapah System; Delhi System; Vindhyan System; Kurnool System. Paleozoic Group: Paleozoic of Spiti; Permo – Carboniferous of Salt Range

Unit:4	Gondwana group and Cretaceous formations	12 hours

Study of the following geological formations of India: Gondwana Group: Classification – lithology – deposits – fossil content – climate - economic importance. Triassic of Spiti; Jurassic of Kutch; Cretaceous of Trichinopoly and Narmada valley.

Unit:5	Deccan traps and Siwalik systems	15- hours

Study of the following geological formations of India: Deccan Traps: distribution – structure - Lameta beds – Inter-trappean and Infra-trappean beds - Bagh beds; Tertiary Group : Eocene of Assam, Cuddalore sandstone of Tamil Nadu and Quilon beds of Kerala; Siwalik System; outline

of Pleistocene Ice Ages in India. Karewa formation; Recent: Placer deposits of Tamil Nadu. Rise of Himalayas.

Unit:6	Contemporary Issues	5 hours

Additional Resources: Web resources related to Stratigraphy and Indian Geology related materials are available.

Assignments: Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks

Field visits to Stratigraphically significant areas within Tamil Nadu under proper supervision is suggested.

	Total Lecture hours	72 hours

Text Book(s)

1. **Krishnan,M.S.** (1986). Geology of India, Burma and Pakistan. CBS. New Delhi.
2. **Wadia,D.N.** (1953). Geology of India. McMillan India. Delhi.
3. **Kumar,R**.(1988). Fundamentals of Historical Geology and Stratigraphy of India,Wiley.New Delhi.

Reference Books

1. **Weller,J.M.**(1960).Stratigraphic Principles and Practice. University Book Stall. New Delhi.
2. **Mehdiratta,R.C** (1974). Geology of India,Pakisthan,Bangladesh and Burma. Atma Ram & Sons. Delhi.
3. **Vaidyanadhan,R& M.Ramakrishnan.** (2008). Geology of India. Geological Society of India. Bangalore.
4. **GSI**.(2005). Geology & Mineral Resources of the States of India.Misc Pub. No.30.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Geological Survey of India. Kolkota. (Several individual volumes available online at GSI portal).

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	S	M	L	S	S	L	S	L
CO2	L	L	S	M	L	S	S	L	S	L
CO3	L	L	S	M	L	S	S	L	S	L
CO4	L	L	S	M	L	S	S	L	S	L
CO5	L	L	S	M	L	S	S	L	S	L

*S-Strong; M-Medium; L-Low

Course code		PAPER VII – IGNEOUS AND METAMORPHIC PETROLOGY	L	T	P	C
Core/Elective/Supportive		CORE	80	75	5	0
Pre-requisite		Basic knowledge in Geochemistry	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Petrology is the foundation for field geology, stratigraphy, mineral exploration and others.
2. The student is introduced to the basics of igneous and metamorphic petrology emphasizing processes, field geology, classification and others.
3. The teaching and learning methodology involves class lectures and practical, field identification demonstrations, and microscopic techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain useful insight into igneous and metamorphic petrology.	K2
2	Get expertise in field geology studies of rocks	K1
3	Get expertise in laboratory studies of rocks	K3
4	Identify Regional metamorphism of rocks	K2
5	Understand field configurations of metamorphic rocks	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	IGNEOUS PETROLOGY	10 hours

Igneous Petrology: definition and scope. Magma: definition, composition and constituents of magma. Crystallization of a unicomponent magma: Augite system. Crystallization of binary magma: Diopside-Anorthite system – simple eutectic. Albite – Anorthite system – solid solution series. Forsterite – Silica system – incongruent melting. Crystallization of a ternary system: Diopside – Anorthite – Albite. Bowen's Reaction Series. Mechanism and processes of magmatic differentiation

Unit:2	Field configurations of igneous rocks	10 hours

Field configurations of igneous rocks: intrusive forms and extrusive forms. Textures and microstructures of igneous rocks. Assimilation of host rocks by magmas. Classification of igneous rocks based on: mode of occurrence, silica and alumina saturation, chemical and mineralogical schemes and Tyrell's tabular classification.

Unit:3		15 hours

Outline of petrography of acid rocks, intermediate rocks, and basic rocks. Descriptive study of lamprophyre, carbonatite, anorthosites, dunite, pyroxenite and kimberlite. A short note on: consanguinity, kindred, petrographic provinces and periods. Short account of Harker's variation diagram.

Unit:4	METAMORPHIC PETROLOGY	15 hours

Metamorphism: definition and scope. Agents and kinds of metamorphism. Metamorphic zones and grades. Concept of metamorphic facies and its applications. Textures and structures of metamorphic rocks. Outline of crystalloblastic series and its applications. Metasomatism and metasomatic processes. Pneumatolytic and injection metamorphism. Contact or Thermal metamorphism of pelitic sediments and calcareous rocks. Cataclastic metamorphism and its products.

Unit:5	Regional metamorphism of Rocks	15- hours
Regional metamorphism of argillaceous, calcareous, and impure calcareous rocks and their products. Plutonic metamorphism and its products. Short notes: retrograde metamorphism, anatexis and palingenesis. Descriptive petrography of the following metamorphic rocks; slate, phyllite, quartzite, schist, gneiss, migmatite, granulite, charnockite, amphibolite, eclogites, hornfels, and marble.		
Unit:6	**Contemporary Issues**	**5 hours**
Additional Resources Igneous and metamorphic petrology related materials are available in CD/DVD format on written request. Web related materials are also available. **Assignments** Any two assignments (within the five units) may be suggested by the Teacher. **Suggested Group Work/Tasks** Field excursion to a known area under proper supervision and submission of a field report.		
	Total Lecture hours	**72 hours**

Text Book(s)

1. **Tyrell,G.W.** (1958). Principles of Petrology. B.I. Publications. New Delhi.
2. **Haung,W.T.** (1962). Petrology. McGraw Hill. New York.
3. **Winter,J.D.**(2010).Principles of Igneous and Metamorphic Petrology. PHI.New Delhi.
4. **Williams,H.** et al. (1982). Petrography. CBS. New Delhi.
5. **McBirney, A.R.** (1993). Igneous Petrology. CBS. New Delhi.
6. **Best,M.G.** (2005). Igneous Petrology.Wiley. New Delhi.
7. **Best,M.G.** (2003). Igneous and Metamorphic Petrology. Wiley.New Delhi.
8. **Hatch,F.H.** et al. Petrology of the Igneous Rcoks. CBS. Delhi.

Reference Books

1. **Hyndman,D.W.** (1985). Petrology of the Igneous and Metamorphic Rocks. McGraw Hill. New York.
2. **Middlemost,E.A.K.** (1985). Magmas and Magmatic Rocks.Longman. UK.
3. **Winkler,H.G.F.** (1970). Petrology of the Metamorphic Rocks. Springer. New Delhi.
4. **Turner,F.J.** (1968). Metamorphic Petrology. McGraw Hill. New York

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/metamorphic-petrology
   http://hacker.faculty.geol.ucsb.edu/geo102C/lectures/part2.html

Course Designed By :Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	M	M	L	S	S	L	S	M
CO2	L	L	M	M	L	S	S	L	S	M
CO3	L	L	M	M	L	S	S	L	S	M
CO4	L	L	M	M	L	S	S	L	S	M
CO5	L	L	M	M	L	S	S	L	S	M

*S-Strong; M-Medium; L-Low

Course code		PART –III MAJOR BASED ELECTIVE 1 - HYDROGEOLOGY	L	T	P	C
Core/Elective/Supportive		ELECTIVE	72	67	5	0
Pre-requisite		Knowledge in geochemistry and stratigraphy	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

5. **Broad Objectives & Methodology:** The student is introduced to the basic principles of hydrogeology. The methodology of teaching involves class lectures and simple laboratory demonstrations

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain insight into the basic principles of hydrogeology.	K1
2	Understand Specific yield and specific retention	K2
3	Differentiate types of aquifers	K3
4	**Understand potential Groundwater exploration**	K2
5	**Understand Groundwater Quality and Chemistry**	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	scope of Hydrogeology	15 hours

Definition and scope of Hydrogeology. Concise account of the hydrologic and hydro-geological cycle. Origin and sources of groundwater: meteoric water, connate water and juvenile water. Vertical distribution of groundwater. Rock properties affecting groundwater occurrence in rocks: porosity: primary and secondary, factors controlling porosity

Unit:2	Specific yield and specific retention.	12 hours

Specific yield and specific retention. D'Arcy's Law and its limitations. Laminar and turbulent flow. Permeability and permeameters. Coefficient of permeability. Water springs and their types. Water wells: definition and types.

Unit:3	Aquifer	12 hours

Aquifers: definition and types of aquifers: unconfined, confined, leaky and perched aquifers. Confining layers of aquifers: aquitard, aquifuge and aquiclude. Isotropic, anisotropic aquifers and layered aquifers. Aquifer properties: transmissivity, storativity, and compressibility. Artesian wells. Determination of subsurface water flow: field and graphical methods.

Unit:4	Groundwater exploration	14 hours

Groundwater exploration: Outline of field geological, remote sensing, and resistivity methods. Outline of drilling techniques for groundwater. Artificial and natural recharge of groundwater. Brief account of rain water harvesting. Fluctuations of groundwater levels.

Unit:5	Groundwater Quality and Chemistry	14- hours

Groundwater Quality and Chemistry: salinity and its causes. Physical criteria of water quality. Chemical analyses of groundwater and units used. TDS and hardness of ground water. Biological analysis of groundwater. Short account of water quality standards. Outline of groundwater provinces of Tamil Nadu.

Unit:6	Contemporary Issues	5 hours

Additional Resources

Web resources related to the above subjects are available .

Assignments

Any two assignments (within the five units) may be suggested by the Teacher.

	Total Lecture hours	**72 hours**

Text Book(s)

1. **Todd,D.K.** (2008). Groundwater Hydrology. 5th ed. Wiley. New Delhi.
2. **Davis,S.N. & R.J.M. DeWiest.** (1966). Hydrogeology. Wiley. Delhi.
3. **Freeze,R.A. & J.A.Cherry.** (1979).Groundwater. Prentice Hall. New York.
4. **Raghunath,H.M.** (1988). Groundwater. East West Pub. Delhi.
5. **Raghunath,H.M.** (1985).Hydrology. East West Pub. Delhi.

Reference Books

1. **Fetter,G.W.** (1989). Applied Hydrogeology. CBS. Delhi.
2. **Ramakrishnan,S.** (2011). Ground Water. Scitech Publications. Chennai.
3. **Garg,S.P.** (1982). Groundwater and Tube Wells. Oxford & IBH. Delhi

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.nature.com/subjects/hydrogeology
   https://en.wikipedia.org/wiki/Hydrogeology

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	M	M	S	M	M	L	M	M
CO2	L	L	M	M	S	M	M	L	M	M
CO3	L	L	M	M	S	M	M	L	M	M
CO4	L	L	M	M	S	M	M	L	M	M
CO5	L	L	M	M	S	M	M	L	M	M

*S-Strong; M-Medium; L-Low

Course code		PART – IV SKILL BASED ELECTIVE PAPER – 3 - SBE III - REMOTE SENSING	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	60	55	5	0
Pre-requisite		Basic knowledge in maps and GIS	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

Broad Objectives & Methodology: The student is introduced to the principles and methods of Remote Sensing relevant to Geology with applications. The methodology of teaching involves class lectures, practical, study of aerial photos and digital imageries for geological applications

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The student gains insight of the applications and uses of Remote Sensing	K2
2	scope of Remote Sensing in Geology	K1
3	Types of remote sensing	K3
4	Photo interpretation elements	K2
5	Understand Thermal Remote Sensing	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	scope of Remote Sensing	11 hours

Definition and scope of Remote Sensing in Geology. Electromagnetic spectrum – definition and components. Energy sources and radiation – outline of interaction of electromagnetic spectrum with atmosphere and earth surface features – spectral signatures – atmospheric windows.

Unit:2	Types of remote sensing	11 hours

Types of remote sensing: based on 1) Energy sources: active and passive. 2) Platforms: aerial and satellite and 3) Sensors: optical, thermal, and microwaves. 4) RADAR. Aerial remote sensing: Types of Aerial Photographs: vertical and oblique. Scale of aerial photographs – flight procedures. Stereoscopes : pocket and mirror stereoscopes

Unit:3	Photo interpretation elements	11 hours

Photo interpretation elements. Mosaics: controlled and uncontrolled mosaics – advantage and disadvantages – application of mosaics in geology studies. Satellite remote sensing: Principles of optical remote sensing: Satellite orbiting mechanisms – Brief account of multi spectral scanning – along track and across track scanning. Types of resolution – data acquisition and interpretation.

Unit:4	Thermal Remote Sensing	11 hours

Thermal Remote Sensing: Thermal radiation principles – atmospheric windows – advantages and disadvantages. SLAR – principle and applications. A short account of LANDSAT, SPOT and India Remote Sensing satellites. Indian Space Missions.

Unit:5	remote sensing and drainage patterns	11- hours

A short account of the remote sensing techniques in the study of drainage patterns, major land forms, geological structures. Ground water exploration and mineral exploration.

Unit:6	Contemporary Issues	5 hours

A Additional Resources:

Remote Sensing related materials are available in CD/DVD format.

Assignments

Any two assignments (within the five units) may be suggested by the Teacher.

	Total Lecture hours	**60 hours**

Text Book(s)

1. **Curran,P.B.** (1985).Principles of Remote Sensing. ELBS. London.
2. **Drury,S.D.** (1993). Image Interpretation in Geology. Allen & Unwin. London.
3. **Miller,V.C.** (1961). Photogeology. McGraw Hill. New York.
4. **Pandey,S.N.** (1989). Principles and Applications of Photogeology. Wiley Eastern. New Delhi.
5. **Sabins,F.F.** (1974). Remote Sensing Principles and Interpretation. Freeman. New York.

Reference Books

1. **Reddy,A.** (2010). Principles of Remote Sensing and GIS. CBS. Delhi.
2. **Guptha,R.P.** (2003). Remote Sensing Geology. Springer. New Delhi.
3. **Lillisand,T.M& R.W.Kiefer.** (2000). Remote Sensing and Image Interpretation. Wiley. Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.youtube.com/watch?v=vJAQHA5XQWI
   https://www.youtube.com/watch?v=G1-lwqvRAEc

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	S	S	L	M	M	L	M	S
CO2	L	L	S	S	L	M	M	L	M	S
CO3	L	L	S	S	L	M	M	L	M	S
CO4	L	L	S	S	L	M	M	L	M	S
CO5	L	L	S	S	L	M	M	L	M	S

*S-Strong; M-Medium; L-Low

Course code		PART –IV SKILL BASED ELECTIVE PAPER – 5 : SBE V - GEMMOLOGY	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	45	40	5	0
Pre-requisite		Basic knowledge in crystallography	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

Introduce the student to the basics of gemmology, gemstone exploration and its exploitation, gemstone processing and cutting techniques, and to the marketing of finished gems.

The topics emphasize the significance of gemmology as an avenue for future self-employment

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain insight into the methods of gemstone identification and exploration.	K2
2	This expertise may be useful in the particular field of gemmology the student wishes to pursue for employment	K1
3	Understand Outline of gemstone extraction and mining	K3
4	Know Gemstone provinces in India and Tamil Nadu	K2
5	Understand quality of gem stones	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Scope of Gemmology	**8 hours**

Definition and scope of Gemmology. Minerals as gemstones. Classification of gemstones: gem minerals and other schemes. Characteristic and desirable features of gemstones. Weight standards used in gemmology and metal jewellery

Unit:2	Identification of Gemstones:	**8 hours**

Identification of Gemstones: Basic megascopic and optical properties of gemstones. Gemstone testing equipment: Gemstone Refractometers, Polaroid films or plates, Gemstone microscope, Hardness testing kits, Heavy liquids, UV light, and Spectroscope methods. Gem simulants,proxies, and synthetic gemstones – their identification from natural gemstones

Unit:3	Exploration techniques	**8 hours**

Introduction to exploration techniques used in gemstone prospecting. Host rocks for gemstone mineralization and gemstone deposits. Outline of gemstone extraction and mining from host rock. Processing of gemstones for cutting and polishing.

Unit:4	Cutting and polishing techniques	**8 hours**

Cutting and polishing techniques applied to different gemstones. Small scale gemstone cutting and polishing industries in Tamil Nadu. Feasibility and economics of gemstone related industries in India (with emphasis on Tamil Nadu).

Unit:5	Outline of important gemstone provinces	**8- hours**

Outline of important gemstone provinces in India. Gemstone areas of Tamil Nadu: Karur – Kangeyam belt, Sittampundi Area, Samalpatti Area, Pakkanadu – Mulakkadu Area, and Edappadi Area. Brief outline of mining regulations relevant to gemstone mining in India.

Unit:6	**Contemporary Issues**	**5 hours**

Additional Resources: Gemmology related animations available in CD/DVD format .**Assignments:**

Any two assignments (within the five units) may be suggested by the Teacher.**Suggested Group Work/Tasks:** Field excursion to a known gemstone bearing area under proper supervision and submission of a field report

	Total Lecture hours	**45 hours**

Text Book(s)

1. **Karanth,R.V.** (2000). Gem and gem industry in India, Memoir 45, Geological Society of India, Bangalore.
2. **Babu,T.M.** (1998). Diamond in India, Economic Geology Series 1, Geological Society of India, Bangalore.
3. **Hall,C.** (2005). Gemstones, Dorling Kindersley,London.
4. **Sinkankas,J.J.** (1964). Mineralogy: A first Course, Van Nostrand Reinhold, New York.
5. **Krishnan,M.S.** (1964). Mineral Resources of Madras, Memoir Vol 80, Geological Survey of India ,Kolkota
6. **Prasad,U.** (2003). Economic Mineral Deposits, CBS Publishers, New Delhi.
7. **Read,P.G.** (1984). Beginner's Guide to Gemmology, Heinemann Professional Publishing Ltd,London.
8. **O'Donoghue,M.** (2006). Gems. Elsevier, Singapore.

Reference Books

1. **Keller,P.C.** (1990). Gemstones and their origins, Van Nostrand Reinhold, New York.
2. **Herbert Smith,G.F** (1912). Gemstones. Metheun,London.
3. **Read,P.G.** (2005). Gemmology, 3rd ed. Elsevier,Singapore.
4. **Walton,L.** (2004). Exploration Criteria for Colored Gemstones, Open File – 2004 – 10. Canada.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://en.wikipedia.org/wiki/Gemology
2. https://giionline.com/gemmology-course/

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	L	M	M	S	M	S
CO2	L	L	L	L	L	M	M	S	M	S
CO3	L	L	L	L	L	M	M	S	M	S
CO4	L	L	L	L	L	M	M	S	M	S
CO5	L	L	L	L	L	M	M	S	M	S

*S-Strong; M-Medium; L-Low

Sixth Semester

Course code		PAPER VIII - SEDIMENTARY PETROLOGY AND ENVIRONMENTAL GEOLOGY	L	T	P	C
Core/Elective/Supportive		CORE	72	67	5	0
Pre-requisite		Knowledge in igneous and metamorphic petrology	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

1. Introduce the fundamentals of sedimentary petrology.
2. Sedimentary petrology is the study of sedimentary rocks generated on the earth's crust.
3. Environmental geology is the application and role of geology in the environmental perspective. The methodology of teaching involves class lectures, practical, and laboratory work.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain insight and understanding of sedimentary petrology and environmental geology.	K2
2	Understand Sedimentary processes. Classification of sedimentary rocks	K1
3	outline depositional sedimentary environments	K3
4	Identify Sedimentary deposits of chemical origin	K3
5	Know about Energy resources	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Sedimentary Petrology	**12hours**

Definition and scope of Sedimentary Petrology. Sedimentary rocks: definition, origin, disintegration and decomposition of rocks. Transportation and deposition of sediments. Outline of sedimentary processes. Classification of sedimentary rocks: Tyrell's classification, Megascopic classification. Textures of sedimentary rocks.

Unit:2	Outline of depositional sedimentary environments	**10 hours**

Outline of depositional sedimentary environments. Structures of sedimentary rocks. Sedimentary residual deposits: soils, regolith,laterite, and terra rosa. Sedimentary mechanical deposits.

Unit:3	Sedimentary deposits of chemical origin	**15 hours**

Sedimentary deposits of chemical origin: evaporite, siliceous, carbonate, ferruginous, and clay rich deposits. Sedimentary deposit s of organic origin: calcareous, phosphatic, iron rich, and silica rich deposits. Petrographic description of: conglomerate, breccia, sandstone, shale and limestones.

Unit:4	Environmental Geology	**15 hours**

Definition and scope of environmental geology. Classification and types of natural resources. Renewable and non renewable resources. Impact of man on the environment. Groundwater pollution: definition, types and remedial measures. Geological factors in environmental health. Trace elements and human health. Chronic disease and geological environment

Unit:5	Energy resources	**15- hours**
Energy resources: definition, types, renewable and non-renewable energy resources. Environmental impact due to mining and mineral processing and its remediation. Coastal environments: definition, pollution in coastal areas, prevention of erosion along coasts. Types of human generated waste and outline of methods of disposal. outlineof Environmental law in India		
Unit:6	Contemporary Issues	**5 hours**
Additional Resources: Sedimentary Petrology and Environmental Geology related materials are available in CD/DVD format .**Assignments:** Any two assignments (within the five units) may be suggested by the Teacher. **Suggested Group Work/Tasks:** Field excursion is suggested under proper supervision and with the submission of a field report.		
	Total Lecture hours	**72hours**

Text Book(s)

1. **Tyrell,G.W.** (1958). Principles of Petrology. B.I. Publications. New Delhi.
2. **Haung,W.T.** (1962). Petrology. McGraw Hill. New York.
3. **Williams,H.** et al. (1982). Petrography. CBS. New Delhi.
4. **Greensmith,J.T.** (1976). Petrology of the Sedimentary Rocks. CBS.Delhi.
5. **Folk,R.L.** (1974). Petrology of the Sedimentary Rocks. Hemphill. Texas.USA.

Reference Books

1. **Keller,E.A.**(1985). Environmental Geology. Merill. New York.
2. **Miller,T.G.**(2004). Environmental Science. Wadsworth Publishing. USA.
3. **Flawn,P.T.** (1970). Environmental Geology. Harper.New York.
4. **Coates,D.R.** (1984). Environmental Geology. McGraw Hill. New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.britannica.com/science/environmental-geology

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	S	L	L	S	M	S	S	M
CO2	L	L	S	L	L	S	M	S	S	M
CO3	L	L	S	L	L	S	M	S	S	M
CO4	L	L	S	L	L	S	M	S	S	M
CO5	L	L	S	L	L	S	M	S	S	M

*S-Strong; M-Medium; L-Low

Course code		PAPER IX – ECONOMIC GEOLOGY	L	T	P	C
Core/Elective/Supportive		CORE	72	67	5	0
Pre-requisite		Basic knowledge on applied geology	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

The student is introduced to the basic principles of economic geology and mineral economics.
The methodology of teaching involves class lectures with mineral sample study and simple laboratory demonstrations

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain insight into the basic principles of economic geology and mineral economics	K3
2	Understand the economic value of the ores	K2
3	Understands ore processing techniques	K2
4	Understans ore textures and structures	K2
5	Understands Demand and supply of ores and Mineral conservation	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Scope of Economic Geology	12 hours

Definition and Scope of Economic Geology. Concepts of: Ore, gangue, tenor, grade, host rock, and economic value. Brief outline of factors controlling the generation of materials of a Mineral Deposit. Outline of Lindgren and Bateman's scheme of classification of mineral Deposits. Controls of ore deposit localization. Ouline of Metallogenic Epochs and Provinces.

Unit:2	Processes of Ore Formation I	12 hours

Processes of Ore Formation I: - Magmatic Concentration – Oxidation and Supergene Enrichment - Sublimation – Residual and Mechanical Concentration – Metamorphic – Metasomatism - Evaporation – Bactriogenic

Unit:3	Processes of Ore Formation II	14 hours

Processes of Ore Formation II: Hydrothermal: Cavity filling deposits and Replacement deposits. outlineof ore shoots. Contact Metasomatism – Sedimentation. Mineralogy, association, mode of occurrence and distribution in India of the minerals used in the following Industries: abrasives – refractory – cement – glass – ceramics – fertilizer – paints and pigments.

Unit:4	Ore textures and structures	15 hours

Brief account of ore textures and structures. Ore mineralogy, association, genesis, mode of occurrence, and Indian distribution of the following metallic ore deposits: - Fe, Cu, Mn, Au, and Mo.

Unit:5	Demand and supply of Ore and Mineral conservation	12- hours

Ore mineralogy, association, genesis, mode of occurrence, and Indian distribution of the following metallic ore deposits: - Al, Pb & Zn, and Cr. Mineral Economics: - Concept of strategic, critical and essential minerals – Demand and supply - Mineral conservation and substitution. Outline of

National Mineral Policy and Mineral Concession Rules. Building stones: - definition – characters – classification – Outlineof Indian distribution. Short account of granite industry in Tamil Nadu

Unit:6	**Contemporary Issues**	**5 hours**

Additional Resources: Web resources related to the above subjects are available .**Assignments:** Anytwo assignments (within the five units) may be suggested by the Teacher.**Suggested Group Work/Tasks:** Field visit to metallic ore deposit mines with proper permission is suggested with proper permission.

	Total Lecture hours	**72 hours**

Text Book(s)

1 **1. Aiyengar,N.K.N.**(1964). Minerals of Madras. Dept. of Industries & Commerce. Guindy,Madras.
2. Bateman,A.M. & M.L.Jensen.(1981). Economic Mineral Deposits. 3rd ed. Wiley. New York.
3. Edwards,R. & K. Atkinson. (1986). Ore Deposit Geology. Chapman & Hall. UK.
4. Krishnan,M.S. (1951). Mineral Resources of Madras. Memoir V.80. Geol.Surv.Ind. Kolkata.
5. Park,C.F. & M.A.MacDiarmid.(1970). Ore Deposits.Freeman.New York.
6. Prasad,U. (2003). Economic Mineral Deposits. CBS. Delhi.
7. Banerjee,D.K. (1998). Mineral Resources of India.World Press. Kolkata.
8. Deb,S.(1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.

Reference Books

1
1. **. Krishnasamy,S.** (1988). India's Mineral Resources. Oxford & IBH. Delhi.
2. **Sharma,N.L& R.K.Sinha.** (1985), Mineral Economics. Oxford & IBH.Delhi.
3. **Gokhale,K.V.G.K.&D.M.Rao**.(1981).Ore Deposits of India. Oxford & IBH.Delhi.
4. **Craig,R.C& D.V.Vaughan.**(1985).Ore Microscopy and Ore Petrography.Wiley.New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 **Additional Resources:** Web resources related to the above subjects are available .**Assignments:** Any two assignments (within the five units) may be suggested by the Teacher.**Suggested Group Work/Tasks:** Field visit to metallic ore deposit mines with proper permission is suggested with proper permission.

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	L	M	M	M	S	M
CO2	L	L	L	L	L	M	M	M	S	M
CO3	L	L	L	L	L	M	M	M	S	M
CO4	L	L	L	L	L	M	M	M	S	M
CO5	L	L	L	L	L	M	M	M	S	M

*S-Strong; M-Medium; L-Low

Course code		PAPER X - MINING GEOLOGY AND ORE DRESSING	L	T	P	C
Core/Elective/Supportive		CORE	72	67	5	0
Pre-requisite		Basic knowledge on ores and mineral resources	Syllabus Version		2021-22	

Course Objectives:

The main objectives of this course are to:

The student is introduced to the basic principles of mining geology and ore dressing. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain insight into the basic principles of mining geology.	K2
2	Understands Open cast mining methods	K2
3	Differentiate Subsurface and underground mining methods	K3
4	Understands Outline of Mine ventilation	K2
5	Learn about Ore Dressing	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Scope of mining geology	12 hours

Definition and scope of mining geology. **Methods of breaking over burden and rocks**: manual methods, mechanical methods, and utility of explosives in mining. **Sampling of mined materials**: channel, grab, chip, and bulk sampling. Sizing, pulverization, and coning and quartering of samples. Drilling: definition and purpose. **Drilling methods**: rotary, percussion, and diamond. Geological logging of bore hole samples.

Unit:2	Open cast mining methods	15 hours

Open cast mining methods: Parts of an open cast Mine: over burden, surface adit, bench,slope,drop-cut,over-break. Open cast mining equipment: bull dozer, front end loader, poclain, drag line with bucket, and wheel excavators. Strip mining and surface augering of coal beds and seams. Quarrying method for hard rocks. Glory hole mining.

Unit: 3	Subsurface and underground mining methods	15 hours

Alluvial mining of unconsolidated sediments and soft rocks. Hydraulicking method – panning and sluicing of sediments. Dredging of off shore unconsolidated sediments.

Subsurface and underground mining methods: Components of an underground mine: adit, shaft, level, cross cut,drift, tunnel, winze,raise,stope, and foot-wall and hanging wall. Mine stoping methods: open stope, level stoping, supported stopes, square set stopes, pillar supported stopes, and shrinkage stopes.

Unit:4	Outline of Mine ventilation	15 hours

Outline of Mine ventilation. Groundwater problems and their management in open cast and under ground mines. Modes of transportation of broken ore in open cast and underground mines. **Subsurface coal mining methods**: stope and pillar, long wall, room and pillar, and caving.

Unit:5	Ore Dressing	10- hours

Definition and scope of ore dressing in mining. Properties of minerals used in ore beneficiation

processes. Manual crushing of ores. Types of crushers: jaw, gyratory, and cone types; Types of grinders: tumbling, ball, and rod mills. Sizing and screening of crushed ores: purpose of screening, types of screens: Outlineof fixed types and moving types. Outlineof ore classifiers. Concentration of ores by jigging, floatation and magnetic separation. Outline of flows sheets used in ore dressing.

Unit:6	**Contemporary Issues**	**5 hours**

Assignments

Any two assignments (within the five units) may be suggested by the Teacher.

Suggested Group Work/Tasks

Field visit to mines with proper permission

	Total Lecture hours	**72 hours**

Text Book(s)

1. **Arogyaswamy, R.N.P.** (1988). Courses in Mining Geology, Oxford & IBH, New Delhi.
2. **Singh,R.D.** (1998). Coal Mining. New Age Publishers,Delhi.
3. **Thomas,R.T.** (1986). Introduction to Mining methods. McGraw Hill, New York.
4. **Peters,W.C.** (1978). Exploration and Mining Geology, Wiley,New York.
5. **Hartman,H.L.** (1992). SME Mining Engineering Handbook, SME Colorado,USA.
6. **McKinstry, H.E.**(1948). Mining Geology, Asia Publishing House,Delhi.

Additional Resources

Web resources related to the above subjects are available.

Reference Books

1. **Hartman,H.L.** (1992). SME Mining Engineering Handbook, SME Colorado,USA.
2. **McKinstry, H.E.**(1948). Mining Geology, Asia Publishing House,Delhi

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://en.wikipedia.org/wiki/Mineral_processing

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	L	L	L	L	M	S	M
CO2	L	L	L	L	L	L	L	M	S	M
CO3	L	L	L	L	L	L	L	M	S	M
CO4	L	L	L	L	L	L	L	M	S	M
CO5	L	L	L	L	L	L	L	M	S	M

*S-Strong; M-Medium; L-Low

Course code		PART –III MAJOR BASED ELECTIVE – 2 - MBE 2 - EXPLORATION GEOLOGY AND MINERAL FUELS	L	T	P	C
Core/Elective/Supportive		ELECTIVE	72	67	5	0
Pre-requisite		Basic knowledge in geochemistry	Syllabus Version	2021-22		

Course Objectives

The main objectives of this course are to:

The student is introduced to the basic principles of exploration and mineral fuels. The methodology of teaching involves class lectures with simple laboratory demonstrations

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The student gains insight into the basic principles of exploration and mineral fuels.	K1
2	Understand the distribution of ore deposits	K2
3	Learn about Geophysical Exploration	K3
4	Get an insight about Mineral Fuel Geology	K2
5	Able to know more about Petroleum Geology	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Ore deposits	12 hours

Exploration Geology: Geological and Geochemical Exploration

Guides to ore deposits: Mineralogic, lithologic, structural, stratigraphic, and physiographic. Controls of ore localization. Sampling of ores and minerals: definition and types of samples. Outline of sampling methodology. **Geochemical Exploration**: definition and scope. Basic principles: Concepts of background, threshold, and anomalous values. Distribution of elements around ore bodies: primary, secondary, and leakage haloes. Outlineof lithogeochemical and hydrogeochemical methods.

Unit:2	Geophysical Exploration	12 hours

Gravity Method: Definition of gravity. Newton's Law of Gravitation. Gravity measurements: Absolute and relative. Gravity units. Gravimeters: Outlineof Stable and Unstable gravimeters. Gravity Surveys. Applications and limitations of gravity methods. **Magnetic Methods:** Components of earth's magnetic field. Magnetic character of rocks and minerals. Units of measurement. Magnetometers: Types. Magnetic surveys. Applications and limitations of magnetic methods.

Unit:3	Physical methods	13 hours

Electrical Methods: Definition – Ohm's Law – Resistivity and conductivity – Electrical properties of rocks and minerals - Units of measurement. Resistivity surveying equipment. Electrode configurations: Wenner – Schlumberger. Applications and limitations of resisitivity methods. **Seismic Methods:** General principles. Methods of generating artificial seismic waves. Geophones – types and their limitations. Recording equipment. **Refraction Methods:** Principle – Instruments and equipment – Field Methods: Fan, Arc, and Profile shooting. **Reflection Methods:** Principle - Instruments and equipment – Field Operations: Shot point and Detector spreads. Applications and limitations.

Unit:4	**MINERAL FUEL GEOLOGY**	**15 hours**

Coal Geology and Radioactive Minerals

Definition of coal geology and its scope. Coal: definition, types and rank of coal. Outlineof chemical and physical characters of coal. Origin of coal. Outlineof Coalification process. Indian Coal deposits: Gondwana Coal and Tertiary Lignite.**Radioactive Minerals**: definition, radioactive minerals and their host rocks. Outlineof Geiger Muller Counter. Distribution of radioactive minerals in India with special reference to Tamil Nadu.

Unit:5	**Petroleum Geology**	**15- hours**

Definition of Petroleum Geology and its scope. Petroleum: definition, composition, physical properties. Outlineof origin. Migration of petroleum. Petroleum Traps and seals. Reservoir rocks and their properties. Oil window. Concept of Kerogen. Oil fields of India: Assam, Gujarat, Bombay High and Cauvery basin. Short account of Natural Gas deposits in India. Natural gas hydrates: definition and Outlineof uses.

Unit:6	**Contemporary Issues**	**5 hours**

Additional Resources: The student may consult the Class Teacher for additional web resources and related materials. Other related materials are available in CD/DVD format .**Assignments:** Any two assignments may be suggested by the Teacher.

Suggested Group Work/Tasks: Field visit to known areas is suggested under proper supervision and with the submission of a field report.

	Total Lecture hours	**72 hours**

Text Book(s)

1 **1.Banerjee,P.K. & S.Ghosh**. (1997). Elements of Prospecting for Non Fuel Mineral Deposits.Allied. Chennai.
2.Arogyaswamy,R.N.P. (1980). Courses in Mining Geology.Oxford & IBH,New Delhi.
3.Hawkes,H.E. (1959). Principles of Geochemical Prospecting. Bulletin 1000F.USGS.
4.Moon,C.J et al.(2006). Introduction to Mineral Exploration. Wiley Blackwell. New Delhi.
5.Ramachandra Rao,M.B. (1993). Outlineof Geophysical Prospecting. EBD Publishers,Dhanbad.
6.Kearey,Pet al.(2002). An Introduction to Geophysical Exploration. Wiley. Delhi.
7.Mussett,A.E.& Khan,M.A.(2000). Looking into the Earth. Cambridge University Press, New Delhi.
8. Sharma,P.V. (2005). Environmental and Engineering Geophysics. Cambridge University Press. Delhi.

Additional Resources & Assignments: Web resources related to the above subjects are available .Any two assignments (within the five units) may be suggested by the Teacher.

Reference Books

1
1. **Prasad,U.** (2003). Economic Mineral Deposits. CBS. Delhi.
2. **Banerjee,D.K.** (1998). Mineral Resources of India.World Press. Kolkata.
3. **Deb,S**.(1985). Industrial Minerals and Rocks of India. Oxford & IBH. Delhi.
4. **Krishnasamy,S.** (1988). India's Mineral Resources. Oxford & IBH. Delhi.
5. **Sharma,N.L& R.K.Sinha.** (1985), Mineral Economics. Oxford & IBH.Delhi.
6. **Gokhale,K.V.G.K.&D.M.Rao**.(1981).Ore Deposits of India. Oxford & IBH.Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.environment.gov.scot/media/1215/natural-resources-fossil-fuels-and-minerals.pdf
Course Designed By:Dr. J. Ebanasar	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	S	L	L	L	M	L	M	S	M
CO2	L	S	L	L	L	M	L	M	S	M
CO3	L	S	L	L	L	M	L	M	S	M
CO4	L	S	L	L	L	M	L	M	S	M
CO5	L	S	L	L	L	M	L	M	S	M

*S-Strong; M-Medium; L-Low

Course code		PART –III MAJOR BASED ELECTIVE – 3: MBE III - ENGINEERING GEOLOGY, COMPUTER APPLICATIONS IN GEOLOGY AND GEOSTATISTICS	L	T	P	C
Core/Elective/Supportive		CORE	72	67	5	0
Pre-requisite		Basic knowledge in computer and statistics	Syllabus Version	2021-22		

Course Objectives:

The main objectives of this course are to:

The student is introduced to the basic principles of engineering geology, computer application in geology, and geostatistics. The methodology of teaching involves class lectures with simple laboratory demonstrations.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	The student gains insight into the basic principles of engineering geology,	K2
2	Understand Engineering properties of rocks	K1
3	Study the site site selection of Dams and Tunnels:	K3
4	Computer applications in Geology	K2
5	Geostatistics	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Engineering properties of rocks	**12 hours**

Definition and scope of Engineering Geology. Engineering properties of rocks. Soils: definition and engineering properties. Geological Investigations in engineering sites. Slope stability: definition, slope failure and safety, geological factors, groundwater conditions and remedial measures.

Unit:2	Dams	**12 hours**

Dams: definition, types, geological conditions, and site investigations. Short note on dam foundations and geological conditions. Outline of important Indian Dams. Reservoirs: definition, selection of reservoir sites, and groundwater conditions. Problems in reservoirs: sedimentation, slope control, leakage and seismicity. Short account of Indian reservoirs.

Unit:3	Tunnels	**13 hours**

Tunnels: definition, parts of a tunnel, types, tunnelling in hard and soft rocks, geological investigations, and groundwater conditions. Foundations: definition, geological investigations, and ground water problems. Outline of support structures: rods, bolts, anchors, arches, rings, linings, and retaining walls.

Unit:4	Computer applications in Geology	**15 hours**

Introduction to flow charts and algorithms. Outline of system configuration for geologically oriented software: GIS and digital mapping software. A short account of: Aqua, Stereoplot, Stereowin, Petrograph, Rockware, and Surfer. Use of Excel spread sheets in Petrology, Hydrogeology and Geostatistics.

Unit:5	Geostatistics	**15- hours**

Definition and scope of statistics in Geology. Measures of central tendency. Distributions – Scales – population. Brief introduction to sampling methods. Outline of errors in sampling. Variables; Tabulation; Introduction to probability. Simple correlation and linear regression. Outline of graphical methods in statistics: bar chart, pie diagram, and XY graph. Outline of application of statistics in geology.

Unit:6	**Contemporary Issues**	**5 hours**

Additional Resources: The student may consult the Class Teacher for additional web resources and related materials. Other related materials are available in CD/DVD format .**Assignments:** Any two assignments may be suggested by the Teacher.

Suggested Group Work/Tasks: Field visit to known areas is suggested under proper supervision and with the submission of a field report.

	Total Lecture hours	**72 hours**

Text Book(s)

1. **Bell,F.G.**(2005).Fundamentals of Engineering Geology. B.S.Publications. Hyderabad.
2. **Blyth,F.G.H. & M.H.De Freitas.**(1984).A Geology for Engineers. 7th ed. Elsevier. New Delhi.
3. **Parbin Singh,B.**(2005). A Textbook of Engineering and General Geology. S.K.Kataria & Sons.Delhi.
4. **Ravichandran,D.**(2001). Introduction to Computers and Communication. Tata McGraw Hill.Delhi.
5. **Guptha,S.**(2004). Basic Statistics. S.Chand & Sons. Delhi.
6. **Davis,J.C.** (1985). Statistical and Data Analysis in Geology.Wiley. Delhi.
7. **Guptha,S.**(1990). Statistical Methods. S.Chand & Sons. Delhi.

Additional Resources: Web resources related to the above subjects are available .
Assignments: Any two assignments (within the five units) may be suggested by the Teacher.

Reference Books

1. **Krynine,P.D. & W.R. Judd.**(1956). Principles of Engineering Geology & Geotechnics. CBS. Delhi.
2. **Legget,R.F. & A.W.Hatheway.**(1988). Geology and Engineering. 3 rd ed. McGraw Hill. New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://en.wikipedia.org/wiki/Engineering_geology

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	S	L	L	L	M	L	M	S	S
CO2	L	S	L	L	L	M	L	M	S	S
CO3	L	S	L	L	L	M	L	M	S	S
CO4	L	S	L	L	L	M	L	M	S	S
CO5	L	S	L	L	L	M	L	M	S	S

*S-Strong; M-Medium; L-Low

Course code		PRACTICAL III - MINERALOGY AND PETROLOGY	L	T	P	C
Core/Elective/Supportive		CORE	90	5	85	0
Pre-requisite		Knowledge on minerals and ores	Syllabus Version		2021-22	

Course Objectives:

The objective of this course is to give hands on experience for the students in identifying and analysing minerals and ores.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	determine system of crystallization of selected groups of minerals	K3
2	Petrographic identification of mineral thin sections	K4
3	Megascopic identification of rocks	K3
4	Identify Regional Metamorphic Rocks	K5
5	Can use ROCK MICROSCOPY and analyze rocks	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	MINERALOGY	15 hours

A. MEGASCOPY

Megascopic Identification of rock forming silicate on the basis of their physical properties, chemical composition and determination of system of crystallization of the following groups of minerals:

Quartz Group: Rock Crystal, Blue quartz, Smoky quartz, Chalcedony, Opal, Agate, Flint, Jasper, Amethyst.

Feldspars Group: Orthoclase, Microcline, Albite, Oligoclase, Labradorite, Anorthite, Perthite.

Feldspathoid Group: Nepheline, Sodalite, Lazurite.

Pyroxene Group: Enstatite, Bronzite, Hypersthene, Augite, Diopside,Rhodonite, Wollastonite.

Amphibole Group: Anthophylite, Actinolite, Tremolite, Hornblende, Glaoucophane.

Mica Group: Muscovite, Biotite, Phlogopite, Lepidolite, Vermiculite.

Alumina Group: Kyanite,Sillimanite,Andalusite.

Zeolite Group: Leucite, Natrolite, Apophyllite,Stilbite.

Miscellaneous Silicates: Olivine, Garnet,Beryl , Zircon, Cordierite, Talc, Steatite, Kaolin, Topaz, Tourmaline.

Non-Silicates: Apatite,Calcite,Dolomite,Fluorite

Unit:2	MINERAL MICROSCOPY	15 hours

Petrographic identification of mineral thin sections based on their crystallography and diagnostic optical properties.

Isometric Minerals: Garnet, Fluorite, Analcite, Spinel, Sodalite, Scapolite.

Tetragonal Minerals: Zircon, Leucite, Apophyllite, Rutile.

Hexagonal Minerals: Quartz – basal and non basal, Tourmaline, Calcite, Dolomite, Beryl, Corundum,

Orthorhombic Minerals: Olivine, Hypersthene, Cordierite, Andalusite, Sillimanite

Monoclinic Minerals :

Staurolite,Orthoclase,Augite,Aegirine,Diopside,Spodumene,Muscovite,Biotite,Chlorite,Epidote, Hornblende, Sphene, Serpentine, Stilbite, Actinolite, Tremolite,

Triclinic Minerals: Microcline, Albite, Oligoclase, Andesine

Unit:3	ROCK MEGASCOPY	20 hours

ROCK MEGASCOPY

Megascopic identification of rocks based on petrographic characters, mineralogy, and other diagnostic megascopic features.

I.Igneous Rocks:

Acid Igneous Rocks: Granites: graphic granite, aplite, pegmatite, tourmaline granite, schorl rock, pyroxene granite, hornblende granite, mica granite, pink granite, porphyritic granite, granodiorite.

Intermediate Igneous Rocks: Syenites**:** quartz syenite, corundum syenite, nepheline syenite, perthitic syenite, pyroxene syenite, hornblende syenite, mica syenite, porphyritic syenite, diorite,

Basic Igneous Rocks: Gabbros: gabbro, norite, dolerite.

Ultrabasic Igneous Rocks: anorthosite.

Ultramafic Igneous Rocks: dunite, peridotite, pyroxenite.

Alkaline Igneous Rocks: lamphrophyre, carbonatite, kimberlite.

Volcanic Igneous Rocks: basalts: vesicular, amygdaloidal, vitrophyric basalt. pitchstone, scoria, pumice, obsidian, rhyolite, rhyodacite, trachyte.

Unit:4	Metamorphic Rocks	20 hours

Metamorphic Rocks

Regional Metamorphic Rocks: slate: colored and porphyroblastic varieties; phyllite; schists: mica, kyanite, amphibole, and talc; gneisses: banded, garnetiferous, injection type, migmatite varieties; amphibolite; eclogite; granulites: charnockite types; khondalite; gondite; grodurite; leptynite.

Contact Metamorphic Rocks: marble, quartzite, skarn,hornfels.

III Sedimentary Rocks

Clastic Rocks: sandstone and its varieties; breccias; conglomerate; shale and its varieties;greywackes.

Non-clastic rocks: limestone and its varieties; flint; chert;

Coal: peat, lignite, bituminous, and anthracite

Unit:5	ROCK MICROSCOPY	15- hours

ROCK MICROSCOPY

Petrographic identification of rock thin sections based on their petrographic characters, mineralogy and diagnostic features.

Igneous Rocks:

Graphic granite, aplite, pegmatite, tourmaline granite, schorl rock, hornblende granite, mica granite, pink granite,porphyritic granite, granodiorite; quartz syenite, nepheline syenite, perthitic syenite, pyroxene syenite, hornblende syenite, mica syenite, porphyritic syenite,diorite; gabbro, norite, dolerite; anorthosite; dunite,peridotite,pyroxenite; lamphrophyre, carbonatite, kimberlite; basalts: vesicular, amygdaloidal, vitrophyric basalt. pitchstone, scoria, pumice, obsidian, rhyolite, rhyodacite, trachyte, phonolite.

Metamorphic Rocks:

Slate,phyllite,schists,:mica,kyanite,amphibole,and talc; gneisses: banded, garnetiferous, injection type, migmatite varieties; amphibolite; eclogite; granulite: charnockite; khondalite; gondite; grodurite; leptynite; marble, quartzite, skarn,hornfels.

Sedimentary Rocks:

Sandstone and its varieties; breccias; conglomerate; shale and its varieties;greywackes; limestone and its varieties;flint;chert

Unit:6	Contemporary Issues	5 hours

FIELD TRAINING PROGRAMME:III Year of the Course.

In part fulfilment of the B.Sc.,Applied Geology degree course, the students should be taken to areas of geological importance for a period of 5 to 7 days, to collect rock and mineral samples for megascopic and microscopic study in the laboratory. They should present the collected specimens and submit a report on the field training at the time of the Main Practical

	Total Lecture hours	90 hours

Text Book(s)

1. **Thomas,R.T.** (1986). Introduction to Mining methods. McGraw Hill, New York.
2. **Peters,W.C.** (1978). Exploration and Mining Geology, Wiley,New York.
3. **Hartman,H.L.** (1992). SME Mining Engineering Handbook, SME Colorado,USA.
4. **McKinstry, H.E.**(1948). Mining Geology, Asia Publishing House,Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. **https://www.gsi.gov.in/webcenter/portal/OCBIS/pageQuickLinks/pageTIPetrology?_afrLoop=3874309304224069&_adf.ctrl-state=r3achsmke_1#!%40%40%3F_afrLoop%3D3874309304224069%26_adf.ctrl-state%3Dr3achsmke_5**

Internal Assessment Marks for the practical are given below:
Attendance in Practical Classes: 5 marks;
Practical Tests: 10 marks.
Full Attendance during field training, collection, and submission of field report: 25 marks.
Total: 40 marks.

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	S	L	M	S	M	L	M	S	S
CO2	L	S	L	M	S	M	L	M	S	S
CO3	L	S	L	M	S	M	L	M	S	S
CO4	L	S	L	M	S	M	L	M	S	S
CO5	L	S	L	M	S	M	L	M	S	S

*S-Strong; M-Medium; L-Low

Course code		PART- IV SKILL BASED ELECTIVE PAPER – 6: SBE VI - ECONOMIC MINERALS, GEOCHEMISTRY AND FIELD GEOLOGY PRACTICAL	L	T	P	C
Core/Elective/Supportive		SUPPORTIVE	45	4	41	0
Pre-requisite		Basic knowledge in field geology and geochemistry	Syllabus Version		2021-22	

Course Objectives:

The student is introduced to the different laboratory based methods and techniques relevant to field and geology and geological mapping. The methodology of teaching involves class lectures with problem solving exercises and simple laboratory demonstrations.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain some expertise by using the different laboratory based methods and techniques relevant to field and geology and geological mapping	K2
2	Identify geomorphological features from Aerial photographs	K1
3	Identify gem stones	K3
4	Analyse and qualitatively determine mineral ores.	K2
5	Able to analyze quality of ground water	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Geomorphology	8 hours

Determination of strike, dip, trend and plunge of geological structures or features using Clinometer Compass and Brunton Compass.

Identification of geomorphologic features and major drainage patterns from scaled Aerial Photographs.

Unit:2	Identification of the following gem stones	8 hours

Identification of the following gem stones:

Diamond,ruby,sapphire,topaz,quartz,amethyst,agate,opal,jasper,cats-eye,diopside,moonstone,labradorite, sodalite,lazurite,beryl,garnet,kyanite

Unit:3	Megascopic identification of industrial and ore minerals:	8 hours

Megascopic identification of industrial and ore minerals:

Industrial Minerals: magnesite, gypsum, asbestos, fluorite, calcite, graphite, barite, talc, witherite, strontianite, anhydrite, halite, dolomite, aragonite, kaolin, garnet, corundum, phosphate nodule.

Ore minerals: **Fe ores**: magnetite, hematite, limonite, pyrite, marcasite and siderite. **Cu ores**: chalcopyrite, cuprite, bornite, malachite, azurite, native copper. **Mn ores**: pyrolusite, psilomelane, rhodochrosite,and rhodonite. **Pb ores**: galena, cerussite, anglesite. **Zn ores**: smithsonite, sphalerite. **Sn ore**: cassiterite. **As and Sb ores**: realgar,orpiment, stibnite. **Other ores**: wolframite, molybdenite, bauxite, chromite, ilmenite, rutile, cinnabar. **Radioactive Ores**: monazite, zircon,pitchblende, and pyrochlore.

Unit:4	Qualitative Analysis of Ores	8 hours
Qualitative Analysis of Ores using the method of Blow pipe. Calcite,dolomite,magnesite,gypsum,bauxite,apatite,anhydrite,celestite,barite,magnetite,hematite, chromite,galena,pyrolusite,psilomelane,stibnite,sphalerite,cuprite,wolframite,malachite, and smithsonite.		
Unit:5	**Groundwater quality**	**9 hours**
Determination of pH value and selected water quality parameters of groundwater samples. (Estimation of silicates, phosphates, Nitrates, alkalinity, Total hardness, Calcium) Determination of elemental concentration of select prepared ore solutions by Spectrophotometer.		
Unit:6	**Contemporary Issues**	**4 hours**
Local collection of ores and identification		
	Total Lecture hours	**45 hours**

Text Book(s)

1.Banerjee,P.K. & S.Ghosh. (1997). Elements of Prospecting for Non Fuel Mineral Deposits.Allied. Chennai.
2.Arogyaswamy,R.N.P. (1980). Courses in Mining Geology.Oxford & IBH,New Delhi.
3.Hawkes,H.E. (1959). Principles of Geochemical Prospecting. Bulletin 1000F.USGS.
4.Moon,C.J et al.(2006). Introduction to Mineral Exploration. Wiley Blackwell. New Delhi.
5.Ramachandra Rao,M.B. (1993). Outlineof Geophysical Prospecting. EBD Publishers,Dhanbad.
6.Kearey,Pet al.(2002). An Introduction to Geophysical Exploration. Wiley. Delhi.
7.Mussett,A.E.& Khan,M.A.(2000). Looking into the Earth. Cambridge University Press, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://en.wikipedia.org/wiki/Geochemistry

Course Designed By:Dr. J. Ebanasar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
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CO2	L	M	L	M	S	M	L	S	S	S
CO3	L	M	L	M	S	M	L	S	S	S
CO4	L	M	L	M	S	M	L	S	S	S
CO5	L	M	L	M	S	M	L	S	S	S

*S-Strong; M-Medium; L-Low

Annexure

B.Sc. Geology

Syllabus
(With effect from 2021-2022)

Program Code :

Bharathiar University
(A State University, Accredited with "A" Grade by NAAC and 13th Rank among Indian Universities by MHRD-NIRF)
Coimbatore 641 046, INDIA