Structure and Detailed Syllabus

Undergraduate Course (B.Sc.) in Geology

Learning Outcome based Curriculum (under CBCS)

for Affiliated Colleges

Manonmaniam Sundaranar University

Common Course Structure for B.Sc., GEOLOGY – 2021-2022

Manonmaniam Sundaranar University

Tirunelveli- 627012

2021

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI
UG - COURSES – AFFILIATED COLLEGES
Course Structure for B.Sc. Geology
Learning Outcome based Curriculum
(Choice Based Credit System)
(with effect from the academic year 2021- 22 onwards)

Vision of the University

To provide quality education to reach the un-reached

Mission of the University

- To conduct research, teaching and outreach programmes to improve conditions of human living.
- To create an academic environment that honors women and men of all races, caste, creed, cultures and an atmosphere that values intellectual curiosity, pursuit of knowledge, academic freedom and integrity.
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development.
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled.

1. Name of the Programme :**B.Sc Geology**

2. Preamble of the Programme

As a geologist, you will study the Earth, learning about the rocks, minerals, fossils and fluids of which it is composed, the physical and chemical processes that drive the evolution and structure of its interior, the oceans, atmosphere and biosphere that sculpt and alter its surface, and the other planets, moons and asteroids to which it is closely related. Geologists seek to understand the Earth and other planets through observation and experiment, and to build their understanding upon fundamental scientific principles using interdisciplinary skills in physics, chemistry, biology, mathematics, computing and engineering.

Candidates for admission to the B.Sc., Degree (Geology) Course shall be required to pass the final examination of the Higher Secondary Course (10+2 level) and equivalent there to with a minimum marks under an academic stream (any Science group) or a course of studies recognized and approved by the syndicate of the Manonmaniam Sundaranar University, Tirunelveli.

3. Programme Structure							
Semester	**Course Code**	**Course**	**Course Nature**	**Credits**	**Contact Hours per Week**	**Continuous Internal Assessment (CIA)**	**End Semester Exam (ESE)**
1		Tamil/Other Languages	Language	**4**	**6**	25	75
		Communicative English-I	Language	**4**	**6**	25	75
		PhysicalGeology	Core-Theory-1	**4**	**4**	25	75
		ProfessionalEnglishfor Physical Sciences-I	Core-Theory-2	**4**	**4**	25	75
		Practical-PhysicalGeology	Major Practical-I	**2**	**2**	50	50
		Chemistry	Allied-I	**3**	**4**	25	75
		Practical-Chemistry	AlliedPractical-I	**2**	**2**	50	50
		EnvironmentalStudies	Common	**2**	**2**	25	75
				25	**30**		
2		Tamil/Other Languages	Language	**4**	**6**	25	75
		Communicative English-II	Language	**4**	**6**	25	75
		StructuralGeology	Core-Theory-3	**4**	**4**	25	75
		ProfessionalEnglish for Physical sciences-II	Core-Theory-4	**4**	**4**	25	75
		Practical-StructuralGeology	MajorPractical-II	**2**	**2**	50	50
		Chemistry	Allied-II	**3**	**4**	25	75
		Practical-Chemistry	AlliedPractical-II	**2**	**2**	50	50
		Valuebasededucation/SocialHarmony	Common	**2**	**2**	25	75
				25	**30**		
3		Tamil/Other Languages	Language	**4**	**6**	25	75
		English	Language	**4**	**6**	25	75
		Crystallographyand Mineralogy	Core-Theory-5	**4**	**4**	25	75
		Practical–Crystallography &Mineralogy	Major Practical-III	**2**	**2**	50	50
		Physics	Allied-III	**3**	**4**	25	75
		Practical-Physics	AlliedPractical-III	**2**	**2**	50	50
		Remote sensing andGISorGemmology	Skill based – 1	**4**	**4**	25	75
		Climatologyor FundamentalsofGeology	Non-Major Elective-I	**2**	**2**	25	75
		*Yoga	Common	**2**	**2**	25	75
		(yoga 2 hours work in extra hours)		**27**	**32**		

4		Tamil/Other Languages	Language	**4**	**6**	25	75
		English	Language	**4**	**6**	25	75
		Palaeontology	Core-Theory-6	**4**	**4**	25	75
		Practical–Palaeontology	Major Practical-IV	**2**	**2**	50	50
		Physics	Allied-IV	**3**	**4**	25	75
		Practical-Physics	AlliedPractical-IV	**2**	**2**	50	50
		StratigraphyorGeostatisticsandComputerApplications	Skill based –2	**4**	**4**	25	75
		GeohydrologyorMineralEconomics	Non-major Elective-II	**2**	**2**	25	75
		ComputersforDigitalEra	Common	**2**	**2**	25	75
		Part V	ExtensionActivity	**1**		25	75
				28	**32**		
5		IgneousPetrology	Core-Theory-7	**4**	**5**	25	75
		Sedimentaryand MetamorphicPetrology	Core-Theory-8	**4**	**5**	25	75
		Hydrogeology	Core-Theory-9	**4**	**4**	25	75
		Marine Geologyor Fuel Geology or EnvironmentalGeology	MajorElective-1	**4**	**4**	25	75
		Practical-IgneousPetrology	Major Practical-V	**2**	**2**	50	50
		Practical-SedimentaryandMetamorphicPetrology	Major Practical-VI	**2**	**4**	50	50
		Practical-HydrogeologyandElective-1	Major Practical-VII	**2**	**4**	50	50
		Personality Development	Skillbased Common	**2**	**2**	25	75
				24	**30**		
6		EconomicGeology	Core-Theory-10	**4**	**6**	25	75
		Geochemistryand Geophysics	Core-Theory-1	**4**	**6**	25	75
		GeologyofTamilnadu	Core-Theory-12	**4**	**6**	25	75
		Geotechnicalstudiesor Natural Hazards orMedical Geology	Elective-2	**4**	**4**	25	75
		Practical - EconomicGeology,GeochemistryandGeophysics	Major Practical-VIII	**2**	**4**	50	50
		Practical - Geology ofTamilnaduandElective-2	MajorPractical-IX	**2**	**4**	50	50

		GeologicalField StudiesandVIVAVOCE	MajorPractical -X	**2**	**0**	50	50
				22	**30**		
		Grand Total		**151**	**184**		

4. Scheme of Evaluation

4.(a) CIA

i. Theory Course : 25 Marks
ii. Practical* : 50 Marks
iii. Project : No internal
iv. Internship* : ----
v. Field visit* : No internal

(At least one Seminar presentation in a semester and a minimum of one Assignment in each unit by a student)

4. (b)ESE

i. Theory Course : 75 Marks
ii. Practical* : 50 Marks
iii. Project : 100 Marks
iv. Internship* : ---
v. Field visit* : 100 Marks

4.(c) Model End Semester Question Paper*

SECTION	TYPE OF QUESTION	MARKS
Part A	Multiple Choice Questions (Two questions from each Unit)	1 x 10 = 10 marks
Part B	Internal Choice Questions (One Question from each Unit)	5 x 5 = 25 marks
Part C	Internal Choice Questions (One Question from each Unit)	5 x 8 = 40 marks
	Total	**75 Marks**

5. (d) Passing Minimum

CIA – No passing minimum (3 Internal Tests – Average of the best 2 will be considered)
ESE – 50%
Cumulative Aggregate – 50%

6. PROGRAMME OUTCOMES (POs) :

PO 1	The syllabus is based on an integrated curriculum with an approach to provide learning through problem solving and hands on training techniques.
PO 2	At the end of three years of B. Sc. Geology course students would gain through understanding in the fundamental concepts of geological sciences.
PO 3	Providing Quality Higher Education and taking care of intellectual, social, economic, emotional needs of students.
PO 4	Program aims to develop intellectual ability and geological skills through an appropriate blending of theoretical subject education, practical exercises and field training.
PO 5	To provide basic degree required to appear for job selections in various services as recruited by UPSC, State and Central Government organisations.
PO 6	To train students to take up the technical assistant functions at various geological organisations like Survey of India, Oil and Natural Gas Commission, Geological Survey of India etc.
PO 7	To motivate students to take up higher studies and ultimately research in different sub disciplines of the subject in India and abroad.
PO 8	To develop appropriate skills in the students to make them competent to take up self-employment in innovative geology related fields.

7. PROGRAMME SPECIFIC OUTCOMES (PSOs) :

PSO1	The student gains insight into both theory with practical observation.
PSO 2	The gains knowledge with respect to understanding the essentials of the dynamics of earth.
PSO 3	Study our Earth's past to forecast and safeguard its future.
PSO 4	Develop a deep understanding of the many processes that shape the Earth and life onIt.
PSO 5	learn how these processes interact and depend on each other.
PSO 6	This expertise may be used in field geology and laboratory studies of minerals, principles of Stratigraphy and Indian Geology, mineral exploration, oil exploration, and tectonics.
PSO 7	Collaborative learning is encouraged during the field training programmes and educational tours.
PSO 8	Use compasses, survey instruments, in geological investigations.

8. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1	Imparting geological knowledge and skills to gain employment in Industry, Science and research organizations and service sectors.
PEO 2	Produce quality manpower in geology that can elevate and lead the organization effectively.
PEO 3	Enable the students to understand and bring solutions to societal problems related to Geology.

PEO 4	Motivate students to pursue higher studies and research in Geology.
PEO 5	Create an environment to auger entrepreneurial skills that will innovate and market geology related products.

9. PEO / PO Mapping

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES							
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
1	X	X	X	X			X	X
2						X	X	X
3	X		X	X	X			
4	X			X	X	X	X	X
5	X		X			X	X	X

		10. MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES									
year	Sem	Subject Status	SubjectTitle	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
I year	1 sem	Core-Theory-1	PhysicalGeology	X	X	X	X	X	X		X
		Major Practical-I	Practical-PhysicalGeology	X	X	X	X	X	X	X	X
	2 sem	Core-Theory-3	StructuralGeology	X	X	X	X	X	X		X
		MajorPractical-II	Practical- StructuralGeology	X	X	X	X			X	X
II year	3 sem	Core-Theory-5	Crystallographyand Mineralogy	X	X	X	X		X	X	X
		Major Practical-III	Practical–Crystallography &Mineralogy	X	X	X	X	X		X	X
	4 Sem	Skill based – Core I	Remote sensing andGISorGemmology	X	X	X	X	X		X	X
		Core-Theory-5	Palaeontology	X	X	X	X	X	X		X
		Major Practical-IV	Practical–Palaeontology	X	X	X	X	X	X	X	X
		Skill based Core II	StratigraphyorGeostatistic sandComputerApplication s	X	X	X	X	X	X		X
		Non-major Elective-II	GeohydrologyorMineral Economics	X	X		X			X	X
		Core-Theory-6	IgneousPetrology	X	X	X	X	X	X	X	X
		Core-Theory-7	Sedimentaryand MetamorphicPetrology	X	X	X		X		X	X

3 year	5 sem	Core-Theory-8	Hydrogeology	X	X	X	X	X		X	X
		MajorElective-1	Marine GeologyorFuel Geologyor EnvironmentalGeology	X	X	X	X	X	X		X
		Major Practical-V	Practical-IgneousPetrology	X	X	X	X	X	X	X	X
		Major Practical-VI	Practical-Sedimentaryand MetamorphicPetrology	X	X	X	X	X	X		X
		MajorPractical-VII	Practical-Hydrogeology andElective-1	X	X	X	X			X	X
	6 sem	Core-Theory-9	EconomicGeology	X	X	X	X	X	X	X	X
		Core-Theory-10	Geochemistryand Geophysics	X	X	X		X		X	X
		Core-Theory-11	GeologyofTamilnadu	X	X	X	X	X		X	X
		Elective-2	Geotechnicalstudiesor Natural Hazards orMedical Geology	X	X		X	X	X		X
		MajorPractical-VIII	Practical - EconomicGeology ,GeochemistryandGeophysics	X	X	X	X	X	X	X	X
		MajorPractical-IX	Practical - Geology ofTamilnaduandElective-2	X	X	X	X	X	X	X	X
		MajorPractical-X	GeologicalField StudiesandVIVAVOCE	X	X	X	X	X	X	X	X

MANDATORYREQUIREMENTSOFB.Sc GEOLOGY PROGRAMME

Students should have to complete two daysshort field trips, as per the decision by Professor in- charge during I and IInd year B.Sc. Geology. Report of this two days short field trip should besubmitted by individuals at the end of the IIIrdyear practical examination and there will be a viva-voce on it. Geological specimens collected during their field trips to be displaced during VIVA VOCE.

Geological mapping of nearby area chosen by professor-in-charge should be held during II year, not more than one week. The reports of the geological mapping will be submitted at the end of IIIrd year course during viva-voce.

A Geological, long field trip not more than two weeks in IIIrd years will be conducted. The geological field report and specimen collected during field trip to be submitted during VIth semester practical examination and their will a viva-voce on it.

PHYSICALGEOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To obtain basic knowledge about various branches of Geology and Earth's origin.
- To learn layeredstructure,composition,endogenicandexogenicprocessesanditsresultantphysiographicfeatures.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1: Rememberthe basics of fundamental sciences

CO2: Understand theorigin and evolution of earth

CO3: Apply the interior of the earth concept in plate tectonics

CO4: Analysis the various types of landforms based on origin and characteristic features

CO5: Evaluate the weathering process and its relation to soil and rock formation.

CO6: Create models of landforms studied during the course.

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Definition and branches of Geology - History of Geology: catastrophism, uniformitarianism-magnitude of Geologic Time- Earth as a System- Earth's spheres: Hydrosphere, Atmosphere,Biosphere, Geosphere- Earth System Science- *Solar system*: its components- a brief accountof various theories regarding the origin of earth. *Interior of the Earth*: an outline of thecomposition and constitution of the interior of the earth. *Age of the earth*: relative datingandabsolute dating – radiometric dating: Potassium – Argon, Rubidium – Strontium, Uranium,Lead-Lead,Fission track datingand Carbondatingmethod.

UNITII

Rockweathering:Geologyandweathering-agentsofweathering,processesofweathering-mechanicalweathering:Frostwedging,frostheaving,saltactionandsheeting,chemicalweathering:solution,hydration,hydrolysis,oxidation/reduction,carbonationandchelation.Bi

oticweathering:biophysicaland biochemical.Mixedprocesses: spheroidal,exfoliationanddifferential weathering. Soil–definition, types and formation process of soils- Soil Horizon*WindasaGeologicalAgent*:erosionalmethods:deflation,corrosionanditsimpact.Erosionalfeatures-
Byabrasion:undercuthills,caverock,mushroomrock,mesa,yardang,ventifacts.ByDeflation:desertpavement,deflationhallows.Transportation-
saltation,suspensionandtraction.Deposition-causesandtypes,pileandsheetsdeposits-duneformation,migrationanddifferentforms.Desert:description, kindsand
desertfeatures:plains,bajadas andpediment.

UNITIII

Work Glaciers: Types of glaciers: cirque, valley, piedmonts and continental glaciers-Glacialmovement-erosionalprocesses-erosionalfeatures-
depositionalfeatures.*Workofseaandits deposits*: waves, breakers, rip-current, long-shore current. Processes of erosion, erosionalfeatures: wave cut terraces, sea cave and arch, headland, stacks, transportation and variousdepositional features: beaches and barriers, spits and bars, deltas, wave-built terraces. Oceandeposits:shallow waterand deep-water deposits.

UNITIV

Development of drainage system and work of stream: channel characteristics- stream erosioncharacteristics, types of streams, drainage patterns, Erosional features- valleys, river piracy,waterfalls, cascade, water gaps, pot holes and plunge pools, river terraces, meanders, ox-bowlakes,pedimentsandpeneplains,transportationmethods,causesofstreamdeposition, depositionalfeatures-
deltas,pointbars,naturallevees,alluvialfans,floodplain,backswamps, and braided rivers. Types of streams and drainage patterns. *Work of Ground water*:movement of ground water due to gravity and pressure difference- ground water discharge-springs, wells and artesian wells and springs, thermal springs. Erosion by ground water anderosional features. Transportation by ground water, deposition by ground water and forms ofdeposits.

UNITV

Plate tectonics – Historical background – theory - Characteristics of plates –World plates -plate movements – Plate boundaries: divergent: mid-oceanic ridges, continental rift, triplejunction, geological characters; convergent: ocean – ocean, ocean – continent, continent –continent convergence, geological characters and transform fault boundary- causes for theplate movement.*Volcanoes:* classification: based on stateof the volcano, structure

ofvolcano,kindofmaterialerupted,eruptiveforceandlocationofvolcano.Productsofvolcano: Gases, liquids, and solids. *Earthquake*- Definition - causes- classification-seismicwaves:Bodywavesandsurfacewaves-earthquakedetectionandmeasurement– determination of epicenter – scale of earthquake: intensity and magnitude scale-effects ofearthquakes– Tsunami-causes andeffects.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basics of fundamental sciences	PO1	H	PSO2, PSO3	H	K1
CO2	Understand origin and evolution of earth	PO1, PO3	H	PSO1, PSO4	H	K2
CO3	Apply the interior of the earth concept in plate tectonics	PO4, PO6,	M	PSO5, PSO6	M	K3
CO4	Analysis the various types of landforms based on origin and characteristic features	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate the weathering process and its relation to soil and rock formation.	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create models of landforms studied during the course.	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

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2. ArthurHolmes(1992)PrinciplesofPhysicalGeology:ThomasNelson&sonsLondon.
3. Charles C. Plummer, Diane H. Carlson and Lisa Hammersley (2019). 'Physical Geology'(16th Ed).McGraw-Hill Education.
4. StrahlerA.M(1965).IntroductiontoPhysicalGeology.,Wiley.
5. Thornbury.W.D(1969).PrinciplesofGeomorphology.,Wiley,NewYork.
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7. Robert S. Anderson,Suzanne P. Anderson(2010). Geomorphology. Cambridge UniversityPress.
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9. RichardJohnHuggett(2017)FundamentalsofGeomorphology.,Routledge,Canada.
10. Kenneth J. Gregory (2010) The Earth's Land Surface: Landforms and Processes inGeomorphology.,SAGEPublicationsLtd.
11. Bloom.A.L.(1992),SurfaceoftheEarth,PrenticeHallIndia,NewDelhi
12. Gass, I.G., Smith, P.S & Wilson, R.C.L., 2ndEdt., (1972), Understanding the Earth, The EnglishLanguage Books Society,London
13. Leopold,L.S, Wolman, K & Miller, J.P, (1970), Fluvial processes in Geomorphology, EurasiaPublishingHousePvtLtd.,NewDelhi.
14. Robert, S.A. and Suzanne, P.A.,(2010) Geomorphology – The mechanics and chemistry oflandscapes.CambridgeUniversityPress.
15. Routledge N. Y. Ritter,D.F., Kochel, R.C.,Miller, J.R.,(2002) Process Geomorphology,Wavelandpress.

MAJORPRACTICAL-1PHYSICALGEOLOGY

L	T	P	C
0	0	2	2

Course Code:

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1: Remember the basics of fundamental sciences formula

CO2: Understand physical parameter of the earth calculations

CO3: Apply the basic science calculation to identify earth features

CO4: Analysis the various types of landforms based known values

CO5: Evaluate the geomorphologic features and its relation to soil and rock formation.

CO6: Create models of landforms studied during the course.

Course Outline:

- InterioroftheEarth andSeismicwaves
- Rock density
- Relativeandabsoluteagedetermination
- Rockweathering
- Riveractivityand slopecalculations, slopestability
- Groundwater
- Seawave activity
- PlateTectonics –rateofmovement
- volcanism
- Earthquake-locatingepicenter

Mapping of Cos to POs and PSOs

	COURSE OUTCOME	PO ADDRESSED	CORRELATION LEVEL	PSO ADDRESSED	CORRELATION LEVEL	COGNITIVE LEVEL
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basics of fundamental sciences formula	PO1	H	PSO1, PSO3	H	K1
CO2	Understand physical parameter of the earth calculations	PO2	H	PSO2, PSO4	H	K2
CO3	Apply the basic science calculation to identify earth features	PO4, PO5,	M	PSO5	M	K3
CO4	Analysis the various types of landforms based known values	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate the geomorphologic features and its relation to soil and rock formation.	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create models of landforms studied during the course.	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

STRUCTURALGEOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To understandthe basic concepts of stress, strain and deformation.
- To acquaint with the primary structures of rocks andFolds,Faults,Joints and Unconformity.

Course Outcomes* (COs):
After completion of this course, students will be able to

CO1: Remember the earth's surface and the structures it features

CO2: Understand various types of forces involved in deformation of rocks and describe attitude of structures

CO3: Apply the basic concepts to distinguish the types of deformational structures

CO4: Analyse deformational structures produced by various deformational processes

CO5: Evaluate the regional tectonic and deformation processes

CO6: Create tectonic maps of a region based on studies and understanding

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Introductiontostructuralgeology–pioneersofstructuralgeology-scopeandaimofStructural Geology –Methods of representing physiographic features:graphical method,topographic map, contours and its characters and Geological maps. Beds and their attitudes:Dipandstrike andits importance-Relationbetweentrue andapparentdips. Widthofoutcrops,Truethickness,verticalthicknessandtheirmutualrelations.Measurement techniquesofdip and strikeusing clinometer andBrunton compass.

UNITII

Physical properties of rocks: deformation, forces causing deformation: Compressional force,Tensional force, andShearing force**.**Types of deformation: brittle, plastic and elastic –factorsaffectingrockdeformation.*GeologicalFieldwork*:BasicsofFieldGeology-PlanningforFieldwork:Objectives,Preparation-FieldEquipment's-FieldSafetyMeasures.
-Recognition of Rocks -Measurements of Structural: Features, Locating Your Position-

measuring dip and strike, , Plotting Attitude of Beds -Specimen collection - Field Sketchesand Photographs - Documentation of Field Observations. Erosional structures: Inlier andOutlier,Klippeand Fenster, Synclinalhill and Anticlinal valley.

UNITIII

Fold – Definition and elements of fold - Classification of folds-causes and mechanism offolding: tectonic and non-tectonic, criteria for recognition of folds- importance of folds,definition, types. *Fault*: Definition – importance of faults - elements of faults - classificationof faults:mechanism andgenetic - causes of faults - criteria for reorganization of fault,Importanceof fault,Fault zoneterminology.

UNITIV

Joint:Definition,Jointsystem,elementandclassification:geneticandgeometric-mechanism and causes of joints. Criteria for reorganization of joints - importance of joints.*Unconformity*:definition-classification- recognition ofunconformity-significance.

UNITV

Cleavage and Schistosity:– Types and origin of rock cleavages, Types of rock cleavage,cracks and fissures. *Lineation* – Kinds and Origin of lineation-Tectonic significance oflineation.

Mapping of Cos to POs and PSOs

	COURSE OUTCOME	PO ADDRESSED	CORRELATION LEVEL	PSO ADDRESSED	CORRELATION LEVEL	COGNITIVE LEVEL
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the earth's surface and the structures it features	PO1	H	PSO1, PSO3	H	K1
CO2	Understand various types of forces involved in deformation of rocks and describe attitude of structures	PO2	H	PSO2, PSO4	H	K2
CO3	Apply the basic concepts to distinguish the types of deformational structures	PO4, PO6,	M	PSO5, PSO6	M	K3
CO4	Analysedeformational structures produced by various deformational processes	PO3, PO5	M	PSO6, PSO7	M	K4
CO5	Evaluate the regional tectonic and deformation	PO7, PO8	H	PSO7, PSO6	H	K5

	processes					
CO6	Create tectonic maps of a region based on studies and understanding	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. BillingsM.P (1974).StructuralGeology, PrenticeHallNew Delhi.
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4. DeSitter,L.U.(1956).Structural geology,McGrawHill,NewYork
5. Gosh,S.K.(1993).Structural Geologyfundamentals and modern developments.
6. Compton,R.R.(1985). Geologyin the Field,John Wiley&SonsInc., NewDelhi.
7. Sathya Narayanaswami, B.S. (1994). Structural Geology. Dhanpat Rai & Sons. NewDelhi.
8. Gokhale,N.W.(1995), Theoryof StructuralGeology, CBS,Delhi.
9. Hills,E.S.(1963).ElementsofStructuralGeology,Chapman&Hall.London.
10. Park,P.G.(1983).FoundationsofStructuralGeology,Blackie,London.

ONLINEOPENRESOURCES

1. Structural Geology & Map Interpretationhttps://ocw.tudelft.nl/courses/structural-geology-map-interpretation/

2. Geological Structures: a Practical Introductionhttps://open.umn.edu/opentextbooks/textbooks/899

MAJORPRACTICAL-2 STRUCTURALGEOLOGY

Course Code:

L	T	P	C
0	0	2	2

Course Objectives:

- To understand the concepts of contours
- To interpret the Geological maps

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1: Remember the basic trigonometric calculations

CO2: Understand the dip and strike and outcrops patterns

CO3: Apply the concepts of contour

CO4: Analyse the 3-point problems

CO5: Evaluate structural features using contour

CO6: Create and prepare geological map of a region.

Course Outline:

- Contourmapsandtheirinterpretation.
- StructuralProblems– problemsrelatingtotruedipandapparentdip;Determinationofverticalandtruethickness.
- InterpretationofGeologicalmaps:tracingtheorebody,3-pointproblem,fold,fault,unconformityand drawingprofile section.

Mapping of Cos to POs and PSOs

	COURSE OUTCOME	PO ADDRESSED	CORRELATION LEVEL	PSO ADDRESSED	CORRELATION LEVEL	COGNITIVE LEVEL
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basic trigonometric calculations	PO1	H	PSO1, PSO3	H	K1
CO2	Understand the dip and strike and outcrops patterns	PO1,PO2	H	PSO2, PSO4	H	K2
CO3	Apply the concepts of contour	PO3, ,	M	PSO4, PSO6	M	K3
CO4	Analyse the 3point problems	PO4, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate structural features using contour	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create and	PO3, PO8	H	PSO8	H	K6

	prepare geological map of a region.					

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

CRYSTALLOGRAPHYANDMINERALOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To know about the nature, forms, habit, symmetry elements, and twins in crystals. Theclassification of crystals into system and classes.
- To learn about the physical and optical properties ofrockforming minerals ofortho, ring,sheet,chainandframeworksilicates.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1: Remember the basic various physical properties, optical properties.

CO2: Understand the crystal parameters in minerals and crystal models

CO3: Applythe understanding of physical, optical and other properties to determine the different groups and crystal systems.

CO4: Analyseindustrial applications and economic importance of various minerals.

CO5: Evaluateminerals on the basis of the different properties and estimate a few physical properties like hardness and specific gravity of minerals

CO6: Create models of crystals and mineral structures.

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Definition for crystal – Morphological characters of crystals – Faces – Forms – Edge, Solidangle – Interfacial angle – Uses of Contact Goniometer. Law of constancy of the Interfacialangles, Symmetry elements, crystallographic axes – Miller indices – Law of rational indices.DefinitionofHolohedral,Hemimorphic, EnantiomorphicandHemihedral.

UNITII

CrystalSystems:ClassificationofCrystalSystems-ClassificationofCrystalsinto7Systems.

-

Morphologicalstudyofsevencrystallographicsystemswithspecialreferencetotheelementsof symmetryoftheirnormalclass.Cubicsystem–Normal(Galenatype)-Tetragonal system –

Zircon type - Hexagonal system – Beryl type - Trigonal system- Calcitetype - Orthorhombic system – Barytes type - Monoclinic system – Gypsum type -Triclinicsystem– Axinite type.Twinningin crystalsand its types.

UNITIII

Mineralogy: Definition, Characters and Uses -Physical Properties of Minerals: Colour,streak, lustre, hardness, habit, cleavage, fracture, Odour, fluorescence and Phosphorescence,feel,tenacityspecificgravity,magnetism.Chemistryofminerals:generalprincipalsofchemicalpropertiesofminerals:atom,ions,molecules,atomicnumber,massnumber, valence,ionicradii–bondinginminerals–atomicsubstitutionandsolidsolution-Isomorphism, polymorphism and pseudomorphism. Classification of minerals: ClassificationSchemes,ChemicalClassification ofMinerals,StructuralClassificationofSilicates.

UNITIV

Rock Forming Minerals Group: Physical properties, chemical composition, classification,diagnostic properties and mode of occurrence of the following groups: Quartz, Feldspar,Feldspathoid,Amphibole, Pyroxene, Olivine, Micaand Garnet.

UNITV

OpticalMineralogy:PropertiesofLight:NatureofLight-ordinaryandplanePolarisedlight - Light interaction with matter; reflection, defuse reflection, refraction, double refraction,refractive Index, total reflection, dispersion, relative retardation and birefringence.PolarisingMicroscope: Parts of Polarising Microscope and its uses - Study of Optical Properties ofMinerals:Optical Properties under Plane Polarised Light: Form, Colour, relief, RefractiveIndex,Cleavage,InclusionandAlteration,Pleochroism,Twinkling.OpticalProperties between Cross Nicol: Isotropism/Anisotropism, Interference colors, Extinction, Twinning,Zoning**.**Construction ofNicol prism-Preparation of Thin Section.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basic physical properties, optical properties	PO1	H	PSO2, PSO3	H	K1
CO2	Understand the crystal parameters	PO1,PO2	H	PSO2, PSO4	H	K2

	in minerals and crystal models					
CO3	Applythe understanding of physical, optical and other properties to determine the different groups and crystal systems.	PO4, PO6,	M	PSO5, PSO6	M	K3
CO4	Analyseindustrial applications and economic importance of various minerals.	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluateminerals on the basis of the different properties and estimate a few physical properties like hardness and specific gravity of minerals	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create models of crystals and mineral structures .	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Ford,W.E.(1988).Dana'sTextbookofMineralogy.Wiley. NewDelhi.(Reprint).
2. Read,H.H.(1916).Rutleyselementsofmineralogy,ThomasMurphy&co,.London.
3. Kerr,Paul.(1977).Opticalmineralogy,McGraw hill,NewYork.
4. Deer, Howie andZussman(1964). an introduction to rock-forming minerals orient ,Longman, London.
5. Naidu,P.R.J.(1967).OpticalMineralogy.
6. Klein,Cand Hurlbut,Jr., C.S.,(1993).Manual of Mineralogy, JohnWiley
7. PutnisAndrew,(1992).IntroductiontomineralSciences,CambridgeUniversityPress
8. Philips,Wm,RandGriffen,D.T.,(1986).Opticalmineralogy,CBSEdition
9. Hutchinson, C.S., (1974). Laboratory hand book of Petrographic Techniques,John Wiley
10. MacKenzie,W.S.&C. Guilford.(1993). Atlas of Rock-Forming Minerals in Thin Section,Longman,UK.

ONLINEOPENRESOURCES

1. MineralogyBook:https://opengeology.org/Mineralogy/
2. CrystallographyandMineralogylearningMaterial :https://serc.carleton.edu/teachearth/themes/11

MAJORPRACTICAL-3CRYSTALLOGRAPHYANDMINERALOGY

Course Code:

L	T	P	C
0	0	2	2

Course Objectives:

- To identify the crystal systems
- To identify the minerals through hand-specimen and thin sections

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1: Remember the basic physical and optical properties of classifications

CO2: Understand the mineral character under light

CO3: Apply the concepts of crystal system in minerals

CO4: Analyse the crystallographic system

CO5: Evaluate the mineral based on megascopic identification

CO6: Create and prepare report on minerals and its crystal properties.

Course Outline:

CRYSTALLOGRAPHY

IdentificationandDescriptionofFollowingCrystals.

CubicSystem :NormalClass–Galena, Spinel,Garnet,Fluorite, Diamond.
:Pyritohedral class–Pyrite.
TetragonalSystem :NormalClass–Zircon,Rutile,Cassiterite,Vesuvianite,
: Apophyllite.
HexagonalSystem :NormalClass–Beryl.
:Hemimorphic class – Zincite
TrigonalSystem : Calcite andCorundum
OrthorhombicSystem:Normalclass–Barite,Staurolite,Sulphur,Topaz.
:Hemimorphicclass–Calamine.
:Sphenoidal class – Epsomite.
MonoclinicSystem : Normal class – Gypsum, Epidote, Orthoclase.
TriclinicSystem :Normal class– Axinite and Albite.

MINERALOGY

MEGASCOPICMINERALOGY

Identification and description of the following silicate mineral groups.Quartz and its varieties,Feldspar group, Feldspathoids, Pyroxene group, Amphibole group, Epidote group, Mica group,Garnet group and AluminumSilicates.

OPTICALMINERALOGY

Microscopic identification and Description of the following:- Quartz, Orthoclase, Microcline,Albite, Oligoclase, Labradorite, Nepheline, Leucite, Enstatite, Hypersthene, Glaucophane,Biotite, Muscovite, Olivine, Epidote, Garnet, Apatite, Zircon, Sphene, Tourmaline, Calcite,Andalusite,Kyanite, Sillimanite, Staurolite, and Cordierite.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basic physical and optical properties of classifications	PO1	H	PSO1, PSO3	H	K1
CO2	Understand the mineral character under light	PO2	H	PSO2, PSO4	H	K2
CO3	Apply the concepts of crystal system in minerals	PO4, PO6,	M	PSO5, PSO6	M	K3
CO4	Analyse the crystallographic system	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate the mineral based on megascopic identification	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create and prepare report on minerals and its crystal properties.	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

SKILLEDBASEDELECTIVE–1.1 REMOTESENSING ANDGIS

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- The objective of this subject is to understand the basic principles of aerial photographs, aerialremote sensing and its applications.
- learn interpretation techniques of Remote Sensing and basics of GIS anditscomponents.

Course Outcomes* (COs):
After completion of this course, students will be able to

CO1: Remember the Indian satellite types

CO2: Understand the various photo recognition elements from remotely sensed data

CO3: Apply the concepts of platforms and satellite orbits

CO4: Analyse the remote sensing principles and photo recognition elements to identify various features

CO5: Evaluate the GIS components and vector and raster data

CO6: Create and compare between different types of remotely sensed data and evaluate its utility

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Remote sensing: Definition, Basic concepts and principles of remote sensing, advantages andlimitations - components of remote sensing - Electromagnetic Radiation:Properties of EMR,Electromagnetic Spectrum – AtmosphereInteraction: Refraction, Scattering, Absorption.Electromagnetic energy-Earth Interaction: Reflection, Transmission – Spectral Signature:Spectral Signatureof Vegetation,Spectral Signature of Soil, Spectral Signature of Water, Spectral Signature ofMineralsand Rocks.

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UNITII

RemoteSensingPlatforms:TerrestrialPlatforms,AirbornePlatforms,SpacebornePlatforms-Types of Satellites: Astronomical Satellites, Communication Satellites, Weather Satellites,Earth Observation Satellites, Navigation Satellites, Reconnaissance Satellites - *Orbits andtheir Types*: Geosynchronous Orbit, Sun synchronous Orbit- Sensor System: MultispectralImaging Sensor System, Thermal Remote Sensing System, Microwave Imaging System -Image Resolution-Types of Image Resolutions: Spatial Resolution, Spectral Resolution,RadiometricResolution, Temporal Resolution.

UNITIII

Aerial photographs –scales and types of aerial photographs- photo interpretation techniques –applications of aerial photographs. Mosaics: controlled and uncontrolled mosaics –advantageand disadvantages – application of mosaics in geology studies. Types of data products – typesofimageinterpretation –basicelementsofimageinterpretation– visualinterpretationkeys.

UNITIV

GIS definition -history of GIS – Components of GIS – Hardware, Software, Data, Peopleand Procedure. – GIS sub systems -Data types: Spatial data: raster, vector, TIN – Nonspatialdata. Coordinate systems: Geographic coordinate system, datum and map projection and itstypes,projectedcoordinate systems.

UNITV

VectorDataModel:SpaghettiVectorModel,TopologicalVectorModels.Rasterdatamodels: Simple Raster Arrays,Hierarchical Raster Structures,Types of Raster GIS Models,Compact Raster Data Models. Attribute data model:Hiearchial, network, relational andobject oriented model.Data Base Management System: functions of DBMS, components ofDBMS,data filemanagement: simplelist, orderedsequential files,indexed files.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the Indian satellite types	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the various photo recognition elements from remotely sensed data	PO1,PO2	H	PSO3, PSO4	H	K2
CO3	Apply the concepts of platforms and satellite orbits	PO4, PO6,	M	PSO3, PSO6	M	K3

CO4	Analyse the remote sensing principles and photo recognition elements to identify various features	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate the GIS components and vector and raster data	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create and compare between different types of remotely sensed data and evaluate its utility	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Curran,P.B.(1985).PrinciplesofRemoteSensing. ELBS. London.
2. Drury,S.D.(1993).ImageInterpretationinGeology.Allen&Unwin. London.
3. Miller,V.C.(1961).Photogeology.McGrawHill.NewYork.
4. Pandey,S.N. (1989). Principles and Applications of Photogeology. Wiley Eastern.NewDelhi.
5. Reddy,A. (2010).PrinciplesofRemoteSensingandGIS.CBS.Delhi.
6. Lillisand,T.M&R.W.Kiefer. (2000). Remote Sensing and Image Interpretation.Wiley.Delhi.
7. Gupta,R.P.(1990).RemoteSensingGeology,Springer Verlag.
8. Benhardsen,T.,(2002).GeographicInformationSystems:anIntroduction,JohnWiley&Sons, New York,
9. Guha,P.K.,(2008).RemoteSensingfortheBeginner,SecondEdition,East-Westpresspvt.ltd, New Delhi.178 pp.
10. IanHeywood,SarahCorrdiusandStevecarver,2000.AnintroductiontoGeographicInformationsystem.LongmanLtd, Newyork

ONLINEOPENRESOURCES

- ACanadaCentreforRemoteSensingRemoteSensingTutorial
- https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_e.pdf
- Jonathan Campbell and Michael Shin (2011)Essentials of Geographic InformationSystems
- https://open.umn.edu/opentextbooks/textbooks/67

SKILLEDBASEDELECTIVE- 1.2 GEMMOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- Theobjectiveofthiscourseistointroducetheorigin,occurrenceandeconomicimportanceofgemsandprecious materials.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1: Remember the attributes of gemstones

CO2: Understand the different gem instruments in identification of the gemstones

CO3: Applythe treatments used in the gemstones to enhance their attributes

CO4: Analyse the various gemstones based on their physical and optical properties.

CO5: Evaluate and Discriminate between synthetic and natural gemstones

CO6: Create and Organize various gemstones into different groups based on their physical and optical properties

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Introduction to Gems - Basic properties of gems -formation of gem stones. Nature of gemmaterial: quality necessary in gems-beauty, rarity, durability. Distinction between crystalline,amorphous and metamict materials. Crystal forms and habits. Classification of gem stones.Observations with hand lens- its importance. Units of measurement: metric scale, carat, pearlandgrain.

UNITII

Nature of crystals: distinction between crystalline and amorphous material, crystal symmetry,Twinning, parallel growth, crystal form, crystal habit, seven crystal system. Identification ofroughstones.

UNITIII

Physical properties: hardness and its applications in gemmology and limitations. Cleavage,Fracture, parting, and their importance in gemology and lapidary work. Specific gravity-utility and determination by hydrostatic weighing, heavy liquids, floatation and pycnometer.Inclusionsand otherfeatures ofgemstones.

UNITIV

Optical properties: The electromagnetic spectrum, reflection and its importance in gemology-
lustre,aventurescence,sheen,chatoyancy,asterism,luminescence,playofcolours,labradores cence and inclusions. Laws of refraction, refractive index (R.I), total reflection-design of refractometer. Construction and use of refractometer. Polariscope-construction anduseingemmology.Dichroscopeconstruction,useofChelseacolourfilter,Infra-redultravioletand x-rays ingem identification.

UNITV

Enhancement and treatments- enhancement methods -coloured and colourless impregnation,dyeing, bleaching and its identification. Methods of treatment – laser drilling, irradiation, heattreatment,surfacemodifications,diffusiontreatmentanditsidentification.Composites-types,classification and identification.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the attributes of gemstones	PO1	H	PSO1,	H	K1
CO2	Understand the different gem instruments in identification of the gemstones	PO1,PO2	H	PSO2, PSO3	H	K2
CO3	Applythe treatments used in the gemstones to enhance their attributes	PO4, PO6,	M	PSO5, PSO6	M	K3
CO4	Analyse the various gemstones based on their physical and optical properties.	PO3, PO5	M	PSO4, PSO7	M	K4
CO5	Evaluate and Discriminate between synthetic and natural gemstones	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create and organize various gemstones into different groups based on their physical and optical properties	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Karanth,R.V. (2000). Gem and gem industry in India, Memoir 45, Geological Societyof India,Bangalore.
2. Babu,T.M. (1998). Diamond in India, Economic Geology Series 1, GeologicalSocietyofIndia, Bangalore.
3. Hall,C.(2005).Gemstones,DorlingKindersley,London.
4. Sinkankas,J.J.(1964).Mineralogy:AfirstCourse, VanNostrandReinhold,NewYork.
5. Krishnan,M.S. (1964). Mineral Resources of Madras, Memoir Vol 80, GeologicalSurveyofIndia ,Kolkota
6. Prasad,U.(2003). EconomicMineralDeposits,CBSPublishers,NewDelhi.
7. Read,P.G. (1984). Beginner's Guide to Gemmology, Heinemann ProfessionalPublishingLtd,London.
8. O'Donoghue,M.(2006). Gems.Elsevier,Singapore.
9. Keller,P.C.(1990).Gemstonesandtheirorigins,VanNostrandReinhold,NewYork.
10. HerbertSmith,G.F(1912).Gemstones.Metheun,London.

Non– MajorElectiveOffered byGeologyDepartment
to students ofanotherDepartment
SKILLEDBASEDELECTIVE–1.1 CLIMATOLOGY

Course Code:

L	T	P	C
2	0	0	2

Course Objectives:

- To understand the flow of energy and its interactionswiththeearth.
- Gain knowledge on componentsofclimatesystem andassociated climateoutcomes.

Course Outcomes* (COs):
After completion of this course, students will be able to

CO1: Remember the interaction between the atmosphere and the earth's surface

CO2: Understand the importance of the atmospheric pressure and winds

CO3: Applythe atmospheric moisture works

CO4: Analyse the cyclones and its impacts.

CO5: Evaluate and seasonal and regional climate variations

CO6: Create the model of climate and seasonal changes

Course Outline:

Unit I: Contact Hours: 6
Unit II: Contact Hours: 6
Unit III: Contact Hours: 6
Unit IV: Contact Hours: 6
Unit V: Contact Hours: 6

UNITI

Introductiontoclimatology:physicalelementsofweatherandclimate:-Fundamentalprinciples of climatology, Atmosphere, Climate system: Components of the climate system -Climate controlling factors. Earth's radiation balance – longitudinal and seasonal variation ofinsolation.

UNITII

Atmospheric moisture and Precipitation: - hydrological cycle - Precipitation and Rainfall:Types and measurements. Weather elements: Temperature, pressure, humidity, clouds, wind,sunshineand rainfall– monsoon patterns.

UNITIII

Atmospheric Pressure: Diurnal and Seasonal Variations – Vertical and Horizontal distributionand factors affecting - Pressure Gradient - Coriolis force and Deflection.

Winds: Causes andTypes - Jet stream, planetary winds, Monsoon and Local winds.Cyclones – Definition, typesandtheireffectsandgeographic distribution.

UNITIV

Classification of climates –Koppen's and Thornthwaite's scheme of classification – climatechange.Ocean circulation, patternand its climate control.

UNITV

Global warming: Definition, greenhouse effect, greenhouse gases, Impact of climate change,prevention of global warming Acid rain: Definition, causes, formation, affected area,effectsandpreventivemeasures.Ozonedepletion:Definition,effectsandpreventivemeasures.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the interaction between the atmosphere and the earth's surface	PO1	H	PSO1,	H	K1
CO2	Understand the importance of the atmospheric pressure and winds	PO1, PO2	H	PSO2, PSO3	H	K2
CO3	Applythe atmospheric moisture works	PO4, PO6,	M	PSO4, PSO5	M	K3
CO4	Analyse the cyclones and its impacts.	PO3, PO5	M	PSO6, PSO7	M	K4
CO5	Evaluate and seasonal and regional climate variations	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create the model of climate and seasonal changes	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Montgomery, C.W. (1989) Environmental Geology. Brown Publishers, Dubuque,Iowa,USA.
2. Strahler, A.N. and Strahler, A.H. (1973) Environmental Geoscience – Interactionbetween Natural Systems and Man. Hamilton Publishing Co., Santa Barbara,California.
3. Kudesia,V.P.(1980)WaterPollution.PragathiPrakasam,Meerut.

4. Kothandaraman, H. (1997) Principles of Environmental Chemistry. BI PublicationsPvt.Ltd., Chennai.
5. Black,W.(1972) AtmosphericPollution.McGraw-HillCo.,NewYork.
6. Trivedy,R.K.andGoel,P.K.(1986)ChemicalandBiologicalMethodsforPollution
7. Studies.EnvironmentalPublications,Karad,Maharashtra.
8. Fairbridge, R.W. (1972) Encyclopedia of Geochemistry and Environmental Science.JohnWiley.
9. Datta,M.andSingh, N.P.etal.(Eds.)(2008)ClimateChangeand FoodSecurity.NewDelhi PublishingAgency.
10. Shyam, S., Verma, H.N. and Bhargava, S.K. (2006) Air Pollution and its Impacts onPlantGrowth. New Delhi PublishingAgency

ONLINEOPENRESOURCES

- Andreas Schmittner (2018) Introduction to Climate Science, Oregon State University.https://open.umn.edu/opentextbooks/textbooks/860

Non– MajorElectiveOffered byGeologyDepartment

SKILLEDBASEDELECTIVE–1.2 FUNDAMENTALSOFGEOLOGY

L	T	P	C
2	0	0	2

Course Code:

Course Objectives:

- ThiscourseprovidesthebasicprinciplesofGeology,Compositionandageoftheearth,Earth'sexodynamicandendodynamic processes anditseffectsonEarth's surface.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1: Remember the basics of earth and atmosphere

CO2: Understand the interior of the earth along with their physical and chemical properties.

CO3: Applythe seismic properties of earth and its influence on earthquakes

CO4: Analyse the weathering of rocks and its relationship with soil formation.

CO5: Evaluate the processes involved in plate movements

CO6: Create the model for river process,

Course Outline:

Unit I: Contact Hours: 6
Unit II: Contact Hours: 6
Unit III: Contact Hours: 6
Unit IV: Contact Hours: 6
Unit V: Contact Hours: 6

Unit–I

Definition of Geology –Branches of Geology – Geology in the service of Man. The Solarsystem: – The Planets – Meteorites – Asteroids – Satellites – Comets; Evolution of the Solarsystem–Nebularhypothesis–Planetesimalhypothesis–StructureandcompositionofEarth'sinterior.

UnitII

Earthquakes:Definition–causesandeffects–FocusandEpicentre–MagnitudeandIntensity–Prediction ofEarthquakes– Tsunami- Earthquakes inIndia.*Volcanoes*: Definition-Types –Causesofvolcanism– Effectsof Volcanic activity-Predictionofvolcanoes.

UnitIII

Mass movements – Definition – Classification –Causes and remedial measures. Concept

of*plate tectonics* – Different kinds of plate margins– Evidences in favor and against theconceptsof ContinentalDrift and PlateTectonics.

UnitIV

Weathering of Rocks –weathering processes, chemical and mechanical weathering Economicimportance ofweathering. Atmosphere–Itscomposition and zones. Wind–Geologicalactionofwind-sand dunes andtheirtypes.

UnitV

Running water –erosion, transportation and deposition – brief study of landforms resultingfromerosionanddeposition.Undergroundwater–sources–watertable–zonesofgroundwater – springs and wells – artesian wells – geysers– aquifers. Glaciers – origin andtypesof glaciers.SeasandOceans–waves,tides andcurrents–sea asa geologicalagent.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basic of earth and atmosphere	PO1	H	PSO1,	H	K1
CO2	Understand the interior of the earth along with their physical and chemical properties.	PO1,PO2	H	PSO2, PSO3	H	K2
CO3	Applythe seismic properties of earth and its influence on earthquakes	PO4, PO6,	M	PSO5, PSO6	M	K3
CO4	Analyse the weathering of rocks and its relationship with soil formation.	PO3, PO5	M	PSO4, PSO7	M	K4
CO5	Evaluate the processes involved in plate movements	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create the model for river process,	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXT AND REFERNCE BOOKS

1. Radhakrishnan,V.,(1996).GeneralGeologyV.V.P.Publishers,Tuticorin.
2. Arthur Holmes (1992) Principles of Physical Geology: Thomas Nelson & sonsLondon.
3. CharlesC.Plummer,DianeH.CarlsonandLisaHammersley(2019) PhysicalGeology(16th Ed). McGraw-Hill Education
4. Thornbury.W.D(1969). PrinciplesofGeomorphology.,Wiley,NewYork.
5. StrahlerA.M(1965).IntroductiontoPhysicalGeology.,Wiley
6. Mahapatra,G.P.(1994).PhysicalGeology,CBSPublishers,NewDelhi.
7. Emiliani,C.(1992).PlanetEarth,CambridgeUniversityPress,Delhi.
8. Leet,D&Judson,S(1987).PhysicalGeology,McGrawHill.NewJersey.
9. Patwardhan,A.M.(1999).DynamicEarthSystem,PrenticeHall,NewDelhi
10. Dasguptha,A.B.(1978).PhysicalGeography, CBSPublishers,Delhi.

PALAEONTOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- to impart knowledge on origin of life and its evolutionthroughgeologicaltime
- to understand preservationfossils,generalmorphology,classification,geologichistory andstratigraphic importanceofvariousphylum.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1: Remember the basic of biological sciences

CO2: Understand the various processes involved in the formation of fossils.

CO3: Apply the morphological studies and classify various types of fossils on the basis of their morphological features.

CO4: Analysesignificance of fossils in the interpretation of depositional environments.

CO5: Evaluate the fossils belonging to various phyla

CO6: Create the significance of fossils in palaeoclimate interpretation

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNIT– I

Definition of Palaeontology- Animal Kingdom – classification of animals –Definition offossils–natureandmodesofpreservationoffossils,Tracefossils-mould,casts,tracks,trails, borings; Uses of fossils – stratigraphic indicators – climatic indicators- indicators ofpalaeogeography– indicators ofevolution and migration oflifeforms.

UNIT-II

PhylumArthropoda: Class – Trilobita- General morphology : classification– geologicalhistory.PhylumPorifera–Ashortaccountofsponges.Phylumcoelentrata– classAnthozoa– zoological features – General morphology : classification – tabulate corals – Rugose coralsgeologicaldistribution–stratigraphicimportance.SubphylumHemichordata– classGraptozoa:orderDendroideaandGraptoloidea– generalmorphology,classification,geologicaldistribution and stratigraphic importance.

UNIT–III

Phylum Mollusca: Class Pelecypoda - General characters – ornamentation , classification ,geological history. Class Gastropoda:- General morphology , shell forms – types of coiling –Dextralandsinistral– ornamentation,classificationandgeologicalhistory.ClassCephalopoda:- General morphology , (Nautilitic , Goniotitic , Ceratitic and Ammonitic) –shell forms – ornamentation – classification, geological history- morphology of a Belemniteshell.

UNIT– IV

PhylumBrachiopoda:-Generalmorphology –Brachialskeleton– morphometricdetails,ornamentation , classification , geological history. Phylum Echinodermata: Class Echinoidea:Generalmorphology,corona(Ambulacra,interambulacra)–peristome– regularandirregularechinoids–classification–geologicalhistory.ClassCrinoidea:- Generalmorphology, classification,geological history. ClassBlastoidea: Generalmorphology.

UNIT– V

Phylum protozoa – Order: Foraminifera: General morphology – dimorphism – classification ,geologicalhistoryandstratigraphicimportance.ClassCrustacea:- Subclass:Ostracoda–morphology – A short account of Devonian fishes, Mesozoic Reptiles, Siwalik mammals.General classification of plant kingdom – plant fossils from India – A brief account of thefollowingplantfossils:- Glossopteris,Gangamopteris,Ptilophyllum,Calamites,Lepidodendronand Sigillaria. Applications ofMicro palaeontology.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basic of biological sciences	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the various processes involved in the formation of fossils.	PO1,PO3	H	PSO3,	H	K2
CO3	Apply the morphological studies and Classify various types of fossils on the basis of their morphological features.	PO4,	M	PSO5, PSO6	M	K3
CO4	Analysesignificance of fossils in	PO4, PO5	M	PSO5,	M	K4

	the interpretation of depositional environments.			PSO7		
CO5	Evaluate the fossils belonging to various phyla	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create the significance of fossils in palaeoclimate interpretation	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Henrywoods (2011)Invertebrate Palaeontology,8th Ed,Cambridge.
2. Romer,A.S.(1945)VertebratePalaeontology,Chicagopress.
3. Arnold,C.A.(1972)An introductiontoPalaeobotany.,MC-Graw Hill.
4. B.U.HagandA. Boersma(1978):IntroductiontomarineMicropalaeontology.Elsevier,Netherlands
5. Jain, P.C., and Anatharaman, M.S. (2016) An introduction to Paleontology, VishalPublications.
6. Foote, M. and Miller, I.A. (2007) Principles of Paleontology. 3rd Edition by W. H.Freemanandcompany
7. Clarkson, E. N. K. (2012) Invertebrate paleontology and evolution. 4th Edition byBlackwellPublishing.
8. Benton,M.(2009).Vertebratepaleontology. JohnWiley&Sons. 4thEdition.
9. Dasgupta,A.,(2005),IntroductiontoPalaeontology, (1Edition),WorldPress
10. Black,R.M.(1988):TheElementsofPalaeontology,Cambridge Univ

MAJORPRACTICAL-IV PALAEONTOLOGY

Course Code:

L	T	P	C
0	0	2	2

Course Objectives:

- To understand and identify the morphological characters of various phylum and study its relationships with stratigraphy.

Course Outcomes* (COs):

After completion of this course, students will be able to

.**CO1:** Remember the basic of morphological studies

CO2: Understand the different mega fossils on the basis of morphological characters.

CO3: Apply the systematic classifications

CO4: Analyse the Biological position and range of time of fossils.

CO5: Evaluate the fossils belonging to palaeo-environment

CO6: Create the significance of fossils in resource estimation

Course Outline:

Coelenterata	Montlivaltia Zaphrentis
Brachiopoda	Productus, Spirifer,Terebratula, Rhynchonella
Pelecypoda	Arca,Spondylus,Trigonia,Meretrix,Venus,Alectryonia,Ostreae,Gryphaea,Exogyra
Gasteropoda	Physa,Turritella, Fusus,Trochus,Conus.
Cephalopoda	Nautilus,Ceratite,Aconthoceras, Belemnites
Trilobites	Paradoxides, Calymene.
Echinoids	Hemiaster,Micraster,Stigmatopygous.

PlantFossils	Glossopteris,Gangamopteris,Ptillophyllum,Woodfossil

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basic of morphological studies	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the different mega fossils on the basis of morphological characters. .	PO1,PO2	H	PSO2, PSO3	H	K2
CO3	Apply the systematic classifications	PO4, PO6,	M	PSO4,	M	K3
CO4	Analyse the Biological position and range of time of fossils.	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate the fossils belonging to palaeo environment	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create the significance of fossils in resource estimation	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

STRATIGRAPHY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To learn about the geological time scale, principles of stratigraphy.
- Understandstrata and their relationship to tectonics, climate, fossils alongwith their distribution in differentparts ofIndia from Precambriantorecent.

Course Outcomes* (COs):

CO1:	Remember the fossils character and geological time scale
CO2:	Understand the various elements of stratigraphy and give their importance.
CO3:	Apply the geological formations knowledge
CO4:	Analyse the geological formations.
CO5:	Evaluate the distribution of geological formations in India
CO6:	Create the significance of various stratigraphic features in India

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours:12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

PrinciplesofStratigraphy:LawsofStratigraphy,Correlation,Geologicaltimescale,Fundamentalconceptsoflithostratigraphy,biostratigraphy,chronostratigraphy,seismicstratigraphy,chemostratigraphyanddynamicstratigraphy.Codeofstratigraphicnomenclature, International Stratigraphic Code – development ofstandardized stratigraphicnomenclature.Conceptofpaleogeographicreconstruction,Faciesandfacieschange,Hiatusinrecords. Physiographicdivisions ofIndia.

UNITII

Precambrian Stratigraphy: Archaean's of Dharwar Province, Archaean's of Eastern Ghat - TheSausar and Sakoli Series, Archaeans of Singhbhum – Iron Ore Series and Gangpur Series.Archaean's of Tamilnadu. The Eparchaean Unconformity, Stratigraphy and Mineral Wealthof Cuddapah, Stratigraphy and Mineral Wealth of Vindhyan, Kurnool group, Life duringPrecambrian

UNITIII

PaleozoicStratigraphy:DistributionofPaleozoicrocksinIndia,CambrianofSaltRange, Upper Carboniferous and Permian rocks of Salt Range, Paleozoic rocks of Kashmir Valley,Paleozoicrocks of SpitiValley, Paleozoic rocksof PeninsularIndia,

UNITIV

MesozoicStratigraphy:TheDepositionalEnvironment-distribution-life-classificationandeconomicimportanceofGondwanaformationsofIndia,CoastalGondwanaof India,Gondwana formations of Tamilnadu, Triassic of Spiti– The Lilang System, Jurassic ofKutch, Cretaceous of Tiruchirapalli – Pondicherry – Bagh Beds, Deccan traps : distribution ,structure,Lameta beds –infratrappean andintertrappeanbeds, ageofthe Deccantraps

UNITV

Cenozoic Stratigraphy: Comprehensive account of the geological events took place duringCenozoicerainIndia,riseofHimalayas,stratigraphyofSiwaliksystem,faunaandfloraof Siwaliks, Tertiary rocks of Assam, Karewa formation, Tertiary rocks of Tamilnadu, Tertiaryrocks of Kerala, Pleistocene Glaciation - Mineral wealth of Tertiary rocks of India: ImportantStratigraphicboundariesinIndia.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the fossils character and geological time scale	PO1	H	PSO2, PSO3	H	K1
CO2	Understand the various elements of stratigraphy and give their importance.	PO1,PO2	H	PSO2, PSO4	H	K2
CO3	Apply the geological formations knowledge	PO4, PO6,	M	PSO5, PSO6	M	K3
CO4	Analyse the geological formations.	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate the distribution of geological formations in India	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create the significance of various stratigraphic features in India	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. KrishnanM.S.,(1968).GeologyofIndiaandBurma,Higginbotham's.
2. WadiaD.N.(1953).GeologyofIndia,McMillianand Co.
3. Ravindra Kumar. (1985). Fundamentals of Historical Geology and Stratigraphy ofIndia.
4. Dunbar,C.O.&Rogers,J. (1961).PrinciplesofStratigraphy,Wiley.
5. Eicher,L.D. (1968).Geologictime.PrenticeHall.
6. Gignoux,M.(1960).StratigraphicGeology,Freeman
7. PascoE.S.(1973).Amanual oftheGeologyofIndia andBurma.
8. StokesW.L. (1965).EssentialsofEarthHistory.
9. Weller, M., (1960) Harper & Brothers, New York Stratigraphic Principles andPractice.Harper &Brothers, NewYork.
10. LemonR.R,(1990)PrinciplesofStratigraphy,Merrillpublishingcompany.

ONLINEOPENRESOURCES

1.Stratigraphy:https://opengeology.org/historicalgeology/stratigraphy-reading-the-pages-of-earth-history/

GEOSTATISTICSANDCOMPUTERAPPLICATIONS

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- *To learn the various statistical analytical methods, data analysis and representation,computerbased analyticalskills and usageofsoftware.*

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the fundamentals of computer
CO2:	Understand the various sampling techniques related to geosciences.
CO3:	Apply the basic geostatistical approach
CO4:	Analyse the geological data
CO5:	Evaluate the computer based geological analysis
CO6:	Create the significance of geostatistics using computer application

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Definition of Statistics - Sampling and population.Measures of central tendency –- mean,median, mode, standard deviation, skewness and kurtosis. Nominal, Ordinal, Interval andRatio scales.Discontinuous and continuous data.Ungrouped and grouped scores.Graphicalrepresentationofdata;barcharts,histograms,linegraph,XYgraph,frequenc yandcumulativefrequencycurves.Hypothesistesting,student's't'and ' F ' tests.

UNITII

Geological Data types - Parametric Statistics and Nonparametric Statistics. Karl Pearson'scorrelation, Spearman'srank correlation - Probability and normal distribution - SimpleLinearRegression-Goodnessof fit tests:Chi-squaretest. Scales ofmeasurements.

UNIT-III

Geological Data Analyses - Principal component analysis – Discriminant analysis - Timeseriesanalyses -mapanalysis– Clusteranalysis–Factor analysis.

UNITIV

IntroductiontoComputer–Elementsof Computer:Hardware andSoftware-Hardware:InputdevicesandOutputdevices.BasicsofAlgorithm,Flowcharts,Programminglanguages, OperatingSystems: DOS and Windows .

UNIT– V

Computer applications in Geosciences:Basics of MS Office: Word, Excel and Power Point.Excel graphical representation in Geology : Bar diagram, pie diagram, role diagrams, scatterplotsandX-Y plots. Application ofGoogleEarth in Earth Science.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the fundamentals of computer	PO1	H	PSO1, PSO3	H	K1
CO2	Understand the various sampling techniques related to geosciences.	PO1,PO2	H	PSO2, PSO4	H	K2
CO3	Apply the basic geostatistical approach	PO4,	M	PSO5, PSO6	M	K3
CO4	Analyse the geological data	PO3, PO6	M	PSO7	M	K4
CO5	Evaluate the computer based geological analysis	PO7, PO8	H	PSO6	H	K5
CO6	Create the significance of geostatistics using computer application	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Ravichandran,D.(2001). Introduction to Computers and Communication. TataMcGraw Hill.Delhi.
2. Guptha,S.(2004). Basic Statistics. S.Chand& Sons. Delhi. 8. Davis,J.C. (1985).Statisticaland Data Analysisin Geology.Wiley. Delhi.
3. Guptha,S.(1990).StatisticalMethods.S.Chand&Sons.Delhi.
4. Schabenberger, O. and Gotway, C. (2005) Statistical Methods for Spatial DataAnalysisChapman&Hall/CRC.

5. PeterJ.Diggle,Paulo J.Ribeiro,Jr(2007)Model-basedGeostatistics,Springer.
6. Cressie,N.(1993).StatisticsforSpatialData(RevisedEd.).JohnWiley&Sons,Inc.
7. Banerjee, S, Carlin, B., andGelfand, A. E. (2004) Hierarchical modelling andanalysisforspatial data.Chapman &Hall
8. Wackernagel,Hans(1998)MultivariateGeostatistics(2nded.)Springer.
9. Alexis Leon and MathewsLeon, 1999,-fundamentals of information technology LeonTech World Publications..
10. Kettell, Hart, Davils,Simmons, Hill -Microsoft office2003– The complete Reference , Tata McGraw Hill.

Non– MajorElectiveOffered byGeologyDepartment

GEOHYDROLOGY

Course Code:

L	T	P	C
2	0	0	2

Course Objectives:

- To learn the origin and distribution of hydrological cycle,groundwater, aquifer, riverfeatures,alongwith hydrogeological properties of rockandgroundwaterinvestigation.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the concept of hydrological cycle
CO2:	Understand the origin of water from various sources
CO3:	Apply the methods to study Groundwater survey and vertical distribution
CO4:	Analyse the concept of aquifers and their boundaries
CO5:	Evaluate the rainwater harvesting techniques
CO6:	Create and prepare the groundwater chart with rock properties

Course Outline:

Unit I: Contact Hours: 6
Unit II: Contact Hours:6
Unit III:Contact Hours: 6
Unit IV:Contact Hours: 6
Unit V: Contact Hours: 6

UNITI

Originofgroundwater-meteoricwater,connatewaterandjuvenilewater–verticaldistribution of groundwater – zone of aeration, zone of saturation and water table. Definitionof aquifer, aquitard, aquifuge and aquiclude. Types of aquifers – unconfined, confined, semiconfined,leakyandperched aquifers –Artesianwells,GeologicformationsofAquifers.

UNITII

Hydrologiccycle–Variouscomponentsofhydrologicalcycle–Precipitation,Run-off,Infiltration, Evaporation and transportation. Groundwater quality – physical, biological andchemicalqualities – drinkingwater standards.

UNITIII

Running water – source and surface flow – erosion, transportation and deposition – landformsby erosionanddeposition;valley development;drainagepatterns–

fluvialcycle(youthmaturityand old age); stream rejuvenation– rivercapture.

UNITIV

Hydrogeological properties of rocks, Rock properties affecting groundwater, Porosity andpermeability.Groundwaterexploration: electrical resistivitymethod.

UNITV

Rainwatermeasurementtechnique-Raingaugesandtheirdistribution.Rainwaterharvesting– Definition, method and their importance. Watershed Management, Groundwater recharge –naturaland artificial rechargemethods.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the concept of hydrological cycle	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the origin of water from various sources	PO2,	H	PSO3	H	K2
CO3	Apply the methods to study Groundwater survey and vertical distribution	PO3, PO6,	M	PSO4,	M	K3
CO4	Analyse the concept of aquifers and their boundaries	PO4, PO5	M	PSO5,	M	K4
CO5	Evaluate the rainwater harvesting techniques	PO7, PO8	H	PSO6,	H	K5
CO6	Create and prepare the groundwater chart with rock properties	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Todd,D.K.(2008).GroundwaterHydrology.5thed.Wiley.New Delhi.
2. Davis,S.N.&R.J.M.DeWiest.(1966).Hydrogeology. Wiley.Delhi.
3. Freeze,R.A.&J.A.Cherry.(1979).Groundwater.Prentice Hall.NewYork.
4. Raghunath,H.M.(1988).Groundwater.East WestPub.Delhi.
5. Raghunath,H.M.(1985).Hydrology.EastWest Pub.Delhi.
6. Fetter,G.W.(1989). AppliedHydrogeology.CBS.Delhi.
7. Ramakrishnan,S.(2011).GroundWater.ScitechPublications.Chennai.
8. Garg,S.P.(1982). Groundwaterand TubeWells.Oxford&IBH. Delhi

Non– MajorElectiveOffered byGeologyDepartment

MINERALECONOMICS

L	T	P	C
2	0	0	2

Course Code:

Course Objectives:

- Understand the origin of ore minerals
- Gain knowledge on distribution of ore minerals in India

Course Outcomes* (COs):
After completion of this course, students will be able to

CO1:	Remember the basic principles of mineralogy
CO2:	Understand the mineral types and classification
CO3:	Apply the methods to explore minerals
CO4:	Analyse the mineral policies in India
CO5:	Evaluate potential mineral fuels in India
CO6:	Create the mineralogical map of the regions

Course Outline:

Unit I: Contact Hours:6
Unit II: Contact Hours: 6
Unit III:Contact Hours:6
Unit IV:Contact Hours: 6
Unit V: Contact Hours:6

UNITI

Introduction to mineral science – Economic minerals – ore – ore minerals, gangue minerals,tenor and grade or ores. Mineral formation process. Physical and chemical properties ofminerals.

UNITII

NationalMineralPolicyandconservationofminerals–anoverviewoftheminesandminerals(regulationanddevelopment)act.Mineralmarkets,Import-ExportpoliciesandInternationalTrade. Rawmaterialsgradecontrol aspectsin mines.

UNITIII

Mineraleconomicsconceptsandtheories.Mineralsandeconomicdevelopment,mineralabun

dance. Specifications for important minerals for industrial use.India's status in mineralproduction.patternsofmineralconsumptionandsubstitution.Conservationofmineral resources– scopeand limitations.

UNITIV

Classification, origin, occurrence and distribution of coal in India.Origin, occurrence anddistribution of petroleum in India.Methods of coal mining. Petroleum explorationmethods,Mineralwealth of Tamil Nadu.

UNITV

Marinemineralresources–Lawsofseabed,marinemineralresources–Mineraltaxation.

Mapping of Cos to POs and PSOs

	Course Outcome	**PO Addressed**	**Correlation Level**	**PSO Addressed**	**Correlation Level**	**Cognitive Level**
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basic principles of mineralogy	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the mineral types and classification	PO2,	H	PSO3	H	K2
CO3	Apply the methods to explore minerals	PO3, PO6,	M	PSO4,	M	K3
CO4	Analyse the mineral policies in India	PO4, PO5	M	PSO5,	M	K4
CO5	Evaluate potential mineral fuels in India	PO7, PO8	H	PSO6,	H	K5
CO6	Create the mineralogical map of the regions	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1 Bateman.A.M.Economicmineraldeposits,John Wiley&Sons

2 Krishnaswamy.S.1972.India'sMineralResources,OxfordandIBHPublishersNewDelhi

3 GokhaleandRaoOredepositsofIndia,Thompson press,NewDelhi.

4 Sinha,R.K.,sharma,N.L.,1976-Mineraleconomics.second edition ,oxford&ibh publicationco.NewDelhi,368pp.

5 Krishnaswamy,S.,-1971–IndianMineral Resources,oxford&ibh publishingco.,NewDelhi.

6 Arogyaswamy,R.N.P.,1973 - Courses in Mining Geology ,oxford and ibh publishing co.,New Delhi.

7 KaulisKisos Chatterjee (1970), An introduction to mineral economics, Wiley

Eastern limitedPublisher,New Delhi.
8 SinhaR.K andSharmaN.L(1970),Mineral economics,OxfordandIBHpublishingco.,
9 UmathyaR.M(2006),Mineral depositsin India,Datisonspublisher,Nagpur.
10 UmeshwarPrasad(1996),Economicgeology,CBSpublishersanddistributors,NewDel hi.

IGNEOUSPETROLOGY

Course Code:

L	T	P	C
5	0	0	4

Course Objectives:

- Gain knowledge on identification, classification, origin, evolution, and processes of formation and crystallization of the igneous rocks.
- Understand the properties of various igneous rocks

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the principles and composition of mineralogy
CO2:	Understand the Classification of rocks on the basis of origin.
CO3:	Apply the knowledge of crystallization of Magma, and explain how uni component, bicomponent and multi component magma gives rise to different types of rocks.
CO4:	Analysemethods to study the forms of igneous rocks and gives the classification
CO5:	Evaluate megascopic and microscopic studies of igneous rocks
CO6:	Create the basic binary diagrams of igneous magma

Course Outline:

Unit I: Contact Hours: 14
Unit II: Contact Hours: 14
Unit III:Contact Hours: 14
Unit IV:Contact Hours: 13
Unit V: Contact Hours: 13

UNITI

Introduction to Petrology - definition of rock - classification of rock - rock cycle - .PhysicalPropertiesofMagma-
CompositionofMagma:ChemicalComposition,MineralogicalComposition-
MajorTypesanditsOrigin-
Bowen‘sReactionSeries:DiscontinuousReactionSeries,ContinuousReactionSeries,Importance ofBowen‘sReactionSeries-Magmatic Differentiation-Assimilation.

UNITII

TexturesofIgneousRocks:Crystallinity,Granularity,ShapeoftheCrystals,MutualRelationship between Crystal and Non-Crystalline Material, Intergrowth textures, ExsolutionTextures, Miscellaneous Textures.Structures of Igneous Rocks: Vesicular and AmygdaloidalStructures,

Scoriaceous and Pumiceous Structures, Lava Tunnels, Blocky and Ropy Lava,Platy and Sheet Structure, Pillow Lava, Columnar/Prismatic Structure, Lava Flow Structure,Rift and Grain, Perlitic Structure, Rapakivi Structure, Xenoliths. Forms of Igneous Rocks:Sill, Dyke, Laccolith, Bysmalith, Lopolith, Phacolith, Chonolith, Volcanic Neck, Batholith,Stock,Boss.

UNITIII

Classification: bases of classification – megascopic classification – classification based oncolour index – based on the proportion of Alkali to plagioclase feldspars. Based on silicasaturation – based on alumina saturation. CIPW classification, Normative minerals, salic andfemicgroups.MeritsanddemeritsofCIPW classification –Tyrrelstabularclassification.

UNITIV

CrystallisationofMagma:PhaseRule:PhaseDiagram,CondensedPhaseRule-Unicomponent System:Crystallizationbehaviourof H_2O System,Crystallizationbehaviourof SiO_2 System - Binary System: Binary System with Complete Solid, Solution of Two EndMembers-Lever Rule -BinaryEutecticSystem.

UNIT V

Texture, Mineralogy, Classification, and Modes of occurrence of: Granite, Granodiorite, Syenite, Diorite, Gabbro, their hypabyssal and volcanic equivalents. Petrographic characters, origin and distribution in India :Charnockite, Pegmatites, Lamprophyres, Alkaline rocks, Dunite, Peridotite , Anorthosites and Kimberlite.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the principles and composition of mineralogy	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the Classification of rocks on the basis of origin.	PO2	H	PSO2, PSO4	H	K2
CO3	Apply the knowledge of crystallization of Magma, and explain how uni component, bicomponent and multi component magma gives rise to different types of rocks.	PO3, PO4,	M	PSO5, PSO6	M	K3
CO4	Analysemethods to study the forms of igneous rocks and gives the classification	PO5, PO6	M	PSO7	M	K4
CO5	Evaluate megascopic and microscopic studies of igneous rocks	PO7, PO8	H	PSO7	H	K5

CO6	Create the basic binary diagrams of igneous magma	PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Tyrrell,G.W. (1963).Principlesofpetrology,Methunn&Co.,.
2. Turner, F.J. and Verhoogen, J., (1960). Igneous and Metamorphic petrology,McGraw-HillBook co.
3. Bowen,N.I.,(1966).EvolutionofIgneousRocks, Doverpublication,
4. Huang,Walter,T. (1962).Petrology,McGraw HillbookCo.
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7. Albert Johannsen, (1962),A Descriptive Petrography of the Igneous Rocks:Vol.IAlliedpacific private limited, Bombay.
8. AnthonyHall, (1996), Igneous Petrology, Second Edition, Longman Group Ltd., UK.Best.,(1986),Igneous Petrology., CBSPublication.
9. Bose,M.K.,(1997). IgneousPetrology.,WorldPress.
10. McBirney, A.R., (1993), IgneousPetrology,Jones&BarletPubl.

ONLINEOPENREFERENCES

1. Introduction to Petrologyhttps://open.umn.edu/opentextbooks/textbooks/introduction-to-petrology

2. PetrologyStudyMaterial https://serc.carleton.edu/teachearth/themes/14

SEDIMENTARYANDMETAMORPHICPETROLOGY

Course Description

L	T	P	C
5	0	0	4

Course Code:

Course Objectives:

- To make students to getknowledge on the process ofsedimentation, classification, structure and texture of sedimentary rocks along with heavy mineralsprovenancestudies, petrographyofimportantsedimentaryrocks.
- ToimportknowledgeonMetamorphiczones,gradesandfacies,andtypesof metamorphism,metamorphicstructuresandtextures,petrographicidentifi cationandoriginofimportantmetamorphicrocks.

Course Outcomes* (COs):
After completion of this course, students will be able to

CO1:	Remember the principles and composition of mineralogy
CO2:	Understand the concept of sedimentary petrology
CO3:	Apply the knowledge of Sedimentary processes and Classification of sedimentary rocks.
CO4:	Analyse thedepositional sedimentary environments and Sedimentary deposits
CO5:	Evaluate megascopic and microscopic studies of sedimentary and metamorphic rocks
CO6:	Create the field configurations of metamorphic rocks

Course Outline:

Unit I: Contact Hours: 14
Unit II: Contact Hours: 14
Unit III:Contact Hours: 14
Unit IV:Contact Hours: 13
Unit V: Contact Hours: 13

UNITI

Sedimentary Petrology: Definition –Importance of Studying Sedimentary Rocks - Kinds ofSedimentaryParticles:Terrigenous,Chemical,andOrganic.Processesinvolvedintheformati on of sedimentary rocks: disintegration and decomposition of rocks : transportation,deposition, burial,lithification:compaction, cementation, consolidation and diagenesis.Diagenesis:Syndiagenesis ,AnadiagenesisandEpidiagenesis – effectsofdiagenesis.

UNITII

Sedimentary textures:Types of Texture: clastic and non-clastic , textures controlling factors-Grain Size - Particle Size Distribution.Grain Size Scale.Measuring Grain Size - GraphicalPresentation of Grain Size Data: Histogram, Frequency Curve, Frequency Cumulative Curve.Grain Size Parameters: Mode, Median, Mean,Sorting or Standard Deviation , Skewness,Kurtosis -Particle Morphology: Shape, Roundness, Sphericity, Surface texture - Packing ofGrains-Components of Clastic Texture: Detrital Grains, Matrix, Cementation , Pore Space -TexturalMaturity-Textureof Non-Clastic Rocks.*Sedimentary Structures* :Primary Structures: Bedding and Stratification, Cross-Bedding ,GradedBedding,RippleMarks,MudCracks,RainDropImprints,SoleStructures.Secondary Structures: Chemical Structures, Organic Structures. Petrography of clastic andnonclasticrocks. Porosityand permeabilityof sedimentaryrocks.

UNITIII

A broad classification of sedimentary rocks:residual, mechanical, chemical and organicGroups. Classification : Based on Mineralogical Composition , Chemical Composition, -SizeandShapesofGrain-ModeofOrigin-Depositionalenvironment.CommonSedimentary Rocks : Clastic Rocksand Non-clastic Rocks.Residual deposits: terra rossa ,clay,lateriteandbauxiteandsoils.Mechanicaldeposits–rudaceous,arenaceousandargillaceousgroups.Heavymineralsinsandandsandstones.Adescriptivestudyof Conglomerate, Breccia,SandstonesandShales.Chemicaldeposits–siliceous,carbonaceous. ferruginousandsaltdeposits.Organicdeposits–calcareous,siliceous,phosphatic,ferruginous and carbonaceous deposits. A brief study of Flint, Chert, Siderite, Gypsum, RockSalt,Calicheand Guano.Importanceof heavyminerals and theirprovenancestudies.

UNITIV

Metamorphism: Definition, agents and kinds.– facies, grades and zones of metamorphism –-Factors Affecting Metamorphism: Temperature, Geothermal Gradient, Load PressureFluidPressure, Shear Stress.Products of Metamorphism: Metamorphic Minerals, Index Minerals.Metamorphic Textures and its types: Relict Texture, Typomorphictexture, Reactiontextures,Intergrowthtextures.Metamorphicstructures:FoliationandLineation,Slaty cleavage, Schistose structure, Gneissose structure, Cataclasticstructure. –anatexis andpalingenesis.

UNITV

TypesofMetamorphism:RegionalMetamorphism,BurialMetamorphism,ContactMetamorphism,CataclasticMetamorphism,Dynamothermalmetamorphismanditsproducts–Plutonicmetamorphismanditsproducts–Metasomatism:Definition,metasomaticprocesses,granitisationandmigmatisation.ImpactMetamorphism,HydrothermalMetamorphism:InjectionmetamorphismandAutometamorphism.Petrographicdescriptionofquartzite,slate,schist,gneiss,marble,hornfels,

migmatiteandcharnockite.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the principles and composition of mineralogy	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the concept of sedimentary petrology	PO2	H	PSO2, PSO4	H	K2
CO3	Apply the knowledge of Sedimentary processes and Classification of sedimentary rocks.	PO3, PO4,	M	PSO5, PSO6	M	K3
CO4	Analyse thedepositional sedimentary environments and Sedimentary deposits	PO5, PO6	M	PSO7	M	K4
CO5	Evaluate megascopic and microscopic studies of sedimentary and metamorphic rocks	PO7, PO8	H	PSO7	H	K5
CO6	Create the field configurations of metamorphic rocks	PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)**TEXTANDREFERNCEBOOKS**

1. Friedman,G.MandSanders,J.L., (1978).PrinciplesofSedimentology,JohnWiley.
2. Davis,R.A.Jr.,(1992).DepositionalSystems.PrenticeHall.
3. Prothero,D.R.andSchwab,F., (1996).SedimentaryGeology.Freeman.
4. Pettijohn,F.J.,Potter,P.E.andSiever,R.,(1990). SandandSandstone.SpringerVerlag.
5. Sengupta,S.,(1997).IntroductiontoSedimentology,Oxford – IBH
6. Selley,R.C.,(1976).AnIntroductiontoSedimentology,AcademicPress, London.
7. Turner,F.J.,(1980).MetamorphicPetrology,McGrawHill.,NewYork.
8. William,TurnerandGilbert.,(1965).Petrography, UFS,Bombay
9. Yardley, B.W., (1989). An introduction to Metamorphic Petrology., LongmanNewYork.
10. Winkler H.G.F. (1974). Petrogenesis of Metamorphicrocks, Third Edn. SpringerVerlag.

ONLINEOPENRESOURCES

1. Sedimentary Petrology study material:https://serc.carleton.edu/NAGTWorkshops/sedimentary/index.html
2. Virtual Microscopehttps://www.virtualmicroscope.org/content/uk-virtual-microscope

HYDROGEOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To gain the basic knowledge in hydrological properties of rocks, verticaldistributionofgroundwater,typesofaquifers,groundwatermovement,groundwaterqualityparameters,groundwater exploration, rechargeand dischargemethods.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the status of groundwater in India and the world
CO2:	Understand Specific yield and specific retention and basic concepts related to fluid motion in porous media.
CO3:	Apply the methods to study Groundwater Quality and Chemistry
CO4:	Analyse the concept of aquifers and their boundaries
CO5:	Evaluate potential Groundwater exploration and hydrogeological survey.
CO6:	Create the filed report based on hydrogeological survey

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Definition of hydrogeology and groundwater – Hydrological cycle -Types of groundwaterbased onorigin -Vertical distribution of groundwater – Types of water bearing formations:aquifers, aquitards, aquifuge and aquicludes - Types Aquifers: Confined, unconfined, semi-confined,andperched– Springs:types,geologicalconditionsfavoringdevelopmentofsprings-Artesian wells.

UNITII

Rock propertiescontrolling groundwater: types of openings, porosity, specific yield, specificretention and permeability – Groundwater movement – Darcy‘s law and its applications –Determination of porosity and permeability in field and lab – Groundwater occurrence inigneous,sedimentaryandmetamorphic rocks.

UNITIII

Explorationofgroundwater:Geological,remotesensingandgeophysicalmethods-electricalresistivitymethod.Welltypes:Openwells,tubewells,jettedwells,infiltrationgalleries and collector wells.Well design and development – Fluctuations of groundwater – Groundwaterrechargemethods: natural and artificial methods.

UNITIV

Pump tests and evaluation of various aquifer parameters through pump tests – Conjunctiveandconsumptiveuseofgroundwater–
Seawaterintrusion:causes,consequencesand,preventiveandcontrolmeasures–
Groundwaterresourcesand itsqualityinTamil Nadu.

UNITV

Groundwaterqualityinvariousrocktypes–Parametersconsideredforassessinggroundwater quality, suitability for drinking and irrigation purposes – The latest drinking andirrigation water standards of WHO and BIS – Rainwater harvesting methods – Water shedmanagement.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the status of groundwater in India and the world	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the Understand Specific yield and specific retention and basic concepts related to fluid motion in porous media.	PO2	H	PSO2, PSO4	H	K2
CO3	Apply the methods to study Groundwater Quality and Chemistry	PO3, PO4,	M	PSO5, PSO6	M	K3
CO4	Analyse the concept of aquifers and their boundaries	PO5, PO6	M	PSO7	M	K4
CO5	Evaluate potential Groundwater exploration and hydrogeological survey.	PO7, PO8	H	PSO7	H	K5
CO6	Create the filed report based on hydrogeological survey	PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Todd,D.K.(2008).GroundwaterHydrology.5thed.Wiley.NewDelhi.
2. Davis,S.N.&R.J.M.DeWiest. (1966).Hydrogeology.Wiley.Delhi.
3. Freeze,R.A.&J.A.Cherry.(1979).Groundwater. PrenticeHall.NewYork.
4. Raghunath,H.M.(1988). Groundwater.EastWestPub.Delhi.
5. Raghunath,H.M.(1985).Hydrology.EastWestPub.Delhi.
6. Fetter,G.W.(1989).AppliedHydrogeology.CBS. Delhi.
7. Ramakrishnan,S.(2011).GroundWater.Scitech Publications.Chennai.
8. Garg,S.P.(1982).GroundwaterandTubeWells.Oxford&IBH.Delhi.
9. Murthy, K.S. (1998). Watershed management in India, 3rd edition, Wiley Eastern Ltd.NewAgeInternationalLtd, NewDelhi, 198 p.
10. KevinM.(2005)Hiscock***Hydrogeology:***PrinciplesandPractice,BlackwellScienceLtd**.**

MAJORELECTIVE-1.1 MARINEGEOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To gain knowledge on the development of ocean sciences, marine resources,basic marinesurvey equipment, ocean floor profile,
- Understand the physical and chemical properties of water, ocean depositsandtheirtypes,shorelinesand theirtypes,coastalenvironmentand coastalregulations.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the marine landforms
CO2:	Understand the development of landforms through Earth's external processes by various geological agents; marine processes and formation of marine landforms.
CO3:	Apply the marine survey methods to understand ocean character
CO4:	Analysethe waves, tides and tides and its impacts
CO5:	Evaluate the physical and chemical properties of marine water
CO6:	Create seafloor morphological and bathymetric mapping

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Definition,nature,scopeofoceanographyanditsrelationshipwithgeology.Historicaldevelopment of oceanography. Marine resources: Definition, types of physical resources,marineenergyresources,biologicalresources,non-extractiveresources.PrinciplesandapplicationofEchosounder,Sidescansonar,PositionfixingatSea.Bottomsedimentsamplers.

UNITII

Physical Oceanography: Salinity, conductivity, temperature, density, light and pressure ofseawater- importance of physical characters of seawater. *Chemical Oceanography*: watermolecule, dissolving power of Seawater, composition of sea water, major and minor elementsin seawater, nutrients in the sea, dissolved gases in sea water,oxidation-reduction potentialofseawater. Relationshipbetween physicaland chemicalproperties

ofseawater.

UNITIII

Mapping the Seafloor: Modern Bathymetric Techniques, Mapping the Ocean Floor fromSpace- Provinces of the Ocean Floor: continental margins: passive and active - continentalrise-Abyssal Plains -Beaches andShoreline.

UNITIV

Waves:Definition,Partsofwaves,Typesofwaves,Classificationofwavesandwaveinteractions with the shore.*Tides*: Definition, Classification and types. *Ocean Currents*:Definitiontypesandcauses.LittoralprocessesandCoastalErosion.Typesofcoasts:erosionalcoast, depositional coasts, drowned coast,uplifted coast.

UNITV

Introduction to the *Law of Sea* - Maritime Territory laws - Territorial Sea laws – EEZ.Introduction to *Marine Pollution - Definition, types, sources ofpollutions:sewage pollution,industrial wastage, oil pollution*, toxic pollution,coastal and deep-sea pollution, - effect ofpollutants.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the marine landforms c	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the development of landforms through Earth's external processes by various geological agents; marine processes and formation of marine landforms.	PO2	H	PSO2, PSO4	H	K2
CO3	Apply the marine survey methods to understand ocean character	PO3, PO4,	M	PSO5, PSO6	M	K3
CO4	Analysethe waves, tides and tides and its impacts	PO5, PO6	M	PSO7	M	K4
CO5	Evaluate the physical and chemical properties of marine water	PO7, PO8	H	PSO7	H	K5
CO6	Create seafloor morphological and bathymetric report	PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Anikouchine,W.A.andSternberg,R.W.,(1973):TheWorldOceans-AnIntroductionto Oceanography, Englewood Cliffs.
2. Garrison,T.,(1998):Oceanography,WadsworthCo.USA.
3. Gerald,S.(1980):GeneralOceanography:AnIntroduction,JohnWiley&Sons,NewYork.
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5. Sharma,R.C.andVatel,M.,(1970):OceanographyforGeographers,CheytanyaPublishingHouse, Allahabad.
6. Kuenen,(1950). Marine Geology.John Wileyand Sons.
7. King,C.A.M(1975).–Introductiontomarine GeologyandGeomorphology.EdwardArnold,London.
8. Radhakrishnan,V(1996).General GeologyV.V.P.Publishers, Tuticorin, 1996.
9. Siddhartha,K.(2002).Oceanography:ABriefIntroduction,KisalayaPublicationsPvtLtd, 347p.
10. Shepard,F.P(1978).GeologicalOceanography,Heinmann, London.

ONLINEOPENRESOURCES

Introduction to Physical Oceanographyhttps://open.umn.edu/opentextbooks/textbooks/introduction-to-physical-oceanography

Paul Webb(2019) Introduction to Oceanography, Rebus Communityhttps://open.umn.edu/opentextbooks/textbooks/732

MAJORELECTIVE1.2 FUELGEOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To gain knowledge on basicsofenergyresources,origin,occurrence,exploration techniques of petroleum and coal. This subject also imparts knowledge on various otheralternativeresources.

Course Outcomes* (COs):
After completion of this course, students will be able to

CO1:	Remember the concepts of energy mineral resources
CO2:	Understand the fundamental concepts of origin and accumulation of oil
CO3:	Apply the knowledge to identify traps and migration properties
CO4:	Analysethe hydrocarbon reservoirs based on seismic interpretation techniques; Well logging techniques
CO5:	Evaluate Physical and chemical characteristics and classification of coal; Coal reserve estimation.
CO6:	Create geological and geographical distribution maps of coalfields in India.

f. Course Outline:

Unit I:Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Introduction to natural energy resources : Types of naturalenergy resources – conventionalandnon-conventionalenergyresources– alternativeenergyresources.Scopeandapplications of Indian energy resources.Role of petroleum and coalin energy scenario.petroliferousbasins ofIndia.

UNITII

OriginofPetroleum-OccurrenceofPetroleum:surfaceandsubsurfaceoccurrences-Migrationof Oil: primary, secondary and tertiary - accumulation of Oil. Trapsandseals: structural, stratigraphicand combined.

UNITIII

Subsurfaceenvironment:subsurfacetemperature-subsurfacepressure-subsurfacefluidcharacters– subsurfacepressureand temperaturerelationships.

UNITIV

Coal- Definition and origin of Coal- Basic classification of coal- Fundamentals of CoalPetrology - Underground coal gasification. Characteristic of coal: physical and chemicalcharacteristics. Methods of coal prospecting and estimation of coal reserves. Coal productionandproblems ofIndia.

UNITV

AlternateEnergyResources:CoalBedMethane-generationofmethaneincoalbeds.Fundamentals of coal bed methane exploration and exploitation. Oil shale , Gas shale and gashydrates.Radioactive minerals: occurrence and sources of radioactive minerals in India.Globalscenario on power generationusingnatural energyresources.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the energy mineral resources	PO1	H	PSO1, PSO3	H	K1
CO2	Understand the fundamental concepts of origin and accumulation of oil	PO2	H	PSO2,	H	K2
CO3	Apply the knowledge to identify traps and migration properties	PO3, PO6,	M	PSO4, PSO5	M	K3
CO4	Analyse the hydrocarbon reservoirs based on seismic interpretation techniques; Well logging techniques	PO4, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate Physical and chemical characteristics and classification of coal; Coal reserve estimation.	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create geological and geographical distribution maps of coalfields in India.	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Chandra,D.,Singh,R.M.,Singh,M.P.(2000)TextBookofCoal(IndianConte xt).TaraPrintingWorks, Varanasi.
2. Leverson,A.L(1970).GeologyofPetroleum.Freemanandco.
3. Selley,R.C(1998).ElementsofPetroleumGeology,IIEdition.Academic Press.
4. Stach,E.etal.(1975)Stach'stextbookofcoalpetrology.Berlin:GebruderB orntraeger.
5. Taylor,G.H.,Teichmüller,M..,Davis,C.(1998)OrganicPetrology:Anewha ndbookincorporatingsomerevised partsofStach's Textbookof Coal Petrology.
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8. Gokhale, K.V. and K.D. Rao, T.C., (1973). Ore deposits of India.ThomsonPressIndiaLtd.,Delhi.
9. Krishnaswamy, S., (1972). India's Mineral Resources, Oxford & IBHPublishingCo.,Chennai.
10. Bateman,A.M.,(1961).Economic Mineral Deposits,AsiaPublishing House

MAJOR ELECTIVE 1.3 ENVIRONMENTALGEOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To assist the students in gaining an understanding of the interactionsbetweengeologic processes, ecologicalprocesses, andsociety.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the fundamentals of environmental sciences
CO2:	Understand the ecological parameters and various types of pollution
CO3:	Apply the knowledge to identify Environmental Impact Assessment.
CO4:	Analysethe man-made pollution and natural pollution
CO5:	Evaluate various environmental issues by taking remedial measures
CO6:	Create and recommend measures for prevention of environmental impact

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Definition of ecology and environmental geology. Different Ecosystems. Classification ofNatural resources: renewable and non-renewable resources. Environmental problems due toexogenic processes: causes, hazards and remedial measures relating to landslides, floods andsoilerosion.Impact of wind on environment-Global warming.

UNITII

River Flooding,and Coastal Hazards: Rivers and Flooding: Sedimentsin River- Rivervelocity, Discharge, Erosion, and Sediments deposition- Effects onLand - use Change -Channel Pattern & Floodplain Formation - River Flooding - Urbanisation& Flooding-TheNatureandExtentofFloodHazards-AdjustmentstoFloodHazards-PerceptionofFlooding.

UNITIII

Influence of endogenetic processes – Earthquake hazards- Earthquake prediction control

andwarning; Reservoir induced seismicity -origin and impact of tsunami – hazards of volcanism-Techniques of volcanic prediction and human adjustments to volcanic environments. Benefits of volcanism.

UNITIV

Man as an agent of environmental modification. Population explosion and their pressure onearth resources. Environmental degradation due to mining and mineral processing – effects ofurbanizationonsurfacewater,causesofgroundwaterpollution.Degradationofcoastalenvironmentand measures forcoastal protection.

UNITV

Global Climate Changes : Earth‘s Climate and Atmosphere- The Greenhouse Effect-StudyPast Climate Change- global warming- effects climate change- Geology and EnvironmentalHealth-AirPollution:GeologicPerspective-wastemanagementandGeology-Environmentalanalysis.Preliminaryconceptsofclimatechange.SeasonsinIndia,Monsoons, El Nino and ENSO.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the concept of environmental sciences	PO1	H	PSO1, PSO3	H	K1
CO2	Understand the ecological parameters and various types of pollution	PO2	H	PSO2,	H	K2
CO3	Apply the knowledge to identify Environmental Impact Assessment.	PO3, PO6,	M	PSO4, PSO5	M	K3
CO4	Analysethe man made pollution and natural pollution	PO4, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate various environmental issues by taking remedial measures	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create and recommend measures for prevention of environmental impact	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. DonaldR.Coates (1981) .,EnvironmentalGeology(Willey).
2. PeterT.Flawan (1970).,EnvironmentalGeology,HarperandRow.
3. ArthurN.StrahlerandAlanH.Strahler(1973).,EnvironmentalGeoscience.
4. Valdiya, K.S. (1987) Environmental geology – Indian Context' Tata McGraw HillNewDelhi 583p.
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ONLINEOPENRESOURCE

1.Environmental Geology Learning Resourcehttps://serc.carleton.edu/NAGTWorkshops/environmental/index.html

MAJORPRACTICAL-5 IGNEOUSPETROLOGY

Course Code:

L	T	P	C
0	0	2	2

Course Objectives:

- To understand the microscopic and megascopic characters of Igneous rocks and its identification.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the Recall textural and mineralogical characters of igneous rocks
CO2:	Understand and categorize igneous rocks on the basis of physical and optical properties
CO3:	Apply the knowledge to identify the rock through megascopic and microscopic characters
CO4:	Analyse the different origin of rocks.
CO5:	Evaluate various properties of rocks using simple analysis
CO6:	Create report about the rock samples identification

Course Outline:

Todevelopskillandabilitiesintheidentificationofrockswiththeirtexture,mineralogyandgenes is .

a. Megascopicidentificationof importantigneous rocks.

b. Microscopicidentificationofrockfabrics,mineralassemblagesofigneousrocks.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO 1	Remember the Recall textural and mineralogical characters of igneous rocks	PO1	H	PSO1,	H	K1
CO 2	Understand and categorize igneous rocks on the basis of physical and optical properties	PO2	H	PSO2,	H	K2
CO 3	Apply the knowledge to identify the rocks through megascopic and microscopic characters.	PO4, PO6,	M	PSO3, PSO4	M	K3
CO 4	Analysethe rocks in different formation	PO3, PO5	M	PSO5, PSO7	M	K4

CO 5	Evaluate various features using simple analysis	PO7, PO8	H	PSO7, PSO6	H	K5
CO 6	Create report about the rock samples identification	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

MAJORPRACTICAL-6 SEDIMENTARYANDMETAMORPHICPETROLOGY

Course Code:

L	T	P	C
0	0	4	2

Course Objectives:

- To gain knowledge to identify and analyses the rocks through hand-specimen and thin sections.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the Recall textural and mineralogical characters of sedimentary and metamorphic rocks.
CO2:	Understand and categorize sedimentary and metamorphic rocks on the basis of physical and optical properties.
CO3:	Apply the knowledge to identify the rocks through megascopic and microscopic characters.
CO4:	Analyse the different origin of rocks.
CO5:	Evaluate various properties of rocks using simple analysis
CO6:	Create report about the rock samples identification

Course Outline:

Todevelopskillandabilitiesintheidentificationofrockswiththeirtexture,mineralogyandgenesisboth in hand specimen and thin sections.

1. Megascopicidentificationstudyofimportantsedimentaryandmetamorphic rocks.
2. Microscopicidentificationand studyofsedimentaryand metamorphicrocks.
3. grainsizeanalysis(shelveanalysis)andstatisticaltreatment:mean,median, mode,kurtosis skewness, and standard deviation.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the Recall textural and mineralogical characters of sedimentary and metamorphic rocks r	Remember	PO1	H	PSO1,	H
CO2	Understand and Categorize	Understand	PO2	H	PSO2,	H

	sedimentary and metamorphic rocks on the basis of physical and optical properties					
CO3	Apply the knowledge to identify megascopic and microscopic rocks	Apply	PO4, PO6,	M	PSO3, PSO4	M
CO4	Analysethe rocks in different formation	Analyse	PO3, PO5	M	PSO5, PSO7	M
CO5	Evaluate various features using simple analysis	Evaluate	PO7, PO8	H	PSO7, PSO6	H
CO6	Create report about the rock samples identification	Create	PO3, PO8	H	PSO8	H

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

MAJORPRACTICAL-7 HYDROGEOLOGYANDELECTIVE-1

Course Code:

L	T	P	C
0	0	4	2

Course Objectives:

- To understand the rainfall data interpretation and aquifer parameter calculations
- To understand the resistivity data interpretation
- To identify the placer minerals

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the flow equation and calculations
CO2:	Understand the rainfall analysis and data interpretation
CO3:	Apply the knowledge to petroleum and coal reserve estimation
CO4:	Analysethe seismic interpretation data and vertical profile
CO5:	Evaluate the beach profile
CO6:	Create report about the environmental issues and prepare seismic zone map

Course Outline:

HYDROGEOLOGY

- Analysisofrainfalldata
- Aquiferpropertiescalculation
- Darcy‘slawcalculation
- waterbudget calculation.
- Wennerandschlumbergerresistivitydatainterpretation.

5.1. MARINEGEOLOGY

- Beachprofile surveydatacalculation andberm shapeindex.
- Placermineralidentificationusingpetrologicalmicroscope.
- Graphicalrepresentation andinterpretationofbathymetricdataset.

5.2 FUELGEOLOGY

- Studyof hand specimensof Coal
- ReserveestimationofCoal andPetroleum
- Map:PreparationofpetroliferousbasinsofIndia
- Map: PreparationofCoalbasinsofIndia
- VerticalprofileofIndianOilfields
- PanelandFencediagrams

5.3 ENVIRONMENTALGEOLOGY

Map preparation:

- seismiczonationmapofIndia,
- earthquake-proneinTamilnadu,
- landslide-proneareainIndiaand
- floodproneareainIndia.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the flow equation and calculations	Remember	PO1	H	PSO1,	H
CO2	Understand the rainfall analysis and data interpretation	Understand	PO2	H	PSO2,	H
CO3	Apply the knowledge to petroleum and coal reserve estimation	Apply	PO4, PO6,	M	PSO3, PSO4	M
CO4	Analysethe seismic interpretation data and vertical profile	Analyse	PO3, PO5	M	PSO5, PSO7	M
CO5	Evaluate the beach profile	Evaluate	PO7, PO8	H	PSO7, PSO6	H
CO6	Create report about the environmental issues and prepare seismic zone map	Create	PO3, PO8	H	PSO8	H

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

ECONOMIC GEOLOGY

Course Code:

L	T	P	C
6	0	0	4

Course Objectives:

- To impart knowledge on the various processes of formation of ore and itsclassification.
- To study the coal andpetroleum deposits and their distribution in India.

Course Outcomes* (COs):
After completion of this course, students will be able to

CO1:	Remember the basic mineral composition
CO2:	Understand the basic principles of economic geology and mineral economics
CO3:	Apply the ore processing techniques.
CO4:	Analysethe various ore minerals on the basis of their physical and chemical properties.
CO5:	Evaluate economic value of the ores
CO6:	Create report about Demand and supply of ores and Mineral conservation

Course Outline:

Unit I: Contact Hours: 14
Unit II: Contact Hours: 14
Unit III:Contact Hours: 14
Unit IV:Contact Hours: 14
Unit V: Contact Hours: 14

UNITI

Introduction to Economic Geology - Materials of mineral deposits: ore, gangue, tenor andgrade, protore. Classification of mineral deposits: Lindgren‘s and Bateman‘s classification.Controls of ore localization – structural controls, stratigraphic, physical and chemical. Briefstudyof metallogeneticepochs and provinces–geologic thermometers.

UNITII

Formationofmineraldeposits:hydrothermal,mechanicalconcentrationmineraldeposits(Placers), Oxidation and supergene sulphide enrichment and residual concentration deposits,Contactmetamorphism / metasomatism process.

UNITIII

Mineralogical characters, Mode of occurrence and Distribution of important ores – Iron,Copper, Lead, Zinc, Manganese, Gold, chromium and Aluminium.Radioactive

minerals,Precious and semi-precious minerals, Minerals required for refractory, cement, ceramic, paintandpigments,Insulators and fertilizers.

UNITIV

Classification, origin, occurrence and distributionand mining methods of coal in India.Origin,occurrenceanddistributionexplorationanddrillingmethods ofpetroleuminIndia.

UNITV

Sampling – Principles – types – collection of sample – core samples and their preservation.Methods of breaking rocks : short note on explosives. Outline of the method of metalmining.Opencast and underground mining. Alluvial mining: Principles and scope of oredressing,Physicalandchemicalpropertiesoforedressing:crushers,grinders,andclassifiers, Concentrationoforemineralsbymagneto– electrostatic andfloatationprocesses.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the basic mineral composition	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the basic principles of economic geology and mineral economics	PO1,PO2	H	PSO3	H	K2
CO3	Apply the ore processing techniques.	PO3, PO6	M	PSO4, PSO6	M	K3
CO4	Analysethe various ore minerals on the basis of their physical and chemical properties.	PO4, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate economic value of the ores	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create report about Demand and supply of ores and Mineral conservation	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Krishnaswamy.S. 1972. India's Mineral Resources, Oxford and IBH,Publishers,NewDelhi.
2. Gokhale.K.V.K.and Rao. T.K. 1972. Ore deposits of India, Thomson press,NewDelhi.
3. Umeshwar Prasad, 1996,Economicgeology,CBSPublishersanddistributors,NewDelhi-
4. EdwardR. andAtkinsanK.1986. OredepositGeology, ChapmonandHall,1.
5. Deb.S.1980.Industrialmineralsandrocksof India.Alliedpublisher.Pvt.Ltd.
6. Evans,A.M.,1993,OreGeologyandIndustrialMinerals, Blackwell
7. Torling,D.H.,1981,EconomicGeologyandGeotectonics.,BlackwellSciPubl.
8. Barnes,H.L.,1979,GeochemistryofHydrothermalOreDeposits.,JohnWiley.
9. Arogyaswamy,R.P.N., 1996,CoursesinMiningGeology, IVEd.,OxfordIBH.
10. Bateman.A.M.1961. Economic mineraldeposits,John Wiley&Sons.

GEOPHYSICSANDGEOCHEMISTRY

Course Code:

L	T	P	C
6	0	0	4

Course Objectives:

- To understand the principles and their significance of geophysics.
- The studentswill acquire skills to use electrical and seismic methods of exploration and data interpretation.
- Inaddition, Geochemistryfocusesonthechemistryofthenaturalworldandthechemicalevolutionofthe Earth overgeologicaltime.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the fundamental concepts associated with gravity, magnetism, electricity and wave motion
CO2:	Understand the principles of geophysics and geochemistry
CO3:	Apply the geophysical concepts in prospecting of economically important deposits.
CO4:	Analysethe various ore minerals on the basis of their physical and chemical properties.
CO5:	Evaluate geophysical and geochemical character of rocks.
CO6:	Create geophysical and geochemical character map of the region

Course Outline:

Unit I: Contact Hours: 14
Unit II: Contact Hours: 14
Unit III:Contact Hours:14
Unit IV:Contact Hours: 14
Unit V: Contact Hours: 14

UNITI

Interrelationship between geology and geophysics-Role of geological and geophysical data inexploration of earth resources. Regional geophysics, oil and gas geophysics, ore geophysics,groundwater geophysics, engineering geophysics. Different types of geophysical methods -gravity,magnetic, electrical and seismic.

UNITII

Electrical Methods: Electrical properties of rocks, Flow of current through ground surface,apparent resistivity, Electrode arrangements of Wenner and schlumberger methods. VerticalElectricalSounding-qualitativeandquantitativeinterpretationofVEScurvesforgroundwaterexploration.

UNITIII

Seismic Methods: Basic principles, types of seismic waves and their propagation characters,Seismic velocities in Earth's materials. Refraction and reflection seismic methods:

Basicprincipal,fieldprocedure,datacollectionandinterpretation.GravityMethods:Basicprinciples,Datacollection and interpretation.

UNITIV

Aims and scope of Geochemistry - Concepts of geochemistry- Stellar evolution and origin ofelements -properties of elements - abundances of elements and Oddo-Harkin's Law, Theperiodic table. Basic concepts and speciation in solutions, Eh, pH relations - Elements ofmarine chemistry- Mineral reactions- diagenesis and hydrothermal reactions. Geochemicalstructureandcomposition of the earth.

UNITV

Meteorites, Chondrites and chonurite. Geochemical classification of elements. Distributionof elements in the geosphere. Geochemical affinity. Geochemical Properties of elements:volatiles,semi-volatiles,alkalis,alkalineearths,REE,HFS,Transitionmetalsandnoble metalsandTraceelements.RadioactiveandStableIsotopesanditsapplicationingeoscience - lithogeochemicalandhydrogeochemicalmethods.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the fundamental concepts associated with gravity, magnetism, electricity and wave motion	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the principles of geophysics and geochemistry	PO1,PO2	H	PSO3	H	K2
CO3	Apply the geophysical concepts in prospecting of economically important deposits.	PO3, PO5	M	PSO4, PSO6	M	K3
CO4	Analyzethe various ore minerals on the basis of their physical and chemical properties.	PO4, PO6	M	PSO5, PSO7	M	K4
CO5	Evaluate geophysical and geochemical character of rocks.	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create geophysical and geochemical character map of the region	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 –

Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. RamachandraRao,M.B.,Prasaranga,1975.OutlinesofGeophysicalProspecting– Amanualforgeologists byUniversityof Mysore, Mysore.
2. BhimasarikaramV.L.S.1990.ExplorationGeophysics-AnOutlineby.,AssociationofExploration Geophysicists, OsmaniaUniversity,Hyderabad.
3. Dobrin,1984.AnintroductiontoGeophysicalProspectingby,M.B.McGrawHill,NewDelhi.
4. TelfordW.M.GeldartL.P.,Sheriff,R.E.andKeysD.A.1976,AppliedGeophysics.OxfordandI BH PublishingCo.Pvt.,Ltd. New Delhi,
5. Parasnis,D.S1975.PrinciplesofappliedGeophysics,ChapmanandHall.
6. Mason,B.andMoore,C.B.,1991,IntroductiontoGeochemistry,WileyEastern.
7. Krauskopf,K.B.,1967, Introductiontogeochemistry,McGrawHill.
8. Faure,G.,1986,PrinciplesofisotopeGeology.,JohnWiley.
9. Hoefs,J.,1980,Stable IsotopeGeochemistry.,Springer Verlag
10. Brounlow,A.N.1979.Geochemistry,Prenticehall.

GEOLOGYOFTAMILNADU

Course Code:

L	T	P	C
6	0	0	4

Course Objectives:

- To give overall exposure to the understanding of the geologic,geomorphic evolution ofTamilnadu region.
- To gain knowledge on,stratigraphy, petrology, and mineral wealth ofTamilnadu.

Course Outcomes* (COs):

CO1:	Remember the principles of stratigraphy, geological time scale and elements of continents and oceans.
CO2:	Understand the Classify cratons, mobile belts and platform basins of India on the basis of lithological and stratigraphic characters.
CO3:	Apply the criteria used in developing the Precambrian Stratigraphy of Tamil Nadu
CO4:	Analysethe economic importance of stratigraphic units of Tamil Nadu
CO5:	Evaluate the various cratons, mobile belts and platform basins of Tamil Nadu
CO6:	Create map for various geological horizon of Tamil Nadu

Course Outline:

Unit I: Contact Hours: 14
Unit II: Contact Hours:14
Unit III:Contact Hours: 14
Unit IV:Contact Hours: 14
Unit V: Contact Hours: 14

UNITI

GeneralGeologicalsettingofTamilNadu:Structure,shearzonesandtectonicssetting of Tamil Nadu. Rivers and Soil types of Tamil Nadu. The Western and Eastern GhatsofTamil Nadu and theirstructural aspects.

UNITII

Archaean and Proterozoic: sathyamangalam group- anorthosites ofSittampoondi,Kadavur and Oddanchatram, Peninsular gneissic complex, Kolar group, Khondalite group.Charnockite group: Pallavaram type area.Migmatite complex, Alkaline complexes, Alkalisyenite and carbonatitecomplexes,Granites ofcentral andsouthern TamilNadu.

UNITIII

Palaeozoic sediments: Talchir formation of Palar basin.Mesozoic sediments – UpperGondwana rocks of Terani and Uttattur,Sivaganga formation, Sriperumputhur formation,Satyavedu formation and Avadi formation.Marine Cretaceous formations of

Trichirapalli,Virudhachalamand Pondicherrysub-basins.

UNITIV

Tertiary sediments:Niniyur formation,Cuddalore Sandstone.Neyveliformation.Panamparaisandstone.Quaternarysediments:PlioceneroksofKambamvalley,Conjeevaram gravels, Pliestocene rocks along the coastal tracts of Tuticorin district andlaterite deposits of Eocene: shevroy, Kollimalai, Anaimalai, Nilgiri, Palani and KodaikanalandMio-Plicene:Pudukkottai,RamanathapuramandCuddalore.TerisandsofRamanathapuram,TuticorinandTirunelvelidistricts.SanddunesofTamilNadu.Coromandalformation and Silicasands of Marakkanam.

UNITV

ResourcesofTamilnadu:limestonedepositsofTamilnadu-origin,modeofoccurrence of iron ores of Kanjamalai and Kavuthimalaichromite deposits of Sittampoondi -Magnesite deposits of Chalk hills, Graphite beds of Sivaganga, Lignite deposits of Neyveliand Jayamkondam, Beach placer deposits of Tamil Nadu coast. Occurrence and distributionofprecious and semi-precious stones ofTamil Nadu.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the principles of stratigraphy, geological time scale and elements of continents and oceans.	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the Classify cratons, mobile belts and platform basins of India on the basis of lithological and stratigraphic characters.	PO1,PO2	H	PSO3	H	K2
CO3	Apply the criteria used in developing the Precambrian Stratigraphy of Tamil Nadu	PO3, PO5	M	PSO4, PSO6	M	K3
CO4	Analyzethe economic importance of stratigraphic units of Tamil Nadu	PO4, PO6	M	PSO5, PSO7	M	K4
CO5	Evaluate the various cratons, mobile belts and platform basins of Tamil Nadu	PO7, PO8	H	PSO7,	H	K5
CO6	Create map for various geological horizon of Tamil Nadu	PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Subramanian. K.S. and Selvan, T.A (2001). Geology of Tamilnadu and Pondicherry.GeologicalSocietyofIndia, Bangalore-192 p.
2. WadiaD.N.(1953).GeologyofIndia,Macmillianand Co.
3. Kumar.(1985).Fundamentalsof HistoricalGeologyand StratigraphyofIndia.
4. Krishnan,M.S.(1982).Geologyof India andBurma,CBSPublishers,Delhi
5. Pascoe, E.H. (1968). A manual of the Geology of India and Burma (Vol.I-IV), Govt.OfIndia Press,Delhi.
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9. Valdiya,K.S. (2010).Themakingof India,Macmillan IndiaPvt.Ltd.
10. G.T,manual(2010),ONGC

MAJOR ELECTIVE 2.1 GEOTECHNICALSTUDIES

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To impartbasicinformation onroleofGeologyinCivilEngineering.
- To understand the engineeringproperties of rocks and soils, geological investigation pertaining to foundation and development ofroads/highways,railways,bridges,buildings,damsites,reservoirs,tunnelsandcoastalstructures.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the principles of civil engineering
CO2:	Understand the concepts of engineering geology and outline the applications of geology in engineering projects
CO3:	Apply the knowledge of various engineering properties of rocks in engineering projects.
CO4:	Analysethe various engineering properties of rocks and aggregates.
CO5:	Evaluate data related to engineering classification of rocks
CO6:	Create Geotechnical order based on various case studies geological data related to site selection of engineering structure

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Role of geology in Engineering - Applications of geology in civil Engineering - Variousengineering properties of rocks- compressive, tensile, shear and triaxial strength of rock.Behaviorofrockunderstress/strain.Variousbuildingstonesusedasconstruction material.

UNITII

Soil – Definition -types of soils - formation of soils - Soil size parameters for buildingconstruction – expensive soil and its problem for building construction.Dam Construction:Types of Dams, Geological factors for consideration for dams and reservoirs sites selectionprocess-Dam foundation problems -criteriafor Reservoirsiteselection.

UNITIII

Siteinvestigationtechniques:definition–Foundationtreatment-Grouting-geologicalinvestigations-Groundwaterproblemsduringfoundation.Geotechnicalevaluationfortunnels: Definition-classification - Methods of tunnelling and tunnel design.Geologicalinvestigationsforroad and bridgeconstruction.

UNITIV

Landslides and slope stability:causes of slides; types: creep, earth flow and subsidence - precautionary measures and mitigations of landslides.Earthquake and seismicity; seismiczonesofIndia– earthquake-proof designsforbuildings.

UNITV

Coastal erosion:types of erosion - Planning and methods of coastprotection works - Coastal protection structures –Remote sensing techniques forcoastalstudies. Applications of Geostatistics in Geotechnical studies: Graphical representation of data- Correlation – Principal componentanalysis – cluster analysis. Application of Geophysics in Engineering projects.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the principles of civil engineering	PO1	H	PSO1, PSO3	H	K1
CO2	Understand the concepts of engineering geology and outline the applications of geology in engineering projects	PO2	H	PSO2, PSO4	H	K2
CO3	Apply the knowledge of various engineering properties of rocks in engineering projects.	PO4, PO6,	M	PSO5, PSO6	M	K3
CO4	Analysethe various engineering properties of rocks and aggregates.	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate data related to engineering classification of rocks	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create Geotechnical order based on various case studies geological data related to site selection of engineering structure	PO7, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze,

K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Bell,F.G.(2005).FundamentalsofEngineeringGeology.B.S.Publications. Hyderabad.
2. Krynine,P.D.& W.R. Judd.(1956). Principles of Engineering Geology &Geotechnics.CBS. Delhi.
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7. Goodman, R.E., 1993. Engineering Geology: Rock in Engineering constructions. JonhWiley&Sons, N.Y.
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10. RoyE.Hunt(2005)EngineeringInvestigationHandbookSecondEditionTaylor&Francis,

MAJORELECTIVE-2.2NATURAL HAZARDS

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- The objective of this course is to understand the everyday geologichazards,theirpredictionsandthe alleviation.

Course Outcomes* (COs):

CO1:	Remember the concepts of hazards
CO2:	Understand the causes and consequences of earthquake
CO3:	Apply the knowledge for prevention techniques for natural hazards.
CO4:	Analysethe various natural hazards and its impact
CO5:	Evaluate the risk reduction techniques and methods
CO6:	Create hazard zone map

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Role of geology in Engineering - Applications of geology in civil Engineering - Variousengineering properties of rocks- compressive, tensile, shear and triaxial strength of rock.Behaviorofrockunderstress/strain.Variousbuildingstonesusedasconstruction material.

UNITII

Soil – Definition -types of soils - formation of soils - Soil size parameters for buildingconstruction – expensive soil and its problem for building construction.Dam Construction:Types of Dams, Geological factors for consideration for dams and reservoirs sites selectionprocess-Dam foundation problems -criteriafor Reservoirsiteselection.

UNITIII

Siteinvestigationtechniques:definition–Foundationtreatment-Grouting-geologicalinvestigations-Groundwaterproblemsduringfoundation.Geotechnicalevaluationfortunnels: Definition-classification - Methods of tunnelling and tunnel design.Geologicalinvestigationsforroad

and bridgeconstruction.

UNITIV

Landslides and slope stability:causes of slides; types: creep, earth flow and subsidence - precautionary measures and mitigations of landslides.Earthquake and seismicity; seismiczonesofIndia– earthquake-proof designsforbuildings.

UNITV

Statistical Analysis: Graphical representation of data- Correlation – Principal componentanalysis – cluster analysis. Coastal erosion:types of erosion - Planning and methods of coastprotection works -Coastal protection structures –Remote sensing techniques forcoastalstudies.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the concepts of hazards	PO1	H	PSO1, PSO2	H	K1
CO2	Understand the causes and consequences of earthquake	PO2	H	PSO3	H	K2
CO3	Apply the knowledge for prevention techniques for natural hazards.	PO3, PO5	M	PSO4,	M	K3
CO4	Analysethe various natural hazards and its impact	PO4, PO5	M	PSO5, PSO6	M	K4
CO5	Evaluate the risk reduction techniques and methods	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create hazard zone map	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. Monroe,J.S.,Wicander,R.,andHazlett,R.(2007).PhysicalGeology:Exploringt heEarth. Sixth Edition.
2. Strahler,A.IntroductiontoPhysicalGeology.Pub.JohnWiley&Sons,Inc.page 632.
3. Hyndman,D.,andHyndman,D.(2011).NaturalHazardsandDisasters.ThirdEd ition.Pages 571.

4. Keller,E.D.(2012).IntroductiontoEnvironmentalGeology.PrenticeHall.Page801.
5. Holmes,A&P.L.Duff.(1996).PrinciplesofPhysicalGeology,4threvisedEdition,ELBS,London
6. Radhakrishnan,V.(1996).GeneralGeology,V.V.P.Publishers, Tuticorin.
7. Mahapatra,G.P.(1994). PhysicalGeology, CBSPublishers, NewDelhi.
8. Porter,S.C.&B.J.Skinner.
J.(1995).TheDynamicEarth,JohnWiley&Sons,NewYork.
9. Leet,D&Judson,S(1987).PhysicalGeology,McGrawHill.NewJersey.
10. Patwardhan,A.M.(1999).DynamicEarthSystem,PrenticeHall,NewDelhi.

ONLINEOPENRESOURCE

Reading Bookhttps://pressbooks.bccampus.ca/readingsnh/

MAJORELECTIVE-2.3 MEDICAL GEOLOGY

Course Code:

L	T	P	C
4	0	0	4

Course Objectives:

- To understand thehealth problems caused or exacerbated by geologic materials such asrocks,minerals,andwaterandgeologicprocessessuchasvolcaniceruptions,earthquakes,anddust.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the major health issues for human
CO2:	Understand the basic concepts and development of Medical Geology
CO3:	Apply the knowledge on Interaction between abundances of elements and isotopes and the health of humans.
CO4:	AnalyseThe public health effects of Earth materials and geological processes
CO5:	Evaluate Geological effects on animal health and Geophagy
CO6:	Create the flowchart of the application of medical minerals and rocks

Course Outline:

Unit I: Contact Hours: 12
Unit II: Contact Hours: 12
Unit III:Contact Hours: 12
Unit IV:Contact Hours: 12
Unit V: Contact Hours: 12

UNITI

Introduction to Medical Geology: Medical Geology: Natural Distribution and Abundance ofElements, Functions of major and minor elements in human body, the functional value ofTraceelements,Distribution,UsesandmedicinalvalueofMagnesite, Gypsum,Calcite,FossiliferousLimestone,RedOcher,Asbestos,Sulphur,Cinnabar,Orpiment,Realgar,Ferrogenous Shale, Chalcanthite, Rock Salt, Borex, Malachite and Azurite, Salt Petre andMica,Hematite, Magnetite and Siderite

UNITII

Pathways and Exposure- Volcanic Emissions and Health, Arsenic in Groundwater and theEnvironment. WHO and BIS Standards for drinking water. Fluoride in Natural Waters, soils,sediments, plants. Fluorides and health: Bioavailability of fluoride, Dental fluorosis,

Skeletalfluorosis,Dental fluorosis inIndia,source, nature,cause andextent.

UNITIII

Water Hardness and Health Effects, Effect of water hardness on urinary stone formation(urolithiasis), Types of stones: Calcium oxalate, Calcium phosphate, Uric acid, Magnesiumammoniumphosphatestones,Cysteine.Iodineandhealth:Theiodinecycleintheenvironment, Iodine in drinking water, Iodine in food, Iodine Deficiency Disorders (IDD),Goitrogens .The nitrogen cycle, Nitrate as fertilizers, Nitrates and health, Nitrates and cancer.Deficienciesin AgriculturalSoils andCropson theNutritionalHealth ofHumans.

UNITIV

Geomedicines, Heavy metals and health hazards Problems associated with fluoride, arsenic,asbestos, mercury, chromium, cadmium, zinc, copper and lead contamination – Alternateenergyresources – MineralremediestodiseasesincludingGemTherapy.Drugsfromocean.

UNITV

EnvironmentalToxicology,EnvironmentalEpidemiology,EnvironmentalMedicine,EnvironmentalPathology,SpeciationofTraceElements.TechniquesandToolsGISinHumanHealthStudies,InvestigatingVector-BorneandZoonoticDiseaseswithRemoteSensing and GIS. Mineralogy of Bones, Inorganic and Organic Geochemistry Techniques,Histochemicaland MicroprobeAnalysis in Medical Geology.

Mapping of Cos to POs and PSOs

	Course Outcome	**PO Addressed**	**Correlation Level**	**PSO Addressed**	**Correlation Level**	**Cognitive Level**
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the major health issues for human	PO1	H	PSO1,	H	K1
CO2	Understand the basic concepts and development of Medical Geology	PO1,PO2	H	PSO2, PSO3	H	K2
CO3	Apply the knowledge on Interaction between abundances of elements and isotopes and the health of humans.	PO4, PO6,	M	PSO4, PSO6	M	K3
CO4	AnalyseThe public health effects of Earth materials and geological processes	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate Geological effects on animal health and Geophagy	PO7, PO8	H	PSO7, PSO6	H	K5

CO6	Create the flowchart of the application of medical minerals and rocks	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

TEXTANDREFERNCEBOOKS

1. C.B.DissanayakeandR.Chandrajith(2009). IntroductiontoMedicalGeology,Springer,London
2. H.Catherine,W.Skinner,AntonyR.Berger(2003).GeologyandHealth:Closinggap,OxfordUniv. press, NewYork.
3. IosifF.Volfson(2010).MedicalGeology:Current StatusandPerspectives, RussianGeologicalSociety(ROSGEO)Publisher.Moscow.
4. K.S.Valdiya (2004).Geology,environment,Society,Universitypress(India),Hyderabad.
5. Lawrence K. Wang, Jiaping Paul Chen, Yung-Tse Hung, Nazih K. Shammas (2009).Heavy Metals in the Environment, CRS Press, Taylor & Francis Group, Boca Raton,FL
6. M.M. Komatica, (2004) Medical Geology, Vol.2, Effects of geological environmentonHuman health, Elsevier, U.K.
7. OileSelinus, B. Elsevier(2003). Essentials of Medical Geology (2005), AcademicPress.,U.K.
8. OileSelinus, B. Finkleman, R.B., A.Jose (2010) Medical Geology-Regionalsynthesis,Springer,London.
9. Scott S. Olson, (1999) International Environmental Standards Handbook , CRC Press,London.CKE
10. William N.Rom,(2012). EnvironmentalPolicyandPublicHealth-AirPollution, Global Climate Change, and Wilderness, by John Wiley & Sons, Inc. Published byJosseyBassA WileyImprint.

ONLINEOPENRESOURCE

1. MedicalGeologyStudyMaterial https://ocw.mit.edu/courses/earth-atmospheric-and-planetary-sciences/12-091-medical-geology-geochemistry-an-exposure-january-iap-2006/lecture-notes/
2. Geology and Human Healthhttps://serc.carleton.edu/NAGTWorkshops/health04/index.html

ONLINEOPENRESOURCE

Reading Bookhttps://pressbooks.bccampus.ca/readingsnh/

MAJORPRACTICAL-8
ECONOMICGEOLOGY,GEOCHEMISTRYANDGEOPHYSICS

Course Code:

L	T	P	C
0	0	4	2

Course Objectives:

- To identify the ore minerals
- To interpret the geophysical data
- To understand the groundwater chemistry

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the mineral and rock composition
CO2:	Understand the economic and industrial minerals in hand specimens and name major oceanic and atmospheric current systems
CO3:	Apply the knowledge on Identify the various subsurface resources from given seismic profiles
CO4:	Analysethe geochemical data for the given sample
CO5:	Evaluate the occurrence of different economically important deposits
CO6:	Create geophysical and geochemical map for the given area data.

COURSE OUTLINE:

ECONOMICGEOLOGY

Identificationanddescriptionofthefollowingeconomicminerals:

Magnetite,Ilmenite,Hematite,Pyrite,Pyrolusite,Psilomelane,Chromite,Wulframite,Chalcopyrite, Malachite, Galena, Magnesite, Bauxite, Stibnite, Cinnabar, Gypsum, Barite,Monazite,Rutile,Sillimanite,Kyanite,Corundum,Calcite,Dolomite,Beryl,Asbestos,Orpiment. Computationoforereserves fromsamplingdata

GEOPHYSICS

Elementary analysis ofelectrical resistivity andElementaryanalysisseismicdata calculation.

GEOCHEMISTRY

Classification of ground water and rock types based on geochemical data.Preparation

ofGeochemistyanomalymaps.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember the mineral and rock composition	PO1	H	PSO1,	H	K1
CO2	Understand the economic and industrial minerals in hand specimens and name major oceanic and atmospheric current systems	PO2	H	PSO2,	H	K2
CO3	Apply the knowledge on Identify the various subsurface resources from given seismic profiles	PO4, PO6,	M	PSO3, PSO4	M	K3
CO4	Analyzethe geochemical data for the given sample	PO3, PO5	M	PSO5, PSO7	M	K4
CO5	Evaluate the occurrence of different economically important deposits	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create geophysical and geochemical map for the given area data.	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

MAJORPRACTICAL-9 GEOLOGYOFTAMILNADUAND ELECTIVE-2

Course Code:

L	T	P	C
0	0	4	2

Course Objectives:

- To understand the Geology, stratigraphy and mineral wealth of Tamilnadu.
- To gain knowledge on engineering properties of rocks

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember the stratigraphy horizon of Tamilnadu
CO2:	Understand the cratons, mobile belts and platform basins of India on the basis of lithological
CO3:	Apply the knowledge on various geological setting of Tamil Nadu
CO4:	Analysethe engineering properties of rocks
CO5:	Evaluate the soil erosion and rain fall data
CO6:	Create Diagrammaticrepresentationofhealthhazard in Tamil Nadu

COURSE OUTLINE:

GEOLOGYOFTAMILNADU

Problems and maps related to Geology of Tamilnadu: structure, stratigraphyboundary,mineral wealth, rocktypes, coastal morphology.

ELECTIVE-GEOTECHINICALSTUDIES

- Calculationofcompressivestrength,ShearstrengthandTensilestrengthofrocks.
- Foundationstrengthcalculations
- Selectasuitablesitefromgeologicalandtopographicalmapsfordamandtunneland otherconstructions.

ELECTIVE -NATURALHAZARDS

- MapPreparationforTamilnaduRegion:Floodhazardmapping,coastalhazards mapping,

Soil erosionmapping and land degradation mapping, Foresttype and degradation mappingand

- Rainfalldataanalysis

ELECTIVE -MEDICALGEOLOGY

- Preparationoflocationmineralsusedinvariousmedicalfields.
- Preparationoffluoridecontamination ingroundwater.
- DiagrammaticrepresentationofhealthhazardinIndia
- Topreparegeochemicalanomaliesinair,soils,sediments,andwaterthatmayimpacton health.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO 1	Remember the stratigraphy horizon of Tamilnadu	PO1	H	PSO1,	H	K1
CO 2	Understand the cratons, mobile belts and platform basins of India on the basis of lithological	PO2	H	PSO2,	H	K2
CO 3	Apply the knowledge on various geological setting of Tamil Nadu	PO4, PO6,	M	PSO3, PSO4	M	K3
CO 4	Analysethe engineering properties of rocks	PO3, PO5	M	PSO5, PSO7	M	K4
CO 5	Evaluate the soil erosion and rain fall data	PO7, PO8	H	PSO7, PSO6	H	K5
CO 6	Create Diagrammaticrepresentationofhealthhazard in Tamil Nadu	PO3, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)

MAJORPRACTICAL-10 GEOLOGICALFIELDSTUDIES ANDVIVAVOCE

Course Code:

L	T	P	C
0	0	0	2

Course Objectives:

- To get exposure to various rock types, structural features, mines and Institutes related to Geological studies.

Course Outcomes* (COs):

After completion of this course, students will be able to

CO1:	Remember standard lithological symbols and colour codes for preparation of geological maps
CO2:	Understand to Interpret toposheets, remote sensing and other resources for reconnaissance studies.
CO3:	Application of field equipment
CO4:	Analysedifferent types of geological data and map
CO5:	Evaluate the rock and mineral specimen in the field, identify the structural features and Measure attitude, thickness, orientations of different features observed in the field
CO6:	Create report on the field studies

- Twodaysfieldtripsto placesrelevanttolstyear&IInd yearmajor courses.
- Geologicalmappingandreportsubmissioninsecondyear(Oneweekmappingcamp)
- Field trip to geologically important placesand report submission in third year(notlessthan 14days)
- Submissionofspecimenscollectedduringall field tripsatVIVA-VOCE
- VIVA-VOCEforfieldtripsduring entire programme andGeologicalmapping.

Mapping of Cos to POs and PSOs

	Course Outcome	PO Addressed	Correlation Level	PSO Addressed	Correlation Level	Cognitive Level
		PO1 to PO8	L/M/H	PSO1 to PSO8	L/ M/ H	K_1 to K_6
CO1	Remember standard lithological symbols and colour codes for preparation of geological maps	PO1	H	PSO1,	H	K1
CO2	Understand to Interpret toposheets, remote sensing and other resources for reconnaissance.	PO1,PO2	H	PSO2, PSO3	H	K2
CO3	Application of field equipment	PO4, PO4,	M	PSO5, PSO6	M	K3
CO4	Analysedifferent types of geological data and map	PO5, PO6	M	PSO4, PSO7	M	K4
CO5	Evaluate the rock and mineral specimen in the field, identify the structural features and Measure attitude, thickness, orientations of different features observed in the field	PO7, PO8	H	PSO7, PSO6	H	K5
CO6	Create report on the field studies	, PO8	H	PSO8	H	K6

(L – Low, M – Medium, H – High; K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5–Evaluate, K_6 – Create)