Since 1919

NATIONAL COLLEGE *(AUTONOMOUS)*

(Nationally Re-Accredited at "A+" Level by NAAC with CGPA of 3.61)

Recognized as a College with Potential for Excellence by UGC

Tiruchirappalli- 620001

Since 1961

POST GRADUATE AND RESEARCH DEPARTMENT OF GEOLOGY

Scheme & Syllabus for B.Sc., Geology
Outcome Based Education System (OBES)
Applicable to the candidates admitted
from the academic year 2022-2023 onwards

POST GRADUATE AND RESEARCH DEPARTMENT OF GEOLOGY

NATIONAL COLLEGE *(AUTONOMOUS)*

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Vision

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

Mission

- To educate and impart training to students towards providing effective geology work force
- To impart knowledge and skills towards developing sustainable solutions for various geological problems relating to the society
- To enhance the performance of the students in competitive examinations such as IIT-JAM, GATE, CSIR-NET, SET, UPSC, TNPSC, etc.
- To invite distinguished geologists and geoscientists of various government and private sectors for special lectures

Programme structure

Category	No of courses	Total Credits
Core Course (T+P)	13	68
Elective Course	03	12
Allied Course (T+P)	06	18
Language /English Course	10	24
Non Major Elective Course	02	04
Skill Based Elective Course	03	06
Soft Skills Course	01	02
Value Education Course	01	02
Environmental Studies Course	01	02
Gender Studies Course	01	01
Extension Activities	01	01
Total	42	140

B.Sc. Programme Outcomes (POs):

The programme outcomes relating to B.Sc. Degree programme include:

PO1	Imparting knowledge on the fundamental concepts, principles and processes in the programme and its various important branches and its linkages with related disciplines.
PO2	Imparting field-based knowledge to make the learning process interesting and to provide a complete knowledge of the programme and its courses.
PO3	Imparting knowledge on acquiring practical knowledge on various fields of the programme using laboratory exercises.
PO4	Imparting technical, analytical, creative and problem-solving skills relating to the programme.
PO5	Moulding the students to become professionals / entrepreneurs and, self-employed in various fields of the programme and its various related fields.
PO6	Orienting the students towards taking up higher learning programmes in various fields of the programme.
PO7	Recognise and appreciate the importance of the programme and its application in academic, industrial, environmental and social contexts.
PO8	Making every student to be a socially responsible citizen.

Programme Specific Outcomes (PSOs):

The student graduating with the **B.Sc. Geology** Degree would have acquired knowledge on:

PSO1	Earth's origin, structure, materials and history along with processes and landforms associated with various geomorphic agents.
PSO2	The linkages with other related discipline such as Geography, Environmental sciences, Physics, Chemistry, Mathematics, Life sciences, Remote Sensing, Information Technology.
PSO3	Geological history of the Earth including the life forms and geological events in a temporal frame work.
PSO4	Endogenetic and Exogenetic processes of the Earth.
PS05	Various skills such as identification of crystals, minerals, rocks, ores, fossils in hand specimens and microscope.
PSO6	Using instruments in field and lab, interpreting topographic maps, geologic maps, constructing cross-sections and visualising in 3D.
PSO7	Various structural features on the stress associate with them.
PSO8	Understanding the pathways, fluxes, and influence of water and other fluids at Earth's surface and in the subsurface. Explore, Identify, interpret and exploit different types of economic deposits in surface and subsurface. Also to explore and exploit economic minerals and materials in surface and subsurface.
PSO9	Improving the presentation skills of our students especially related to complex geologic concepts.
PSO10	Enlighten their knowledge on higher learning programmes.
PSO11	Social responsibilities and obligations.

B. Sc. Geology - Scheme of Examination

(Applicable to the candidates admitted from the academic year 2022-2023 onwards)

Semester	Part	Course Title	Title	Instr. Hours/week	Credit	Exam Hours	Marks			Total
							Internal	External		
								Oral	Theory	
I	I	Language Course–I (U22T1/ U22H1/ U22S1)		6	3	3	25		75	100
	II	English Language Course–I (U22E1)		6	3	3	25		75	100
	III	Core Course – I (U22GY1)	The Dynamic Earth	5	5	3	25		75	100
		Core Course – II (U22GY2P)	Practical I – Surveying and Palaeontology	3	-	-	-	-	-	-
		First Allied Course–I (U221AC 1)		5	3	3	25		75	100
		First Allied Course – II (U221AC 2)		3	-	-	-	-	-	-
	IV	Environmental Studies (U22ES)		2	2	3	25		75	100
		Total		**30**	**16**					**500**
II	I	Language Course–II (U22T2/ U22H2/ U22S2)		6	3	3	25		75	100
	II	English Language Course – II (U22E2)		4	2	3	25		75	100
		Communicative English – I (U22CE1)		2	1	3	25	5	70	100
	III	Core Course – II (U22GY2P)	Practical I – Surveying and Palaeontology	3	5	3	25	5	70	100
		Core Course – III (U22GY3)	Palaeontology	5	5	3	25		75	100
		First Allied Course – II (U221AC 2)		3	3	3	25	5	70	100
		First Allied Course – III (U221AC 3)		5	3	3	25		75	100
	IV	Skill Based Elective – I (U22SBEI)	Basic Computer Studies	2	2	3	25		75	100
		Total		**30**	**24**					**800**
III	I	Language Course – III (U22T3/ U22H3/ U22S3)		6	3	3	25		75	100
	II	English Language Course –IV (U22E3)		6	3	3	25		75	100
	III	Core Course – IV (U22GY4)	Mineralogy	4	4	3	25		75	100
		Core Course – V (U22GY5P)	Practical II –Mineralogy and Crystallography	3	-	-	-	-	-	-
		Second Allied Course – I (U222AC 1)		4	3	3	25		75	100
		Second Allied Course – II (U222AC 2)		3	-	-	-	-	-	-
	IV	Skill Based Elective Course – II (U22SBE2)	Geostatistics	2	2	3	25		75	100
		Skill Based Elective Course – III (U22SBE3P)	Basic Computer Studies and Geostatistics	2	2	3	25		75	100
		Total		**30**	**17**					**600**

IV	I	Language Course – IV (U22T4/ U22H4/ U22S4)		6	3	3	25		75	100
	II	English Language Course –IV (U22E4)		4	2	3	25		75	100
		Communicative English – II (U22CE2)		2	1	3	25		75	100
	III	Core Course – V (U22GY5P)	Practical II – Mineralogy & Crystallography	3	5	3	25	5	70	100
		Core Course – VI (U22GY6)	Crystallography and Gemology	4	4	3	25		75	100
		Second Allied Course – II (U222AC 2)		3	3	3	25	5	70	100
		Second Allied Course – III (U222AC 3)		5	3	3	25		75	100
	IV	Non Major Elective Course – I (U22NME1)	Elements of Geology	2	2	3	25		75	100
		Value Education Course –(U22 VE)		1	2	3	25		75	100
		Total		**30**	**25**					**900**
V	III	Core Course – VII (U22GY7)	Igneous and Metamorphic Petrology	5	5	3	25		75	100
		Core Course – VIII (U22GY8)	Sedimentary Petrology and Structural Geology	5	5	3	25		75	100
		Core Course – IX (U22GY9P)	Practical III – Petrology and Structural Geology	6	6	3	25	5	70	100
		Elective Course – I (U22GY10E1 / U22GY10E2)	Environmental Geology and Marine Geology / Natural Disasters	5	4	3	25		75	100
		Elective Course – II (U22GY11E1 / U22GY11E2)	Remote Sensing and Field Geology / GIS and GNSS	5	4	3	25		75	100
	IV	Non Major Elective Course – II (U22NME2)	Geology and Environment	2	2	3	25		75	100
		Soft Skills (U22SS)		2	2	3	25		75	100
		Total		**30**	**26**					**700**
VI	III	Core Course – X (U22GY12)	Stratigraphy	6	6	3	25		75	100
		Core Course – XI (U22GY13)	Economic Geology	6	6	3	25		75	100
		Core Course – XII (U22GY14)	Mineral Prospecting and Mining Geology	6	6	3	25		75	100
		Core Course – XIII (U22GY15P)	Practical IV –Economic Geology, Mining Geology and Hydrogeology	6	6	3	25	5	70	100
		Elective Course III (U22GY16E1 / U22GY16E2)	Hydrogeology and Engineering Geology / Geoexploration	5	4	3	25		75	100
	V	Gender Studies Course (U22GS)		1	1	3	25		75	100
		Extension Activities		--	1	--	--	--	--	--
		Total		**30**	**30**					**600**
			Total	**180**	**140**					**4100**

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

MAPPING OF PROGRAMME SPECIFIC OUTCOMES (PSO) WITH COURSE OUTCOMES (CO)

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11
CC1	✓	✓	✓	✓			✓		✓	✓	✓
CC2	✓	✓	✓		✓	✓	✓		✓	✓	✓
CC3	✓	✓	✓	✓	✓			✓	✓	✓	✓
CC4	✓	✓		✓	✓	✓		✓	✓	✓	✓
CC5	✓	✓		✓	✓			✓	✓	✓	✓
CC6	✓	✓		✓	✓			✓	✓	✓	✓
CC7	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
CC8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CC9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CC10	✓	✓	✓	✓			✓	✓	✓	✓	✓
CC11	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
CC12	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CC13	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
10EC1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10EC2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11EC1	✓	✓		✓		✓	✓	✓	✓	✓	✓
11EC2	✓	✓				✓	✓		✓	✓	✓
16EC1	✓	✓		✓		✓	✓	✓	✓	✓	✓
16EC2	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
SBE1		✓				✓			✓	✓	✓
SBE2		✓							✓	✓	✓
SBE3		✓							✓	✓	✓

CO - Course Outcome, CC-Core Course, EC-Elective Course, SBE- Skill Based Elective.
PSO - Programme Specific Outcome

MAPPING OF COURSE OUTCOMES (CO) REVISED BLOOM'S TAXONOMY (BT)

CO/BT	K1	K2	K3	K4	K5	K6
CC1	✓	✓	✓	✓		
CC2	✓	✓	✓	✓		
CC3	✓	✓	✓	✓	✓	✓
CC4	✓	✓	✓	✓		
CC5	✓	✓	✓	✓		
CC6	✓	✓	✓	✓		
CC7	✓	✓	✓	✓		
CC8	✓	✓	✓	✓		
CC9	✓	✓	✓	✓	✓	✓
CC10	✓	✓	✓	✓		
CC11	✓	✓	✓	✓		
CC12	✓	✓	✓	✓		
CC13	✓	✓	✓	✓	✓	✓
10EC1	✓	✓	✓	✓		
10EC2	✓	✓	✓	✓		
11EC1	✓	✓	✓	✓		
11EC2	✓	✓	✓	✓		
16EC1	✓	✓	✓	✓		
16EC2	✓	✓	✓	✓		
SBE1	✓	✓	✓	✓	✓	✓
SBE2	✓	✓	✓			
SBE3	✓	✓	✓	✓	✓	✓

CO – Course Outcome, CC-Core Course, EC-Elective Course, SBE- Skill Based Elective.
BT-Bloom's Taxonomy, K1-Remember, K2- Understand, K3-Apply, K4-Analyse, K5-Evaluate, K6- Create.

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
I	U22GY1	THE DYNAMIC EARTH	5	25	75	100

Course Objectives

To impart knowledge on

- Geology and its branches, Solar System and its origin, various spheres of the Earth, continents and oceans, materials and a brief history of the Earth
- Earth's interior, Earth's gravitational and magnetic fields, salient aspects of continental drift, sea floor spreading and plate tectonics
- Earthquakes, volcanism, orogeny, mountain belts, age determination of rocks and, past views and present estimation of age of the Earth
- Concepts of study of landforms, weathering, processes and landforms of running water and groundwater, drainage patterns and, lakes
- Processes and landforms of glaciers, wind, sea waves, coral reefs, geologic structures and, major landforms of India

Unit 1: Geology: importance and branches – Solar System: components, important theories of its origin – Earth: shape and size – Outline of primary geochemical differentiation – Salient features of Earth's atmosphere, hydrosphere, biosphere and lithosphere – Continents and oceans, their important features – Elements in the Earth, crustal abundance of elements, rock cycle – Outline of the geological history of the Earth.

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

Unit 3: Earthquakes: causes, types of seismic waves, earthquake belts of the world and its relation to plate tectonics, expression of earthquake strength, effects – Volcanism: causes, types of eruption, products, global volcanic belts, effects – Orogeny, orogenic cycles, epeirogeny – Mountain belts: their characteristics, size, alignments, age – Time and Geology: principles used for the determination of relative and absolute time – Age of the Earth: outline on past and present views

Unit 4: Basic concepts of the study of landforms – Applications of the study of landforms – Weathering: types and products – Fluvial processes and landforms – Drainage patterns – Landforms formed due to the action of groundwater – Lakes: types of lakes and lake deposits.

Unit 5: Glacial processes and landforms, glacial distribution and types – Processes and landforms formed due to wind – Coastal processes and landforms – Coral reefs: importance, types and distribution – Major landforms of India.

Text Books

1. Arthur Holmes (1965). Principles of Physical Geology (II Revised Edition), Thomson Learning Australia.
2. Dayal, P (2010). A Text Book of Geomorphology, Rajesh Publications, New Delhi.
3. Duff, P.M.D (1993). Principles of Physical Geology (IV Edition), Springer.
4. Kale, V and A. Gupta (2010). Introduction to Geomorphology, Universities Press, Hyderabad
5. Mahapatra, G.B (2016). Text Book of Physical Geology, CBS Publishers & Distributors, New Delhi
6. Mukherjee, P.K (1981). A Text Book of Geology. World Press
7. Patwardhan, A.M (2010). The Dynamic Earth System (II edition), PHI Learning Private Ltd., New Delhi
8. Roy, A.B (2010). Fundamentals of Geology, Narosa Publishing House Pvt. Ltd., New Delhi
9. Savindra Singh (2018). Geomorphology, Pravalika Publications, Allahabad

Reference Books

1. Chernicoff, S and H.A. Fox (2000). Essentials of Geology, Houghton Mifflin Company, New York
2. Cesare Emiliani (1997). Planet Earth, Cambridge University Press, Cambridge
3. Carlson D.H and C.C. Plummer (2009). Physical Geology: Earth Revealed, McGraw-Hill, New York
4. Christiansen, E.H and W. K. Hamblin (2014). The Dynamic Earth, Jones & Bartlett Publishers, Inc., New York
5. Plummer, C.C., Carlson, D.H and L. Hammersley (2016). Physical Geology (XV Edn.), McGraw-Hill, New York
6. Sreepat Jain (2014). Fundamentals of Physical Geology, Springer India, New Delhi
7. Turbuck. J.E and F.K. Lutgens (2014). Earth: An Introduction to Physical Geology, Pearson Education, New York
8. Thompson, G.R and J. Turk (1997). Introduction to Physical Geology (II Edn.), Brooks Cole Publishers, New York

Course Outcomes

At the end of the course the student would have gained sufficient knowledge on

- Components and origin of Solar System, spheres of the Earth, continents and oceans, materials of the Earth, and Earth's history
- Earth's interior, internal temperature, gravitational and magnetic fields, continental drift, sea floor spreading and plate tectonics
- Earthquakes, volcanism, orogeny, mountain belts, age determination of rocks and, past views and present estimation of age of the Earth
- Concepts of the study of landforms, weathering, processes and landforms produced by running water and groundwater, drainage patterns, and, lakes
- Processes and landforms related to glaciers, wind, sea waves, coral reefs, and major landforms of India

Semester	Course Code	Course Title	Credit	Marks			
				Internal	Oral	External	Total
II	U22GY2P	PRACTICAL I – SURVEYING AND PALEONTOLOGY	5	25	5	70	100

Course Objectives

To impart knowledge on

- Identification and description of the features in Topographic sheets
- Chain survey, plane-table survey, compass survey methods and interpretation of data
- Levelling and height measurements using Dumpy level and Auto level
- Determination of dip and strike of beds using clinometer and Brunton compass
- Identification of selected fossils of corals, brachiopods, echinoderms, pelecypods, gastropods, cephalopods, trilobites and plant fossils

A. Surveying

- Cartographic Appreciation of Survey of India (SOI) Topographic Sheets: Description of features in SOI's toposheet: extramarginal, marginal, intramarginal information, major conventional signs and symbols, physical and socio-cultural features.
- Procedure for Chain survey
- Determination of distance between two far off objects using Plane-table survey and Compass survey methods
- Measurement of various heights of stations with respect to bench mark using Dumpy level & Auto level.
- Determination of dip and strike of the beds using clinometer & Brunton compass

B. Palaeontology

a. <u>Identification and description of the following fossils:</u>

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

b. <u>Diagrams of selected fossils</u>

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

Course Outcomes

On completion of the course the student would have gained sufficient knowledge on

- Identification and description of the features in Topographic sheets

- Chain survey, plane-table survey, compass survey methods and interpretation of data
- Levelling and height measurements using Dumpy level and Auto level
- Determination of dip and strike of beds using clinometer and Brunton compass
- Identification of selected fossils of corals, brachiopods, echinoderms, pelecypods, gastropods, cephalopods, trilobites and, plant fossils

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
II	U22GY3	PALAEONTOLOGY	5	25	75	100

Course Objectives

To impart knowledge on

- Origin of life and its evolution through geological time, classification of organism
- Fossils, their types and applications, conditions for their formation & modes of their preservation
- General morphology, classification, geologic history and stratigraphic importance of trilobites, graptolites, brachiopods, pelecypods, gastropods and cephalopods
- General morphology, classification, geologic history and stratigraphic importance of corals, echinoids, crinoids, blastoids, and important invertebrate, vertebrate and plant fossils of India

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

Unit 2: Trilobites: general morphology, classification, geological history and stratigraphic importance – Graptolites: general morphology, classification, geological history and stratigraphic importance – Corals: general morphology, classification, geological history and stratigraphic importance.

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

Unit 4: Brachiopods: general morphology, geological history and stratigraphic importance, differences between Articulata and Inarticulata – Echinodermata: general morphology and geological history of Echinoidea, Crinoidea and Blastoidea – Short account on the following vertebrate fossils: Devonian fishes, Mesozoic reptiles and Cenozoic mammals.

Unit 5: Short account on the following plant fossils: Glossopteris, Gangamopteris, Ptilophyllum, Calamites, Lepidodendron and Sigillaria – Gondwana flora and their stratigraphic significance – Important vertebrate, invertebrate and plant fossils in Indian Stratigraphy.

Text Books

1. Clarkson, Euan and N.K. Clarkson (1998). Invertebrate Palaeontology and Evolution, Wiley-Blackwell.
2. Doyle Peter (1996). Understanding Fossils: An Introduction to Invertebrate Palaeontology, John Wiley & Sons Ltd.

3. Jain P.C and M.S. Anatharaman (2018). An Introduction to Paleontology, Vishal Publications
4. Raup, D.M and S.M. Stanley (1985). Principles of Paleontology, CBS Publications
5. Sreepat Jain (2017). Fundamentals of Invertebrate Palaeontology, Springer
6. Woods, H (1959). Invertebrate Palaeontology, Cambridge.

Reference Books

1. Arnold, C.A (1947). An Introduction to Palaeobotany, McgGraw-Hill Book Company, Inc.
2. Benton, M. J (2015).Vertebrate Palaeontology and Evolution (IV Edition*),* Wiley-Blackwell.
3. Easton W. H (1960). Invertebrate Paleontology,Harper's Geoscience Series.
4. Hag, B.U and A. Boersma (1978). Introduction to Marine Micropalaeontology. Elsevier, Netherlands, 376 P.
5. Moore R.C., Lalieker, C.D and A.G. Fischer (1952). Invertebrate Fossils, McGraw Hill.
6. Reed Wicander and J. S. Monroe (2007). Historical Geology: Evolution of Earth and Life Through Time (VI Edition)
7. Romer A.S (1960). Vertebrate Palaeontology, Chicago press.
8. Shrock, R.R and W.H. Twenhofel (1953). Principles of Invertebrate Palaeontology, Arnold Publication

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- Origin of life and its evolution through geological time, classification of organism
- Fossils, their types & applications, conditions for formation & modes of preservation of fossils
- General morphology, classification, geologic history and stratigraphic importance of trilobites, graptolites, brachiopods, pelecypods, gastropods and cephalopods
- General morphology, classification, geologic history and stratigraphic importance of corals, echinoids, crinoids, blastoids, and important invertebrate, vertebrate and plant fossils of India.

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
II	U22SBE1	SKILL BASED ELECTIVE-1 BASIC COMPUTER STUDIES	2	25	75	100

Course Objectives

To impart knowledge on

- Hardware, software, operating systems of computer
- Microsoft office and its core application (Word, Excel, Access, PowerPoint, Outlook)
- Photoshop and its tools to create special effects and design
- Coral draw and its tools to create special effects and design

Unit 1: Introduction to Computers - Hardware and Software - Operating System: Short account on Windows - Accessories in Windows - Microsoft office and its core applications - Microsoft Word: Creating, Editing and Formatting Document – Page layout: Margins, column, water mark, page border, Indent – Inserting of page brake, Illustrations, tables, header and footer, text box, Word art - Creating Envelops and Labels - Short account on Mail merge.

Unit 2: Microsoft Excel: Creating and Navigating workbooks - Formatting rows, columns, and cells - Creating database - Sorting and Filtering of data - Creating charts and graphs - Insert of Functions and Formulas:, Statistical, Logical and Financial - Short account on PivotTables and Pivot Charts – Microsoft Access: Creation of table, Import and export of data, queries.

Unit 3: Microsoft PowerPoint: Creating, Editing, Navigating and Formatting Presentation –Applying Design Templates – Applying Transition and Animation Effects - Adding Video and audio to presentation - Viewing and Setting up a Slide Show - Microsoft Outlook: Sending and receiving emails, managing contacts.

Unit 4: Photoshop: Page set up and file format - Layers: New layer, Duplicate layer and Merge layers - Layer Styles: Drop shadow, inner shadow, outer glow & inner glow, Bevel and Emboss, Gradient overlay, Stroke - Photoshop Tools : Move, Type, Marquee, Lasso, Crop, Shapes, Healing, Brush, Patch, Cloning Stamp, Eraser, Gradient, Blur, Smudge, Dodge, Pen, Eye Dropper, Patch selection and Zoom tool.

Unit 5: Corel draw: Drawing Tools: Pick, Shape, Knife, eraser, Smudge, Roughen brush, free transform, Artistic Pen, Poly line, Point, Spiral tool - Colour Tool: Paint Bucket Tool, Eye Dropper, Fill Tools. Fill Options, Stroke Options - Special Effects: 3D effects, Add perspective, Blend, Contour, Artistic media, lens, and Power clip. - Shaping Options: Weld, trim, Intersect.

Reference Books

1. Jill Murphy, 2003, Microsoft Office Word- Comprehensive Course, Labyrinth Publications.
2. Deborah Hinkle, 2003, Microsoft Office 2003 PowerPoint: A Professional Approach, Comprehensive w/ Student CD, McGraw-Hill/Irwin-New Delhi,
3. Nellai Kannan, C., 2002, MS-Office, Nels Publications, Tamil Nadu.
4. Shalini Gupta, 2008, CorelDraw In Simple Steps, Dreamtech Press India Pvt. Ltd, New Delhi, India

5. Deborah Miller, 1998, Corel DRAW Bible John Wiley & Sons
6. Rose Carla, 2000, Teach Yourself Adobe Photoshop, Sams publisher.

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- Hardware, software, operating systems of computer
- Microsoft office and its core application (Word, Excel, Access, Power point, Outlook)
- Photoshop and its tools to create special effects and design
- Coral draw and its tools to create special effects and design

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
III	U22GY4	MINERALOGY	4	25	75	100

Course Objectives:

To impart knowledge on

- Atomic bonding in minerals, structure, classification and physical properties of minerals
- Mineralogy, structure, chemistry, optical and physical properties, mode of occurrences and industrial uses of quartz, feldspar, feldspathoids, mica, zeolites group and alumino silicates
- Mineralogy, structure, chemistry, optical and physical properties, mode of occurrences and industrial uses of pyroxene, amphibole, olivine and garnet group minerals
- Principles of Optical Mineralogy, parts and functioning of petrological microscope and optical accessories
- Optical properties of minerals, determination of optic axial angle and optic sign

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

Unit 2: Mineralogy, structure, chemistry, optical and physical properties, mode of occurrences and industrial uses of the following groups of minerals: Quartz group, Feldspar group, Feldspathoids, Mica, Zeolites and alumino silicates.

Unit 3: Mineralogy, structure, chemistry, optical and physical properties, mode of occurrences and industrial uses of the following groups of minerals: Pyroxenes, Amphiboles, Olivine and Garnet – Physical and optical properties, chemical composition, uses and modes of occurrence of the following minerals: Epidote, Chlorite, Cordierite, Talc, Serpentine, Steatite, Calcite, Dolomite, Topaz, Staurolite, Beryl, Tourmaline, Fluorite, Apatite, Zircon, Rutile and Corundum.

Unit 4: Nature of light, wave nomenclature, phase, Perception of colour – Reflection, critical angle and total internal reflection – Isotropic and anisotropic media – Dispersion – Ordinary and polarized light – Methods of polarization: by selective absorption, by double refraction, Brewster's angle and Snell's law, polarisation by reflection – Petrological microscope and its parts – Optical accessories, their construction and uses: quartz wedge, gypsum plate, mica plate, and Bereck's Compensator.

Unit 5: Optical properties of isotropic and anisotropic minerals – Definition of optic axis, optically uniaxial and biaxial minerals, fast ray and slow ray, birefringence, uniaxial and biaxial indicatrix, retardation – Interference phenomena, orders of interference colours – Extinction: types of extinction, extinction angle and procedure for its determination – Sign of elongation and its determination – Pleochroism and dichroism – Characters of Uniaxial and biaxial minerals – Optic axial angle – Acute and obtuse bisectrix – Optic sign of uniaxial and biaxial minerals – Optical anomalies.

Text Books

1. Dana, F.S (1955). A Text Book of Mineralogy,Asia Publishing House, Wiley.
2. Read, H.H (1974). Rutley's Elements of Mineralogy, Thomas Murby & Co.
3. Mason, Band L.G. Berry (2004). Elements of Mineralogy (II Edition), CBS Publishers, 561p.
4. Winchell, A.N (1968). Elements of Optical Mineralogy, Wiley Eastern Pvt. Ltd.

Reference Books:

1. Deer, W.A., Howoe, R.A and J. Zuessman (1966). An Introduction of the Rock Forming Minerals, Longmans.
2. Cornelis Klen and Cornelius S. Hurlbut (1985). Manual of Mineralogy, John Wiley &Sons
3. Dyar, M and M.E. Gunter (2007). Mineralogy and Optical Mineralogy, Mineralogical Society of America, 705p.
4. Gribble, C.D and A.J. Hall (1985). A Practical Introduction to Optical Mineralogy, Springer, 252p.
5. Kerr, P.F (1959). Optical Mineralogy, McGraw Hill, New York, 442p.
6. Nesse, W.D (1991). Introduction to Optical Mineralogy, Oxford University Press, Oxford, 335p.

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- Atomic bonding, structure, classification and physical properties of minerals
- Mineralogy, structure, chemistry, optical and physical properties, mode of occurrences and industrial uses of quartz, feldspar, feldspathoids, mica, zeolites group and alumino silicates
- Mineralogy, structure, chemistry, optical and physical properties, mode of occurrences and industrial uses of pyroxene, amphibole, olivine and garnet group minerals
- Principles of Optical Mineralogy, parts and functioning of petrological microscope and optical accessories
- Optical properties of minerals, determination of optic axial angle and optic sign

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
III	U22SBE2	SKILL BASED ELECTIVE - 2 GEOSTATISTICS	2	25	75	100

Course Objectives:

To impart knowledge on

- The concept of statistics, collection of data and sampling techniques
- The organisation, presentation and summary of data
- The correlation, Regression and probability techniques
- The basic statistical Software

Unit 1: Statistics: Concepts, Merits and limitation – Descriptive and Inferential statistics – Data analysis process - Collection of data: Primary data and Secondary data - Sampling techniques: Random Sampling, Stratified Random Sampling, Cluster Sampling, Systematic Sampling

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

Unit 3: Statistics summary: Measures of central tendency: Arithmetic Mean, Median and Mode - Measures of Dispersion: Standard deviation, Skewness, Kurtosis – Measures of variability: Range, Inter-quartile range, Variance

Unit 4: Correlation: Auto correlation, Rank correlation and Cross correlation, scatter diagrams - Regression: Linear regression and lines of regression, Multiple Regressions.

Unit 5: Probability: Concepts, Addition and Multiplication theorems – Short account on following statistical Software: SPSS, PAST, GSTAT, GRADISTAT

Reference Books

1. Rober L. Miller and James Stevenkahn, 1962, Statistical analysis in the Geological Sciences, John Wiley & sons, Inc.
2. David M. Lane, Introduction to Statistics, Rice University; University of Houston, Open text book, online Edition
3. David S. Moore, George P. McCabe. Bruce A. Craig, 2017 Introduction to the Practice of Statistics, W. H. Freeman and Company
4. John C. Davis, 1962, Statistics and Data Analysis in Geology Third Edition John Wiley & Sons

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- The concept of statistics, collection of data and sampling techniques
- The organisation, presentation and summary of data
- The correlation, Regression and probability techniques
- The basic statistical Software

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
III	U22SBE3P	SKILL BASED ELECTIVE PRACTICAL - 3 BASIC COMPUTER STUDIES AND GEOSTATISTICS	2	25	75	100

Course Objectives:

To impart knowledge on

- Text formatting and mail merge in MS word
- Statistical Function, Mathematical Function, Preparation of Chart in MS Excel
- Creating image in multi layers in Photoshop
- Creating logo in Coral draw
- Organisation, presentation and summary of data
- Correlation, Regression and their interpretation

Exercises

1. MS Word: Text Formatting
2. MS Word: Mail Merge
3. MS Word: Preparing an invitation for Department Association meeting
4. Ms Excel: Implement the Statistical & Mathematical Function
5. Ms Excel: Prepare a Chart for a given Data using Pie diagram / Histogram
6. Photoshop: Create a single image from multiple image
7. Photoshop: Creating an image with multilayer's
8. Coral draw: Create a logo for a Company /College /Department
9. Statistics: Presentation of data
10. Statistics: Measures of tendency
11. Statistics: Measures of Dispersion
12. Statistics: Correlation and scatter diagram

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- Text formatting and mail merge in MS word
- Statistical Function, Mathematical Function, Preparation of Chart in MS Excel
- Creating image in multi layers in Photoshop
- Creating logo in Coral draw
- Organisation, presentation and summary of data
- Correlation, Regression and their interpretation

Semester	Course Code	Course Title	Credit	Marks			
				Internal	Oral	External	Total
III	U22GY5P	PRACTICAL - 2 MINERALOGY AND CRYSTALLOGRAPHY	5	25	5	70	100

Course Objectives:

To impart knowledge on

- The physical properties and identification of important minerals
- The optical properties and identification of important minerals using petrological microscope
- the identification of selected crystal models and twin crystal models, based on the study of their characteristics

1. Mineralogy

a. Megascopic Description and Identification of the Following Minerals:

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

b. Microscopic Description and Identification of the Following Minerals:

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

2. Crystallography

a. Identification and description of the following crystal models:

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

b. Identification and description of the following twin crystal models:

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

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- The physical properties and identification of important minerals
- The optical properties and identification of important minerals using petrological microscope
- the identification of selected crystal models and twin crystal models, based on the study of their characteristics

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
IV	U22GY6	CRYSTALLOGRAPHY AND GEMMOLOGY	4	25	75	100

Course Objectives

To impart knowledge on

- Morphological characters of crystals, laws of crystallography, crystallographic system and classes
- Symmetry elements and forms of different classes of crystallographic systems
- Twinning in crystals and laws of twinning
- Gemstones – their origin, occurrence, types, evaluation, weighing, cutting techniques, their global and Indian distribution
- Gemstone identification properties, identification instruments, properties of important gemstones

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

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

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

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

Unit 5: Gemstone identification properties: crystallography, cleavage, parting, fracture, hardness, specific gravity, density, colour, lustre, sheen, reflection, refraction, dispersion, pleochroism, spectroscopy, luminescence,

electrical and thermal properties – Gemstone identification instruments – Gemstone identification flow chart – Properties of the following gemstones: Alexandrite, aquamarine, diamond, emerald, ruby, sapphire, pearl and coral.

Text Books

1. Berry, L.G and B. Mason (2019). Elements of Mineralogy (2nd eBook Edition), CBS Publishers and Distributors, New Delhi.
2. Dana, F.S (1955). A Text Book of Mineralogy, Asia publishing House, Wiley.
3. Read, H.H (1974). Rutley's Elements of Mineralogy, Thomas Murby& Co.
4. Phillips, P.C (1956). An Introduction to Crystallography, Longmans Green & Co.
5. Read, P.G (1988). Beginner's Guide to Gemology,Newnes Publishers, 234p.

Reference Books:

1. Karnath K.V (1989). Gem and Gem Industry in India, Geo. Soc. India Pub., Bengaluru,
2. Read, P.G (2005). Gemmology (III Edition), Elsevier Butterworth-Heinemann, London, 341p.
3. Schumann, W (2013). Gemstones of the World (V Edition), Sterling Publishers, 320p
4. Wade, F.A and R.B. Mattox (1960). Elements of Crystallography and Mineralogy, Harper & Bros.

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Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- Morphological characters of crystals, laws of crystallography, crystallographic system and classes
- Symmetry elements and forms of different classes of crystallographic systems
- Twinning in crystals and laws of twinning
- Gemstones – their origin, occurrence, types, evaluation, weighing, cutting techniques, their global and Indian distribution
- Gemstone identification properties, identification instruments, properties of important gemstones

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
IV	U22NME1	**Non-Major Based Elective Course I** **ELEMENTS OF GEOLOGY**	2	25	75	100

Course Objectives

To impart knowledge on

- The subject of Geology and its branches, components and origin of Solar System, Earth's interior and, seas and oceans
- Weathering and its types, landforms produced by running water, wind and coastal processes
- The outline of plate tectonics, fault, fold, joints, unconformities, bedding in sedimentary rocks
- Geological Time Scale, Indian Stratigraphic Divisions, fossils – their types, modes of preservation, and applications, outline of important fossils of India and their geological ages
- Minerals and physical properties with special reference to quarts and feldspars, forms of igneous rocks, types of metamorphism, outline on the characteristics of some important rocks

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

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

Unit 3: Structural Geology: Outline of plate tectonics – Outline of faults, folds, joints and unconformities – Bedding in sedimentary rocks, dip and strike of beds

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

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

Text Books

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

Reference Books

1. Billings, M.P. (2016). Structural Geology (IIII Edition), Pearson Publishers, 624p.
2. Dana, F.S (1955). A Text Book of Mineralogy, Asia Publishing House, Wiley.
3. Woods, H (1959). Invertebrate Palaeontology, Cambridge.

4. Krishnan, M. S (2003). Geology of India and Burma (VI Edition), CBS Publishers and Distributors, Delhi.
5. Patwardhan, A.M (2010). The Dynamic Earth System (II Edition), PHI Learning Private Ltd., New Delhi
6. Savindra Singh (2018). Geomorphology, Pravalika Publications, Allahabad
7. Thornbury, W.D (1969). Principles of Geomorphology (Revised II Edition), 2015 Reprint, New Age International Pvt. Ltd. Publishers, New Delhi

Course Outcomes

At the end of the course the students would have acquired sufficient knowledge about

- The subject of Geology and its branches, components and origin of Solar System, Earth's interior, seas and oceans
- Weathering and its types, landforms produced by running water, wind and coastal processes
- The outline of plate tectonics, fault, fold, joints, unconformities, bedding in sedimentary rocks
- Fossils – their types and modes of preservation, morphological characteristics of important fossils, outline of Geological Time Scale
- Minerals and physical properties with special reference to quarts and feldspars, forms of igneous rocks, types of metamorphism, outline on the characteristics of some important rocks

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
V	U22GY7	IGNEOUS AND METAMORPHIC PETROLOGY	5	25	75	100

Course Objectives:

To impart knowledge on

- The forms, structures, textures and classification of igneous rocks
- Types of magma and their properties, crystallisation of unitary and binary systems
- Petrographic characters of Granite, Syenite, Diorite, Gabbro and their volcanic equivalents, petrography and origin of Anorthosites of Sittampundi and Ottanchatram, Syenites of Sivanmalai and Dunites of Salem.
- Metamorphic zones, grades and facies, and types of metamorphism
- Metamorphic structures and textures, petrography and origin of important metamorphic rocks

Unit 1: Magma: outline on types, chemical composition and physical properties – Bowen's reaction principle – Crystallization of unitary magma: SiO_2 System – Crystallization of binary magma: Diopside–Anorthite eutectic system, Albite–Anorthite solid-solution system, Forsterite–Silica incongruent melting system – Short notes on magmatic differentiation, fractional crystallization, liquid immiscibility and assimilation – Short notes on variation diagrams and petrographic provinces.

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

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

Unit 4: Metamorphism: definition and agents – Types of metamorphism: thermal metamorphism, dynamothermal metamorphism, plutonic metamorphism, regional metamorphism, contact metasomatism, metamorphism of partial melting, anataxis and palingenesis – Metamorphic zones – Metamorphic grades – Metamorphic facies – Outline of ACF, AKF and AFM.

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

Text Books

1. Best, M.G (1993). Igneous and Sedimentary Petrology, CBS Publishers and Distributors.
2. Hatch, R.H and A.K. Wells (2003). Petrology of the Igneous Rocks, CBS Publishers and Distributors.
3. Turner, F.J and J. Verhoogen (1960). Igneous and Metamorphic Petrology, McGraw Hill.

4. Tyrrell, G.W (1963). Principles of Petrology, Asia Publishing House
5. Winter J.D (2014). Igneous and Metamorphic Petrology, Prentice Hall.

Reference Books

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

Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- The forms, structures, textures and classification of igneous rocks
- Types of magma and their properties, crystallisation of unitary and binary systems
- Petrographic characters of Granite, Syenite, Diorite, Gabbro and their volcanic equivalents, petrography and origin of Anorthosites of Sittampundi and Ottanchatram, Syenites of Sivanmalai and Dunites of Salem.
- Metamorphic zones, grades and facies, and types of metamorphism
- Metamorphic structures and textures, petrography and origin of important metamorphic rocks

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
V	U22GY8	SEDIMENTARY PETROLOGY AND STRUCTURAL GEOLOGY	5	25	75	100

Course Objectives:

To impart knowledge on

- The process of sedimentation, classification, structure and texture of sedimentary rocks
- Residual and mechanical deposits, heavy minerals and provenance studies, petrography and origin of conglomerate, breccia, sandstone and shale.
- Chemical deposits and organic deposits
- Procedure for studying beds and their attitudes, outcrops, thickness of beds, and on petrofabric diagrams
- Stress and strain, behaviour of rocks on deformation
- Geological structures including folds, faults, shear zones, joints, unconformities

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

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

Unit 4: Structural Geology: Beds and their attitudes: strike, true dip and apparent dip, relation between strike and dip – Outcrops and trends of outcrop: Rule of V of outcrops, width of outcrops, true thickness, vertical thickness and their mutual relations –Basic concepts of deformation:force, stress, strain and deformation – Stress and strain, and their types –Behaviour of rocks under deformation: brittle and ductile deformation.

Unit 5: Ductile Structures: Folds: geometry, description, classification of folds, recognition of folds in the field and map – Foliation and lineation: cleavage and its types, lineation and its types – Unconformities: types, significance, recognition of unconformities in field and map – Outline on overlap, offlap, inlier and outlier.

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

Text Books

1. Billings, M.P. (2016). Structural Geology (IIII Edition) Pearson Publishers, 624p.
2. Ghosh, S. K (1993). Structural Geology: Fundamental and Modern Developments, Pergamon Press.

3. Gokhale, N.W (1996). Theory of Structural Geology, CBS Publishers.
4. Petijohn, F.J (2002). Sedimentary Rocks (III Edition), CBS Publishers & Distributors.
5. Prothero, D. R and Schwab, F (2003). Sedimentary Geology: An Introduction to Sedimentary Rocks and Stratigraphy, W. H. Freeman.

Reference Books

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

Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- The process of sedimentation, classification, structure and texture of sedimentary rocks
- Residual and mechanical deposits, heavy minerals and provenance studies, petrography and origin of conglomerate, breccia, sandstone and shale.
- Chemical deposits and organic deposits
- Procedure for studying beds and their attitudes, outcrops, thickness of beds, and on petrofabric diagrams
- Stress and strain, behaviour of rocks on deformation
- Geological structures including folds, faults, shear zones, joints, unconformities

Semester	Course Code	Course Title	Credit	Marks			
				Internal	Oral	External	Total
V	U22GY9P	PRACTICAL 3 – PETROLOGY AND STRUCTURAL GEOLOGY	5	25	5	70	100

Course Objectives:

To impart knowledge on

- Megascopic characters of important igneous, sedimentary and metamorphic rocks
- Optical properties of important igneous, sedimentary and metamorphic rocks
- Geologic interpretation from contour maps
- Problems relating to determination of dip and thickness of beds

A. Petrology:

i) Megascopic identification of the following rocks:

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

•Sedimentary rocks: Conglomerate, Breccia, Sandstone, Arkose, Shale, Shell limestone, Laterite, Lignite.

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

ii) Microscopic identification and description of the following rocks:

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

•Sedimentary rocks: Sandstone, Conglomerate, Breccia, Arkose, Shale, Shell limestone.

•Metamorphic rocks: Garnet mica schist, Hornblende schist, Hornblends gneiss, Charnockite, Amphibolite, Quartzite and Marble.

b. Structural Geology:

i) Contour maps and their interpretation**:** Exercises to predict trends of the outcrop of horizontal, vertical and inclined beds with respect to topography – Reading of solid conformable maps – Deciphering dip and strike of outcrops – Construction of map when three points over a bedding plane are given - Construction of vertical sections, thickness and order of superposition – Reading of solid fold and fault maps – Construction of vertical sections – Determination of throw of vertical faults – Reading of unconformable solid maps and construction of sections - Reading of solid maps of areas when more than one structure is involved – Determination of comparative ages of structures and intrusions – Deciphering geological history.

ii) Structural Geology problems relating to true dip and apparent dip – Determination of vertical and true thickness.

iii) Stereographic projection of linear and planar structures

Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- Megascopic characters of important igneous, sedimentary and metamorphic rocks
- Optical properties of important igneous, sedimentary and metamorphic rocks
- Geologic interpretation from contour maps
- Problems relating to determination of dip and thickness of beds

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
V	U22GY10E	Elective Course – I ENVIRONMENTAL GEOLOGY AND MARINE GEOLOGY	4	25	75	100

Course Objectives:

To impart knowledge on

- The concepts of Environmental Geology, river flooding, mass movement and, coastal erosion, their hazards, and the role of Geology in their mitigation
- Earthquakes, volcanic activity, mining activities, with special reference to their hazards, mitigation measures and, the role of geology in it, and about water and marine pollution and, environmental laws in India
- Oceans and seas, their dimension and origin, oceanographic explorations, features of ocean floor, shorelines and their types, and their characteristics
- General water circulation in oceans, physical and chemical properties of water, ocean deposits and their types, degradation of coastal environment and their mitigation

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

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

Unit 3: Man as an agent of environmental modification surface water, groundwater and marine pollution: causes, hazards and strategies for their reduction– Desertification: causes, consequences, mitigation planning and role of Geology – Waste disposal: solid, wastes, hazardous chemical wastes, radioactive wastes, liquid wastes and their disposal – Environmental Impact Assessment: objectives and procedures.

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

Unit 5: Brief account on waves, tides, oceanic currents, storm surges and tsunami – Factors affecting general oceanic circulation of water – Coriolis effect and Ekman spiral and, their impacts – Physical and chemical properties of ocean water – Ocean sediments and their types – Marine mineral resources –

Marine pollution: causes, hazards, their preventive and remedial measures – Laws of Seas and Oceans – Sea level changes: causes and effects – El Nino and La Nina and their effects.

Text Books

1. Keller, E.A (2012). Introduction to Environmental Geology (V Edition), Pearson Prentice Hall, New York, 705p.
2. Kind, A.H (1979). Introduction to Marine Geology and Geomorphology, Edward Arnold
3. Montgomery, C.W (2011). Environmental Geology (IX Edition), McGraw-Hill Pub., New York, 511p.
4. Shepard, F.P (1973). Submarine Geology, Harper and Row

Reference Books

1. Erickson, J., Timothy and Kusky (2002). Marine Geology: Exploring the New Frontiers of the Ocean, Facts on file, Inc., New York, 337p.
2. Eugen Seibold and Wolfgang Berger (2017). Sea Floor: An Introduction to Marine Geology, Springer, New York, 272p.
3. McConnell, R.L and D.C. Abel (2015). Environmental Geology Today, Jones and Bartlett Learning, Burlington, 844p.
4. Menard, H.W (1977). Ocean Sciences – Readings from Scientific American, Freeman
5. Reichard, J.S (2011). Environmental Geology, McGraw Hill, New York, 545p.
6. Valdiya, K.S (1987). Environmental Geology – Indian Context, Tata McGraw Hill Publications, New Delhi, 583p.

Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- The concepts of Environmental Geology, about river flooding, mass movement and, coastal erosion, their hazards, and the role of Geology in their mitigation
- Earthquakes, volcanic activity, mining activities, with special reference to their hazards, mitigation measures and, the role of geology in it, and about water and marine pollution and, environmental laws in India
- Oceans and seas, their dimension and origin, oceanographic explorations, features of ocean floor, shorelines and their types, and their characteristics
- General water circulation in oceans, physical and chemical properties of water, ocean deposits and their types, degradation of coastal environment and their mitigation
- Oceans and seas, their dimension and origin, oceanographic explorations, features of ocean floor, shorelines and their types, and their characteristics
- General water circulation in oceans, physical and chemical properties of water, ocean deposits and their types, degradation of coastal environment and their mitigation

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
V	U22GY10E	Elective Course – I NATURAL DISASTERS	4	25	75	100

Course Objectives

To impart knowledge on the

- Natural disasters, their classes, major natural disasters since 1900, and their trends, energy sources of disasters and, an account of UNDRR, NDMA
- Earthquake, volcanic eruption, mass movements and their hazards and, strategies for their mitigation
- Floods, cyclones, global climatic change: factors governing their severity, hazards and their mitigation
- Droughts, heat waves, forest fires: factors governing their severity, their hazards and strategies for their mitigation.
- Desertification, dust and sand storms, pandemics and epidemics, lightning strikes and meteoritic impacts

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

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

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

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

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

Text Books

1. Abbott, P.L (2020). Natural Disasters (XI Edition), McGraw Hill Publishers, 546p.
2. Ebert, C.H.V (2000). Disasters: An Analysis of Natural and Human Induced Hazards (IV Edition), Kendall/Hunt Pub., 240p.
3. Cheval, S (2012). Natural Disasters, InTech free online edition, Croatia, 166p.

Reference Books:

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

Course Outcomes

On completion of the course, the student would have gained a comprehensive gained knowledge on

- Natural disasters, their classes, major natural disasters since 1900, and their trends, energy sources of disasters and, an account of UNDRR, NDMA
- Earthquake, volcanic eruption, mass movements and their hazards and, strategies for their mitigation
- Floods, cyclones, global climatic change: factors governing their severity, hazards and their mitigation
- Droughts, heat waves, forest fires: factors governing their severity, their hazards and strategies for their mitigation.
- Desertification, dust and sand storms, pandemics and epidemics, lightning strikes and meteoritic impacts

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
V	U22GY11E	Elective Course – II REMOTE SENSING AND FIELD GEOLOGY	4	25	75	100

Course Objectives

To impart knowledge on

- The fundamentals of Remote Sensing along with an outline of the latest developments in the field, various aspects of Aerial Remote Sensing and Satellite Remote Sensing, along with an outline on Digital Image Processing, GIS, GPS techniques
- Essentials of field geological investigations
- Topographic features in topographic sheets, types of field mapping techniques, preparation of geological map and geological field report

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

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

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

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

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

Text Books

1. Compton, R. R (1962). Field Geology, Wiley Publishers.
2. Lahee, F. H (2002). Field Geology (VI Edition), McGraw Hill Publishers.
3. Lillesand, T.M., Keifer, R.W and J.W. Chipman (2015). Remote Sensing and Image Interpretation (VII Edition), John Wiley & Sons, Inc., 719p.
4. Gupta, R.P (2008). Remote Sensing Geology (II Edition), Springer Pub., New Delhi
5. Pandey, S.N (1987). Principles and Applications of Photogeology, New Age International, 366p.

Reference Books

1. Chuvieca, E and Huete, A (2016). Fundamentals of Satellite Remote Sensing (II Edition), Taylor & Francis Inc., 433p.
2. Mathur, S. M (2001). Guide to Field Geology, Prentice Hall of India.
3. Sabins, F.F (2007). Remote Sensing Principles and Interpretation (III Edition), Waveland Pr Inc., 512p.

Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- The fundamentals of Remote Sensing along with an outline of the latest developments in the field, various aspects of Aerial Remote Sensing and Satellite Remote Sensing, along with an outline on Digital Image Processing, GIS, GPS techniques
- Essentials of field geological investigations
- Topographic features in topographic sheets, types of field mapping techniques, preparation of geological map and geological field report

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
V	U22GY11E	Elective Course – II GIS AND GNSS	4	25	75	100

Course Objectives

To impart knowledge on

- History and development of GIS, its components, coordinate systems, map projections and, geospatial data input
- Important data models data collection, capture and geoprocessing
- GIS modelling and analysis
- Applications of GIS in fields relating to geosciences
- History, development and applications of GPS, GLONASS, GALILEO, COMPASS, DGPS, GNSS and RNSS

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

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

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

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

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

Text Books

1. Burrough, P.A., McDonnell, R.A and C.D Lloyd (2016). Principles of Geographical Information Systems, Oxford University Press, 307p.
2. Kang-Tsung Chang (2017). Introduction to Geographic Information Systems, McGraw Hill Education, 468p.
3. Heywood (2009). An Introduction to Geographical Information Systems, Pearson Education, 464p.
4. Hofmann-Wellenhof, B., Lichtenegger, H and J. Collins (2012). GPS: Theory and Practice (V Revised Edition), Springer Verlag, 382p.

Reference Books

1. Demers, M.N (2012). Fundamentals of Geographic Information Systems (IV Edition), John Wiley, 460p.
2. Kaplan, E and C. Hegarty (2006). Understanding GPS: Principles and Applications, Artech House, INC, Norwood, 680p.
3. Lo, C.P and A.K.W. Yeung (2016). Concepts and Techniques of Geographic Information Systems, Pearson Education, 544p.
4. Rahman, A and Shahab Fazal (2017). Global Positioning System, New Age Publishers, 210p.
5. Tasha Wade and Shelly Sommer (2006). A to Z GIS: An Illustrated Dictionary of Geographic Information Systems (II Edition), ESRI Press, 268p.
6. Tian, B (2017). GIS Technology Applications in Environmental and Earth Sciences, Taylor & Francis Group, 278p.

Course Outcomes

On the completion of the course the student would have gained knowledge on the

- History and development of GIS, its components, coordinate systems, map projections and, geospatial data input
- Important data models data collection, capture and geoprocessing
- GIS modeling and analysis
- Applications of GIS in fields relating to geosciences
- History, development and applications of GPS, GLONASS, GALILEO, COMPASS, DGPS, GNSS and RNSS

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
V	U22NME2	**Non-Major Based Elective Course II** **GEOLOGY AND ENVIRONMENT**	2	25	75	100

Course Objectives

To impart knowledge on

- Environment, ecology, natural resources and pollution
- Weathering and its types, causes, hazards and remedial measures relating to soil erosion, landslides and floods
- The outline on earthquakes, volcanic eruption and their hazards and remedial measures
- Causes and impacts of Coastal degradation, and the protective measures, causes and hazards pertaining to marine pollution, environmental problems relating to coral reefs and mangroves
- Environmental impacts relating to mining and mineral processing, urbanisation, desertification and the role of Man in environmental degradation

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

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

Unit 3: Influence of deep seated geological processes: Earthquake – origin, hazards, mitigation measures – Volcanoes: types, products, hazards mitigation measures of volcanic eruption

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

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

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Text Books

1. Keller, E.A (2012). *Introduction to Environmental Geology (V Edition),* Pearson Prentice Hall, New York, 705p.
2. Montgomery, C.W (2011). *Environmental Geology (IX Edition),* McGraw-Hill Pub., New York, 511p.

Reference Books

1. McConnell, R.L and D.C. Abel (2015). Environmental Geology Today, Jones and Bartlett Learning, Burlington, 844p.
2. Reichard, J.S (2011). Environmental Geology, McGraw Hill, New York, 545p.
3. Valdiya, K.S (1987). Environmental Geology – Indian Context, Tata McGraw Hill Publications, New Delhi, 583p.

Course Outcomes

At the end of the course the students would have acquired sufficient knowledge about

- Environment, ecology, natural resources and pollution
- Weathering and its types, causes, hazards and remedial measures relating to soil erosion, landslides and floods
- The outline on earthquakes, volcanic eruption and their hazards and remedial measures
- Causes and impacts of Coastal degradation, and the protective measures, causes and hazards pertaining to marine pollution, environmental problems relating to coral reefs and mangroves
- Environmental impacts relating to mining and mineral processing, urbanisation, desertification and the role of Man in environmental degradation

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
VI	U22GY12	STRATIGRAPHY	6	25	75	100

Course Objectives:

To impart knowledge on

- Principles of Stratigraphy, correlation methods, classification of stratigraphic units, physiographic divisions and tectonic framework of India and, Indian Geologic Time Scale.
- Distribution, classification, economic importance and life forms of Precambrian in India
- Distribution, classification, economic importance and life forms of Paleozoic in India
- Distribution, classification, economic importance and life forms of Mesozoic of India, including Deccan traps
- Geological events of Cenozoic Era in India, important Tertiary formations in South India

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

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

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

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

Unit 5: Cenozoic Stratigraphy: Geological events of Cenozoic Era in India: Rise of Himalayas and Pleistocene glaciation – Stratigraphy, conditions of deposition, fauna and flora of Siwalik System – Tertiary formations of Assam– Karewa Series – Important Tertiary formations of South India: Cuddalore

sandstone, Rajahmundry sandstone, Warkala beds and Quilon beds – Mineral wealth of Tertiary formations of Tamil Nadu.

Text Books

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

Reference Books

1. Doyle, P and M.R. Bennett (1996). Unlocking the Stratigraphic Record, John Wiley India Publications.
2. Dunbar, C. O and J. Rodgers (1960). Principles of Stratigraphy, McGraw Hill.
3. Geological Society of India (1990). Stratigraphic Boundary Problems in India, Memoir 16, ISSN No: 0016-7622, Geological Society of India, Bangalore, 116p.
4. Lemon, R. Y (1990). Principles of Stratigraphy, Merrill Publishing Co.
5. Naqvi, S. M and J.J.W. Rogers (1987). Precambrian Geology of India, Oxford University Press.
6. Ramakrishnan, M and R. Vaidyanadhan (2008). Geology of India (Vols. 1 & 2), Geological Society of India, Bangalore.
7. Valdiya, K. S (2010). The Making of India, Macmillan India Publications, New Delhi

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- Principles of Stratigraphy, correlation methods, classification of stratigraphic units, physiographic divisions and tectonic framework of India and, Indian Geologic Time Scale.
- Distribution, classification, economic importance and life forms of Precambrians in India
- Distribution, classification, economic importance and life forms of Paleozoic in India
- Distribution, classification, economic importance and life forms of Mesozoic of India, including Deccan traps
- Geological events of Cenozoic Era in India, important Tertiary formations in South India

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
VI	U22GY13	ECONOMIC GEOLOGY	6	25	75	100

Course Objectives:

To impart knowledge on

- The various processes of formation of economic mineral deposits
- Classification of mineral deposits, controls of ore localisation, origin and uses of coal and petroleum deposits, and their distribution in India
- Composition, mode of occurrences and uses of important metalliferous deposits, and their distribution in India
- Composition, mode of occurrences and uses of important industrial minerals, and their distribution in India

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

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

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

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

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

Text Books

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

Reference Books

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

Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- The various processes of formation of economic mineral deposits
- Classification of mineral deposits, controls of ore localisation, origin and uses of coal and petroleum deposits, and their distribution in India
- Composition, mode of occurrences and uses of important metalliferous deposits, and their distribution in India
- Composition, mode of occurrences and uses of important industrial minerals, and their distribution in India

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
VI	U22GY14	MINERAL PROSPECTING AND MINING GEOLOGY	6	25	75	100

Course Objectives:

To impart knowledge on

- The essentials of geological exploration including geological guides for mineral prospecting, sampling and drilling methods and ore reserve estimation
- Principles, applications and limitations and applications of various geophysical exploration methods
- The essentials of geochemical exploration
- Nomenclature in mining, surface and alluvial mining methods and equipments used
- Underground mining, coal mining methods and equipments used

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

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

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

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

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

Text Books

1. Arogyaswamy, R.N.P (1986). Courses in Mining Geology, Oxford & IBH Publishing Co., New Delhi.
2. Hawkes, H.E and J.S. Webb (1980). Geochemistry in Mineral Exploration, Harper & Row.

3. Mason, B (1966). Principles of Geochemistry, Willey Toppan.
4. McKinstry, H. E (2000). Mining Geology, Asia Publishing House.
5. Ramachandra Rao, M. B (1975). Outlines of Geophysical Prospecting - A manual for Geologist, English Book Depot, Dehradun.
6. Lowrie, W (1997). Fundamentals of Geophysics, Cambridge.

References Books

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

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- The essentials of geological exploration including geological guides for mineral prospecting, sampling and drilling methods and ore reserve estimation
- Principles, applications and limitations and applications of various geophysical exploration methods
- The essentials of geochemical exploration
- Nomenclature in mining, surface and alluvial mining methods and equipments used
- Underground mining, coal mining methods and equipments used

Semester	Course Code	Course Title	Credit	Marks			
				Internal	Oral	External	Total
VI	U22GY15P	PRACTICAL 4 ECONOMIC GEOLOGY, MINING GEOLOGY AND HYDROGEOLOGY	6	25	5	70	100

Course Objectives:

To impart knowledge on

- Megascopic characters, Indian occurrences and uses of important economic minerals
- Identification of economic minerals using blow pipe test
- Solving problems relating to the estimation of ore reserves
- Solving problems relating to hydrogeology

A. Economic Geology:

i) Megascopic identification and description, Indian occurrences and uses of the following ore and industrial minerals:

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

ii) Identification of the following mineral powders by simple blow pipe tests:

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

B. Mining Geology:

- Calculation of ore reserves – Included area method.

C. Hydrogeology:

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

Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- Megascopic characters, Indian occurrences and uses of important economic minerals
- Identification of economic minerals using blow pipe test
- Solving problems relating to the estimation of ore reserves
- Solving problems relating to hydrogeology

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
VI	U22GY16E1	**Elective Course – III** **HYDROGEOLOGY AND ENGINEERING GEOLOGY**	4	25	75	100

Course Objectives:

To impart knowledge on

- Hydrological properties of geological formations and groundwater movement
- Vertical distribution of groundwater, types of aquifers, groundwater quality parameters, drinking water standards of WHO and BIS, and groundwater exploration methods
- Natural and artificial discharge of groundwater, groundwater recharge, rainwater harvesting, groundwater fluctuations and salt water intrusion
- The principles Engineering Geology, role of Geology in Civil Engineering, engineering properties of rocks and soils, geological investigation pertaining to foundation and development of roads/highways, railways, bridges and buildings
- Geological investigations pertaining to dam sites and reservoirs, tunnels, coastal protection structures and landslides

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

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

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

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

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

Text Books

1. David Keith Todd (2005). Groundwater Hydrology, Wiley India Pvt. Ltd., New Delhi.
2. Raghunath, H.M (2007). Groundwater, Wiley Eastern Limited, New Delhi.
3. Ramakrishnan S (1998). Groundwater, KJ Graphs arts, Chennai.
4. Bell, F. G (1983). Fundamentals of Engineering Geology, Butterworths.
5. Blyth, F. G. H and M.H. De Freitas (1984). Geology for Engineers (VII Edition), Butterworth-Heinemann Pub., 336p.
6. Sathyanarayanaswami, B. S (2000). Engineering Geology, Dhanpat Rai & Co., Delhi.
7. Parbin Singh (2003). Engineering Geology and General Geology, S. K. Kataria & Sons, New Delhi.
8. Venkat Reddy, D (2010). Engineering Geology, Vikas Publishing House Pvt. Ltd., New Delhi.

Reference Books

1. Fetter C.W (2007). Applied Hydrogeology, CBS Publishers, New Delhi.
2. Gokhale N.W (2009). All about Water, CBS Publishers, New Delhi.
3. Gokhale, K.V.G.K and D.M. Rao (1981). Experiments in Engineering Geology, McGraw Hill.
4. Krynine, D.P and W.R. Judd (1957). Principles of Engineering Geology and Geotechniques, McGraw Hill.
5. Legget, R F (1962). Geology and Engineering, McGraw Hill.
6. Maslov, N.N (1987). Basic Engineering Geology and Soil Mechanics, Mir Publishers, Moscow.
7. Murthy, V.N.S (2018). Soil Mechanics and Foundation Engineering, CBS Publishers and Distributors Ltd., New Delhi.
8. Ries, H and T.L Watson (2016). Elements of Engineering Geology. Wentworth Press, 772p.
9. Pandey, V.K and A. Mishra (2017). Handbook of Engineering Geology, CBS Publishers & Distributors Pvt. Ltd., New Delhi.

Course Outcomes

On completion of the course the students would have acquired a comprehensive knowledge on

- Hydrological properties of geological formations and groundwater movement
- Vertical distribution of groundwater, types of aquifers, groundwater quality parameters, drinking water standards of WHO and BIS, and groundwater exploration methods
- Natural and artificial discharge of groundwater, groundwater recharge, rainwater harvesting, groundwater fluctuations and salt water intrusion
- The principles Engineering Geology, role of Geology in Civil Engineering, engineering properties of rocks and soils, geological investigation pertaining to foundation and development of roads/highways, railways, bridges and buildings
- Geological investigations pertaining to dam sites and reservoirs, tunnels, coastal protection structures and landslides

Semester	Course Code	Course Title	Credit	Marks		
				Internal	External	Total
VI	U22GY16E2	Elective Course – III GEOEXPLORATION	4	25	75	100

Course Objectives:

To impart knowledge on

- Principles of geological exploration, guides to ore search, sampling and its types, types of drilling
- Principles, equipments, data interpretation, and applications of geophysical methods for ore search
- Principles and procedures of geochemical and biogeochemical methods of exploration.

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

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

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

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

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

Text Books

1. Dhanaraju, R (2009). Handbook of Mineral Exploration and Ore Petrology: Techniques and Applications, Geological Society of India, 494p.
2. Mason, B and C.B. Moore (1991). Introduction to Geochemistry, Wiley Eastern.
3. Misra, K. C (2012). Introduction to Geochemistry: Principles and Applications, Wiley-Blackwell.
4. Ramachandra Rao, M. B (1975). Outlines of Geophysical Prospecting - A Manual for Geologist, English Book Depot, Dehradun.
5. Solovov, A. P (1987). Geochemical Prospecting, Mir Publishers, Moscow.

References Books

1. Dobrin, M. B (2001). Introduction to Geophysical Prospecting, McGraw Hill Inc.
2. Faure, G (1998). Principles and Applications of Geochemistry, Prentice Hall.
3. Kovalevskll, A. L (1987). Biogeochemical Exploration for Mineral Deposits, VSP Publishers, 227p.
4. Krauskauf, B. K (1988). Introduction to Geochemistry (II Edition), McGraw-Hill Book Company, 601p.
5. Kreiter, V. M (2004). Geological Prospecting and Exploration, University Press of the Pacific.
6. Lowrie, W (1997). Fundamentals of Geophysics, Cambridge.
7. Marjoribanks, R (2010). Geological Methods in Mineral Exploration and Mining (II Edition), Springer, 253p.
8. Moon, C. J., Whateley, M. K. G. and A. M.Evans (2006). Introduction to Mineral Exploration (Ed.2**),** 481p.

Course Outcomes:

On completion of the course the students would have acquired a comprehensive knowledge on

- Principles of geological exploration, guides to ore search, sampling and its types, types of drilling
- Principles, equipments, data interpretation, and applications of geophysical methods for ore search
- Principles and procedures of geochemical and biogeochemical methods of exploration.
- Essentials of field geological investigations
- Topographic features in topographic sheets, types of field mapping techniques, preparation of geological map and geological field report