ALAGAPPA UNIVERSITY, KARAIKUDI
NEW SYLLABUS UNDER CBCS PATTERN (w.e.f. 2023-24)

B.Sc. GEOLOGY-PROGRAMME STRUCTURE

Sem	Part	Course Code	Courses	Title of the Paper	T/P	Cr.	Hrs./ Week	Max. Marks		
								Int.	Ext.	Total
I	I	2311T	T/OL	தமிழ்இலக்கிய வரலாறு-I/ Other Languages – I	T	3	6	25	75	100
	II	2312E	E	General English - I	T	3	6	25	75	100
	III	23BGE1C1	CC-I	General Geology	T	5	5	25	75	100
		23BGE1C2	CC-II	Geostatistics	T	3	4	25	75	100
		-	Generic Elective (Allied)	Mathematics/ Physics	T	3	3	25	75	100
				Respective Allied Theory Practical	P	2	2	25	75	100
	IV	23BGE1S1	SEC -I	Understanding the Earth	T	2	2	25	75	100
		23BGE1FC	FC	Fundamentals of Geology	T	2	2	25	75	100
				Total		23	30	200	600	800
II	I	2321T	T/OL	தமிழ் இலக்கிய வரலாறு-II / Other Languages-II	T	3	6	25	75	100
	II	2322E	E	General English - II	T	3	6	25	75	100
	III	23BGE2C1	CC-III	Palaeontology	T	4	5	25	75	100
		23BGE2P1	CC -IV	Practical I : Palaeontology	P	4	4	25	75	100
		--	Generic Elective (Allied)	Allied - II : Mathematics / Physics	T	3	3	25	75	100
		--		Allied Lab II : Mathematics / Physics	P	2	2	25	75	100
		23BGE2S1		Basics of Earth Sciences	T	2	2	25	75	100
	IV	23BGE2S2	SEC-II	Stratigraphy	T	2	2	25	75	100
		--		Naan Mudhalvan Course			-			
				Total		**23**	**30**	**200**	**600**	**800**
III	I	2331T	T/OL	**தமிழக வரலாறும் பண்பாடும்** /Other Languages-III	T	3	6	25	75	100
	II	2332E	E	General English – III	T	3	6	25	75	100
	III	23BGE3C1	CC-VI	Mineralogy	T	3	3	25	75	100
		23BGE3C2	CC-VII	Crystallography	T	3	3	25	75	100
		23BGE3P1	CC-VIII	Practical II : Crystallography	P	3	3	25	75	100
		--	Generic Elective (Allied)	Allied – III : Chemistry	T	3	3	25	75	100
		--		Allied Lab – III : Chemistry	P	2	2	25	75	100
	IV	233AT/ 23BGE3S1	SEC-III	Adipadai Tamil / Geo-heritage and Geo-tourism	T	2	2	25	75	100
				Naan Mudhalvan Course		2	2	25	75	100
				Total		**24**	**30**	**200**	**600**	**800**

IV	I	2341T	T/OL	தமிழும் அறிவியலும் /Other Languages -IV	T	3	6	25	75	100
	II	2342E	E	General English – IV	T	3	6	25	75	100
	III	23BGE4C1	CC-IX	Structural Geology	T	4	4	25	75	100
		23BGE4P1	CC-VIII	Practical III : Mineralogy	P	3	3	25	75	100
		--	Generic Elective (Allied)	Allied – IV : Chemistry	T	3	3	25	75	100
		--		Allied Lab- IV : Chemistry	P	2	2	25	75	100
	IV	234AT/ 23BGE4S1	SEC-IV	Adipadai Tamil / Field Geology	T	2	2	25	75	100
		23BES4	E.V.S	Environmental Science	T	2	2	25	75	100
				Naan Mudhalvan Course		2	2	25	75	100
				Total		**24**	**30**	**225**	**675**	**900**

V	III	23BGE5C1	CC-IX	Igneous Petrology	T	4	5	25	75	100
		23BGE5C2	CC-X	Sedimentary and Metamorphic Petrology	T	4	5	25	75	100
		23BGE5C3	CC-XI	Photogeology, Remote sensing and GIS	T	4	4	25	75	100
		23BGE5P1	CC-XII	Practical IV: Structural Geology and Survey	P	4	4	25	75	100
		23BGE5E1	DSE-I	Regional Geology	T	3	4	25	75	100
		23BGE5E2	DSE-II	Mineral Economics and Industrial minerals	T	3	4	25	75	100
	IV	23BVE5	VE	Value Education	T	2	2	25	75	100
				Naan Mudhalvan Course		2	2	25	75	100
				Total		**26**	**30**	**200**	**600**	**800**
VI		23BGE6C1	CC-XIII	Economic Geology	T	4	5	25	75	100
		23BGE6P1	CC-XIV	Practical V: Petrology	P	4	6	25	75	100
		23BGE6P2	CC-XV	Practical VI : Economic Geology	P	4	5	25	75	100
		23BGE6E1	DSE-III	Hydrogeology	T	3	5	25	75	100
		23BGE6E2	DSE-IV	Engineering and Mining Geology	T	3	5	25	75	100
		23BGE6P3		Practical VII : Geological Field Training / Extension Activity	P	2	-	25	75	100
		23BGE6S1		Professional competency skill- Essential Reasoning and Quantitative Aptitude	T	2	2	25	75	100
				Naan Mudhalvan Course		2	2	25	75	100
				Total		**24**	**30**	**200**	**600**	**800**
				Grand Total		**144**	**180**	**1225**	**3675**	**4900**

- TOL-Tamil/Other Languages,
- E – English
- CC-Core course
- Generic Elective (Allied)
- SEC-Skill Enhancement Course
- FC-Foundation Course
- DSE – Discipline Specific Elective

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE1C1	**GENERAL GEOLOGY**	Core	Y	-	-	-	5	5	25	75	100

Course Objectives	
CO1	To understand the Earth's various endogenetic processes like earthquake, volcanoes
CO2	To know about mountains and their classification, Concepts of Isostacy and plate tectonics
CO3	Understand the importance of various geomorphological agencies
CO4	Process of Geomorphological features and creation of landforms
CO5	To study the geological action of groundwater, wind, running water, glacier and sea.

	Details	**No. of Hours**	**Course Objectives**
UNIT I	Volcanoes – types of volcanic eruption – central vent and fissure types; dormant and extinct volcanoes. Types of volcanic cones; classification of volcanoes based on the nature of volcanic activity; Products of volcanoes – distribution and causes of volcanism. Earthquakes – Definition – Seismic waves, definition of Focus, Epicentre and isoseismal lines. Seismograph and seismogram – effects and causes of earth quakes – Richter's scale of earthquake – Mercalli's intensity scale – Distribution of earthquake.	12	CO1
UNIT II	Mountains and mountain chains – Classification of mountains – origin of Tectonic mountains. Isostasy – concept; Airy's and Pratt's theories. Continental drift – concept and evidences –Sea floor spreading – definition and evidences. The concept of plate tectonics: a brief account on lithopheric plates, plate boundaries and mechanism of plate motion.	12	CO2
UNIT III	Geological work and landforms produced by wind. Sand dunes and their types. Definition of Groundwater- Water table -- Springs — Hot springs and Geysers.Geological work and landforms produced by groundwater. Karst topography.	12	CO3
UNIT IV	Geological work and landforms produced by fluvial process. Base level of erosion – graded profile – rapids, cascades and water falls. River capture, river meandering, stream rejuvenation, river terraces, entrenched meanders, braided streams. Development of river valleys. Drainage patterns. Glaciers, definition; origin of glacier – types of glaciers and their movement. Glacial wastage – ablation and calving, icebergs. Geological action and landforms produced by Glacier. A brief outline on glacial epochs and causes of glaciations.	12	CO4
UNIT V	Seas and oceans.Waves, tides and currents. Landforms produced by marine processes. Shorelines – types of	12	CO5

	shorelines. Coral reefs, types and origin. Lakes; Origin and classification of lakes deposits and Indian lakes.		
	Total	**60**	

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.
The blooms taxonomy verbs will be given as a separate annexure for your reference.
Each course outcome should be mapped with the POs.
The mapping of each CO can be done with any number of POs.

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Get knowledge about volcanoes and earth quakes	PO1
CO2	Internal process including mountain development	PO1, PO2
CO3	Geomorphic process of wind and underground water	PO4, PO6
CO4	Landforms produced by surface fluvial process	PO4, PO5, PO6
CO5	Action of seas and glaciers on earth surface	PO3, PO8

Text Books
(Latest Editions)

1.	Holmes, A. (1986). *Principles of Physical Geology*. ELBS Publications, UK.
2.	Principles of Geomorphology; William D. Thornbury, (2004) CBS Publishers and Distributors, New Delhi.
3.	Patwardhan,A.M., Dynamic Earth System, PrenticeHall, New Delhi(1999)
4.	Mukherjee A.K, Principles of Geology, EW Press, KoIkata(1990)
5.	Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005

References Books
(Latest editions, and the style as given below must be strictly adhered to)

1.	Mahapatra, G.B. (2002). *A Text Book of Geology*, New Delhi: CBS publishers & Distributors.
2.	Worcester, P.G. (1948). *A Text book of Geomorphology* (2nded.). New York: D Van Nor strand company.
3.	Dayal, P. (2019). *A Text Book of Geomorphology*, New Delhi: Rajesh Publications.
4.	Bloom, A.L. (1979). *Geomorphology*, New Delhi: Rawat publications.
5.	Radhakrishnan, V, General Geology, V.V.P. Publishers, Tuticorin (1996)

Web Resources

1.	*"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005*. Retrieved 2006-01-10.
2.	*Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.*
3.	Geo.libretexts.org
4.	www.nationalgeographic.org
5.	Solarsysytem.nasa.gov

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.
The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Level**

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	3	3	3	3	2	2	2	3

S-Strong(3) M-Medium (2) L-Low (1)

To explain various components of crystals and crystallography
To study various class and forms of an crystal system.
To determine various crystallographic properties of crystals with suitable examples.

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE1C2	**GEOSTATISTICS**	Core	Y	-	-	-	3	4	25	75	100

Course Objectives	
CO1	The main objective of this course is to importance of statistics in science.
CO2	To describe the concepts of basic statistics
CO3	To explain various components of advanced statistical methods
CO4	To study various graphical methods and its applications
CO5	To determine various correlation and regression studies and its importance in the field of Geology

	Details	**No. of Hours**	**Course Objectives**
UNIT I	Definition and scope of statistics-Tabulation of data-Formation of Frequency Distribution-Diagrammatic representation of data-Bar diagrams, Pie diagrams-Graphic Representation of data-Histogram, Frequency polygon-Ogives.	12	CO1
UNIT II	Measures of Central Tendency-Arithmetic Mean Median, Mode, Combined arithmetic mean-merits and demerits.	12	CO2
UNIT III	Measures of Dispersion- Absolute and Relative measures Range, Quartile deviation, Mean deviation, Standard deviation	12	CO3
UNIT IV	Cure filling by the Method of Least square-Fitting straight line of the form Y=ax+b and parabola Y= a x^2 + b x +c (Simple problems)	12	CO4
UNIT V	Correlation-Karl person's coefficient of correlation, Rank correlation- Spearman's Rank correlation coefficient. Reregression-regression equation and their properties.	12	CO5
	Total	**60**	

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The mapping of each CO can be done with any number of POs.

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	To describe the definition, scope, classification, tabulation, drawing diagrams and plotting graphs of Statistics through Geological information.	PO1
CO2	To measure and interpret the various measures of averages using Geological data.	PO1, PO2
CO3	To measure and interpret the various measures of dispersions using Geological data.	PO4, PO6
CO4	To measure and interpret the relationship among the geological variables and to estimate and predict the unknown and future value through the regression lines using geological data.	PO4, PO5, PO6
CO5	To fit the curve using geological data.	PO3, PO8

Text Books (Latest Editions)	
1.	Statistics – R.S.N. Pillai and V. Bhagavathi, Publications S. Chand.
2.	Statistical Methods, Gupta, S.P. (2007): Sultan Chand & Sons Pvt Ltd, New Delhi, 35th Revised Edition.
3.	Statistics for Geoscientists - Marsal, D. Pergamon press, New York.
4.	*Cline, Graysen (2019)*. Nonparametric Statistical Methods Using R. *EDTECH*. ISBN 978-1-83947-325-8. OCLC 1132348139. Archived *from the original on 2022-05-15*. Retrieved 2021-09-16.
5.	Anderson, D.R.; Sweeney, D.J.; Williams, T.A. (1994) Introduction to Statistics: Concepts and Applications, pp. 5–9. West Group. ISBN 978-0-314-03309-3
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Statistics for Geoscientists - Marsal, D. Pergamon press, New York.
2.	Statistics – R.S.N. Pillai and V. Bhagavathi, Publications S. Chand.
3.	Statistical Methods, Gupta, S.P. (2007): Sultan Chand & Sons Pvt Ltd, New Delhi, 35th Revised Edition.
4.	*Cline, Graysen (2019)*. Nonparametric Statistical Methods Using R. *EDTECH*. ISBN 978-1-83947-325-8. OCLC 1132348139. Archived *from the original on 2022-05-15*. Retrieved 2021-09-16.
5.	Anderson, D.R.; Sweeney, D.J.; Williams, T.A. (1994) Introduction to Statistics: Concepts and Applications, pp. 5–9. West Group. ISBN 978-0-314-03309-3
Web Resources	
1.	**https://en.wikipedia.org/wiki/Statistics**
2.	**http://onlinestatbook.com/2/introduction/descriptive.html**
3.	**https://socialresearchmethods.net/kb/statdesc.php**
4.	**https://en.wikipedia.org/wiki/Descriptive_statistics**
5.	Philosophy of Statisticsfrom theStanford Encyclopedia of Philosophy

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- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Level**

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	3	3	3	3	2	2	2	3

S-Strong(3) M-Medium (2) L-Low (1)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE1S1	UNDERSTANDING THE EARTH	NME	Y	-	-	-	2	2	25	75	100

Course Objectives

CO1	The main objective of this course is to understand various properties of Earth.
CO2	To describe the concepts of internal structure of the Earth
CO3	To explain various components related to external processes of Earth
CO4	To study concepts of various currents and atmospheric circulation.
CO5	To understand the availability of elements in the Earth.

	Details	No. of Hours	Course Objectives
UNIT I	Understanding of planet Earth: Astronomy, Geology, Meteorology and Oceanography. General characteristics and origin of the Universe, Solar System and its planets. The terrestrial and jovian planets. Meteorites and Asteroids Earth in the solar system - origin, size, shape, mass, density, rotational and revolution parameters and its age.	12	CO1
UNIT II	Internal structure: core, mantle, crust; External Structure: hydrosphere, atmosphere and biosphere. Earth's magnetic field.	12	CO2
UNIT III	Plate tectonics, sea-floor spreading and continental drift; Mid Oceanic Ridges, trenches, transform faults and island arcs Origin of oceans, continents, mountains and rift valleys Earthquake and Volcanoes.	12	CO3
UNIT IV	Concepts of eustasy; Land-air-sea interaction Oceanic current system and effect of Coriolis force; Wave erosion and beach processes Atmospheric circulation; Weather and climatic changes.	12	CO4
UNIT V	Distribution of elements in solar system and in Earth; Chemical differentiation and composition of the Earth; General concepts about geochemical cycles and mass balance Properties of elements; Geochemical behavior of major elements; Mass conservation of elements and isotopic fractionation.	12	CO5
	Total	**60**	

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Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Understand the properties of Earth	PO1
CO2	Knowledge on Dating of Earth Age	PO1, PO2
CO3	Correlate various Hypothesis on Origin of Earth	PO4, PO6
CO4	Analyze the importance of Crystallography Studies	PO4, PO5, PO6
CO5	Various Type minerals and their respective crystal system	PO3, PO8

Text Books
(Latest Editions)

1.	Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.
2.	Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment.Cambridge University Press.
3.	Patwardhan,A.M., Dynamic Earth System, PrenticeHall, New Delhi(1999)
4.	Mukherjee A.K, Principles of Geology, EW Press, KoIkata(1990)
5.	Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Gross, M. G. (1977). Oceanography: A view of the earth.
2.	Principles of Geomorphology; William D. Thornbury, (2004) CBS Publishers and Distributors, New Delhi.
3.	Crystals and Crystal Structures – Richard J. D. Tilley(2006), John Wiley & Sons, England.
4.	Introduction to Mineralogy, Crystallography & Petrology – Carl W. Correns (1967), 2nd edition, Springer
5.	Radhakrishnan, V, General Geology, V.V.P. Publishers, Tuticorin (1996)
Web Resources	
1.	*"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005*. Retrieved 2006-01-10.
2.	*Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.*
3.	Geo.libretexts.org
4.	www.nationalgeographic.org
5.	Solarsysytem.nasa.gov

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- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Level**

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	3	3	3	3	2	2	2	3

S-Strong(3) M-Medium (2) L-Low (1)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE1FC	FUNDAMENTALS OF GEOLOGY	FC	Y	-	-	-	2	2	25	75	100

Course Objectives	
CO1	To discuss the theories of origin of the Earth
CO2	To know the interior of the Earth and concepts of dating
CO3	To understand various geomorphological agencies and Earth's various exogenetic processes including weathering.
CO4	To know about Earth's atmosphere and its composition, mass movements and their types.
CO5	To understand the origin of oceans and continents

	Details	**No. of Hours**	**Course Objectives**
UNIT I	Geology: Introduction-Branches-Scope. Solar system – outer and inner planets. Earth as a member of the Solar system – its relation to other planets – size and density of the Earth. Origin of the Earth – Nebular, Planetesimal, Tidal, and Dust cloud hypotheses; their merits and demerits.	12	CO1
UNIT II	Interior of the earth – the structure and constituents – Density – Shape – Seismic waves – Composition and thickness of the crust, mantle and core. Discontinuities: Conrad Discontinuity – Mohorovicic Discontinuity – Weichert-Guttenberg Discontinuity. Dating the rocks – Absolute and relative dating – An outline of radioactive and other dating methods. Age of the Earth.	12	CO2
UNIT III	Definition of geomorphic agent, gradation, degradation, aggradation. Weathering – definition of processes, climatic influences and products. Relief features – Classification of relief feature into I, II and III orders.	12	CO3
UNIT IV	The atmosphere, El Nino – hydrosphere – lithosphere. Composition and zones of Atmosphere. Mass wasting – Slow flowage types and rapid flowage types.	12	CO4
UNIT V	Ocean basins and Continents – their distribution. Definition of continental margins – continental shelf, continental rise; abyssal plain. An introduction on submarine canyons, sea mounts, guyots and mid oceanic ridges.	12	CO5
	Total	**60**	

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Each course outcome should be mapped with the POs.

The mapping of each CO can be done with any number of POs. **Course Outcomes**		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the origin of Galaxy, Our Solar System and Crystal Science	PO1
CO2	Knowledge on Dating of Earth Age	PO1, PO2
CO3	Correlate various Hypothesis on Origin of Earth	PO4, PO6
CO4	Understands the geomorphic process	PO4, PO5, PO6
CO5	gains knowledge about ocean and continent structures	PO3, PO8
Text Books **(Latest Editions)**		
1.	Savindra Singh, (2003). *Geomorphology*, Allahabad: PrayagPustakBhawan.	
2.	Principles of Geomorphology; William D. Thornbury, (2004) CBS Publishers and Distributors, New Delhi.	
3.	Patwardhan,A.M., Dynamic Earth System, PrenticeHall, New Delhi(1999)	
4.	Mukherjee A.K, Principles of Geology, EW Press, KoIkata(1990)	
5.	Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005	
References Books **(Latest editions, and the style as given below must be strictly adhered to)**		
1.	Mahapatra, G.B. (2002). *A Text Book of Geology*, New Delhi: CBS publishers & Distributors.	
2.	Worcester, P.G. (1948). *A Text book of Geomorphology* (2nded.). New York: D Van Nor strand company.	
3.	Dayal, P. (2019). *A Text Book of Geomorphology*, New Delhi: Rajesh Publications.	
4.	Bloom, A.L. (1979). *Geomorphology*, New Delhi: Rawat publications.	
5.	Radhakrishnan, V, General Geology, V.V.P. Publishers, Tuticorin (1996)	
Web Resources		
1.	*"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005*. Retrieved 2006-01-10.	
2.	*Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.*	
3.	Geo.libretexts.org	
4.	www.nationalgeographic.org	
5.	Solarsysytem.nasa.gov	

Semester – II: Palaeontology

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE2C1	**PALAEONTOLOGY**	Core	Y	Y	-	-	4	5	25	75	100
Course objectives											
CO1	To understand the basics of fossils										
CO2	To understand the importance of fossils in Geological studies										
CO3	To study the morphological characters of species of different phylum										
CO4	To understand and correlate fossils with various geologic formations										
CO5	To study the significance of Palaeontology in dating and evolution studies										

UNIT	Details	No. of Hours	Course Objectives
UNIT I	Definition of Palaeontology, organic world, animal kingdom habits and habitats. Definition of fossil – Nature and modes of preservation of fossils – Zone fossils, index fossils, trace fossil uses of fossils. General morphology, classification, and geological history of the following invertebrates. **Phylum Protozoa** – order Foraminifera **Phylum Porifera** – Sponges	12	CO1
UNIT II	General morphology, classification, and geological history of the following invertebrates. **Phylum Coelenterata** – Class Anthozoa (Corals) **Phylum Echinodermata** – Classes Echinoidea, Crinoidea and Blastoidea	12	CO2
UNIT III	General morphology, classification, and geological history of the following invertebrates. **Phylum – Brachiopoda** **Phylum: Mollusca-** classes, Pelecypoda, Gastropoda, Cephalopoda	12	CO3
UNIT IV	General morphology, classification, and geological history of the following invertebrates. **Phylum – Arthropoda** Class – Trilobita **Phylum Hemichordata** – Class Graptoloidea Introduction to Paleobotany, Gondwana Flora.	12	CO4
UNIT V	A short account of the following : Dinosaurs, Saurischian Dinosaur and Ornithistian Dinosaurs, Archaeopteryx, Elementary idea of Vertebrate fossils of India,	12	CO5
	Total	**60**	

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will be acquainted with once he completes that particular unit. There will be an equal number of Course objectives and Course outcomes.
Bloom's taxonomy verbs will be given as a separate annexure for your reference.
Each course outcome should be mapped with the POs.
The mapping of each CO can be done with any number of POs.

Course Outcomes	On completion of this course, students will;	
CO1	Understand the basics of Fossils	PO1
CO2	Understand the importance of fossils in Geological studies	PO1, PO2
CO3	Know different phylum and their species with morphological changes	PO4, PO6
CO4	Understand and correlate Plant fossils during the Gondwana Period	PO4, PO5, PO6
CO5	Understand the importance of Vertebrate fossils through time.	PO3, PO8

Text Books	
1.	Palaeontology Evolution and animal distribution. C. Jain and M.S. Anantharaman, (1996), Vishal Publications, Jalandhar.
2.	Invertebrate Palaeontology - H.Woods, (1985), CBS Publishers and Distributors, New Delhi.
3.	Agashe, S.N, Paleo botany, Oxford & IBH. Delhi (1995)
4.	Stewart W.N. & G.W. Rothwell, Palaeobotany, Cambridge University Press. D 2005)
5.	Moore R.C. et al., Invertebrate Fossils. CBS. Delhi (1952).
References Books	
1.	Principles of Invertebrate Palaeontology, Shrock R.R and Twenohofel W.H, (2005), CBS Publishers and Distributors, New Delhi.
2.	Invertebrate Fossils. Moore R.C, Lalicker C.G and Fisher A.G (1952) McGraw Hill.
3.	The Vertebrate Story, Romer A.S, (1959) University of Chicago Press, 4thEdt. Chicago.
4.	Paleontology An Introduction, E.W.Nield and V.C.T.Tucker (1985) Pergamon Press, Oxford.
5.	Colbert E.H. et al., Evolution of the Vertebrates, Wiley. New Delhi 2002)
Web Resources	
1.	*"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005.* Retrieved 2006-01-10.
2.	*Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.*
3.	Digitalatlas.cose.ISU.edu>geo>basics>fossil
4.	www.sciencedirect.com>topic>hemichordata
5.	w.qm.qid.au>biodiscovery>corals

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Level**

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	3	3	3	3	2	2	2	3

S-Strong(3) M-Medium (2) L-Low (1)

Semester – II: Palaeontology practical

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE2P1	**PALAEONTOLOGY PRACTICAL**	Core	Y	-	Y	-	4	4	25	75	100

Course objectives	
CO1	To identify and describe the fossils of Protozoa, Coelenterata, and Brachiopoda
CO2	To identify and describe the fossils of Mollusca
CO3	To identify and describe the fossils of Brachiopoda and Arthropoda
CO4	To identify and describe the fossils of Echinodermata
CO5	To identify and describeplant fossils

UNIT	Details	No. of Hours	Course Objectives
UNIT I	**Phylum: Protozoa** Foraminifera, Textularia, Globigerina, Nummulites, Fusulina **Phylum: Coelenterata** Zaphrentis, Cyathophyllum, Omphyma, Lithostrotion, Calceola, Montlivoltia, Isastrea, Thecosmilia, Heliolites, Favosites, Halysites. **Phylum: Brachiopoda** Lingula, Orthis, Productus, Pentamerus, Rhynoconella, Terebratula, Atrypa, Spirifer and Athyris.	12	CO1
UNIT II	**Phylum: Mollusca** **Class: Lamellibranchia** Arca, Spondylus, Meretrix, Pecten, Cardita, Cardium, Venus, Alectryonia, Inoceramus, Gryphaea, Exogyra, Ostrea, Trigonia and Pholadomya **Class: Gastropoda** Turritella, Turbo, Cerithium, Trochus, Physa, Murex, Voluta, Helix, Euomphalus, Cyprea. **Class: Cephalopoda** Orthoceras, Nautilus, Goniatites, Ceratites, Phylloceras, Lytoceras, Acanthoceras, Scholenbachia, Scaphites, Perisphinctus, Hamites, Turrilites, Baculites, Beleminites	12	CO2

UNIT III	**Phylum: Brachiopoda** Lingula, Orthis, Productus, Pentamerus, Rhynoconella, Terebratula, Atrypa, Spirifer and Athyris**.** **Phylum: Arthropoda** **Class: Trilobita** Paradoxides, Olinus, Ollenellus, Calymene, Phacops	12	CO3
UNIT IV	**Phylum: Echinodermata:** **Class: Crinoidea**: Encrinus, Marsupites **Class: Blastoidea**: Pentremites **Class: Echinoidea:**Cidaris, Hemicidaris, Stigmatopygus, Holaster, Hemiaster, Micraster.	12	CO4
UNIT V	**Plant fossils:** Calamites, Sphenophyllym, Lepidodendron, Sigillaria, Glossopteris, Gangamopteris, Ptilophyllum, Vertebraria, Elatocladus (Taxites).	12	CO5
	Total	**60**	

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes. The blooms taxonomy verbs will be given as a separate annexure for your reference. Each course outcome should be mapped with the POs. The mapping of each CO can be done with any number of POs.

Course outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Understand the basics of Fossils	PO1
CO2	Understand the importance of fossils in Geological studies	PO1, PO2
CO3	Know different phylum and their species with morphological changes	PO4, PO6
CO4	Understand and correlate fossils with various rock formations	PO4, PO5, PO6
CO5	Understand the importance of Palaeontology in dating and evolution studies	PO3, PO8

Text Books

1.	Palaeontology Evolution and animal distribution. .C. Jain and M.S. Anantharaman, (1996), Vishal Publications, Jalandhar.
2.	Invertebrate Palaeontology - H.Woods, (1985), CBS Publishers and Distributors, New Delhi.
3.	Agashe, S.N, Paleo botany, Oxford & IBH. Delhi(1995)
4.	Stewart W.N. & G.W. Rothwell, Palaeobotany, Cambridge University Press. D 2005)
5.	Moore R.C. et al., Invertebrate Fossils. CBS. Delhi (1952).

References Books

1.	Principles of Invertebrate Palaeontology, Shrock R.R and Twenohofel W.H, (2005), CBS Publishers and Distributors, New Delhi.
2.	Invertebrate Fossils. Moore R.C, Lalicker C.G and Fisher A.G (1952) McGraw Hill.
3.	The Vertebrate Story, Romer A.S, (1959) University of Chicago Press, 4thEdt. Chicago.
4.	Paleontology An Introduction, E.W.Nield and V.C.T.Tucker (1985) Pergamon Press, Oxford.
5.	Colbert E.H. et al., Evolution of the Vertebrates, Wiley. New Delhi 2002)
6.	Principles of Invertebrate Palaeontology, Shrock R.R and Twenohofel W.H, (2005), CBS Publishers and Distributors, New Delhi.
Web Resources	
1	Digital atlas.cose.ISU.edu>geo>basics>fossil
2	www.sciencedirect.com>topic>hemichordata
3	w.qm.qid.au>biodiscovery>corals

To avoid pulling the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, and L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	3	3	3	3	2	2	2	3

S-Strong(3) M-Medium (2) L-Low (1)

Semester-II: Basics of Earth Sciences

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE2S1	**Basics of Earth Sciences**	SEC	Y	Y	-	-	2	2	25	75	100

Course Objectives	
CO1	The main objective of this course is to understand various properties of Earth.
CO2	To describe the concepts of internal structure of the Earth
CO3	To explain various components related to external processes of Earth
CO4	To study concepts of various currents and atmospheric circulation.
CO5	To understand the availability of elements in the Earth.

UNIT	Details	No. of Hours	Course Objectives
UNIT I	A short account on the following: Universe – Evolution of the Universe. Solar System – Inner and outer planets – characteristics of solar system. Origin of the Earth.	12	CO1
UNIT II	Satellites – Asteroids – Meteors – comets. Earth – movements – revolution – rotation – solstice – equinox. Atmosphere - El Nino – hydrosphere – lithosphere	12	CO2
UNIT III	A short account on the following: Age of the Earth - old methods – new methods – Radioactivity – Half-life period – Radiometric methods. Interior of the Earth– Seismic waves – Composition and thickness of the crust, mantle and core. Discontinuities: Conrad Discontinuity – Mohorovicic Discontinuity.	12	CO3
UNIT IV	Definition of Geomorphology – Introduction to Geological action of wind, water, glaciers and ground water, volcanoes and earthquakes. Rock deformation: A brief account on Fold, Fault, Joint, Cleavage, Unconformity. Concepts of plate tectonics, sea floor spreading and geosynclines.	12	CO4
UNIT V	Geological Record and its nature, Geological Time Scale. Study of Fossils-Introduction, Definition of Paleontology, Classification of Plants, Invertebrate and Vertebrate fossils. Types of fossilization, Mode of preservation- Applications of Fossils – National fossil parks across India.	12	CO5
	Total	**60**	

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.
The blooms taxonomy verbs will be given as a separate annexure for your reference.
Each course outcome should be mapped with the POs.
The mapping of each CO can be done with any number of POs.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Gather basic information on Earth Sciences	PO1
CO2	Understand the importance of various components of Earth	PO1, PO2
CO3	Process of Geomorphological features	PO4, PO6
CO4	Understand, predict and analyze the fossil and dating	PO4, PO5, PO6
CO5	Apply the geological knowledge in various civil structures	PO3, PO8
Text Books		
1.	Mineralogy – Dexter Perkins (2014), 3rd edition, Pearson New International Edition.	
2.	Principles of Geomorphology; William D. Thornbury, (2004) CBS Publishers and Distributors, New Delhi.	
3.	Patwardhan,A.M., Dynamic Earth System, PrenticeHall, New Delhi(1999)	
4.	Mukherjee A.K, Principles of Geology, EW Press, KoIkata(1990)	
5.	Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005	
References Books		
1.	Introduction to Mineralogy – William D. Nesse (2000), Oxford University press, New York. USA.	
2.	Textbook of Mineralogy – E.S. Dana, (2000), 3rd edition, CBS Publishers & Distributers, New Delhi.	
3.	Crystals and Crystal Structures – Richard J. D. Tilley(2006), John Wiley & Sons, England.	
4.	Introduction to Mineralogy, Crystallography & Petrology – Carl W. Correns (1967), 2nd edition, Springer	
5.	Radhakrishnan, V, General Geology, V.V.P. Publishers, Tuticorin (1996)	
Web Resources		
1.	*"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005.* Retrieved 2006-01-10.	
2.	*Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.*	
3.	Geo.libretexts.org	
4.	www.nationalgeographic.org	
5.	Solarsysytem.nasa.gov	

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**

- **Evaluate and Create – Strong Level**

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	3	3	3	3	2	2	2	3

S-Strong(3) M-Medium (2) L-Low (1)

Semester-II: Stratigraphy

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE2S2	**STRATIGRAPHY**	SEC	Y	Y	-	-	2	2	25	75	100

Course objectives	
CO1	To understand the basic principles of Stratigraphy; to study the characteristics and description of Archaean rocks and their mineral resources
CO2	To study the characteristics and description of Proterozoic rocks and their economic importance.
CO3	To study the characteristics and description of Palaeozoic rocks
CO4	To study the characteristics and description of Mesozoic and Cenozoic formations
CO5	To study the characteristics and description of Tertiary and Quaternary formations of India.

UNIT	**Details**	**No. of Hours**	**Course Objectives**
UNIT I	General Stratigraphy: International Standard Stratigraphic Chart, Geological Time scale. Principles of Stratigraphy – Stratigraphic Units-Lithostratigraphy, Biostratigraphy, Chronostratigraphy, Magnetostratigaphy and Chemostratigaphy. Correlation-Criteria and types. INDIAN STRATIGRAPHY: Tectonic divisions of India-Cratons and Mobile belt. Physiographic division of India and its comparative study. General characteristics and descriptive study of Archaean rocks of Peninsular India. Mineral riches of Archaean rocks.	12	CO1
UNIT II	General characteristics and descriptive study of Proterozoic rocks - Cuddapah supergroup and its equivalents. Delhi supergroup. Vindhyan supergroup and its equivalents. Kurnool group. Mineral resources of Proterozoic rocks.	12	CO2
UNIT III	General characteristics and descriptive study of Palaeozoic rocks - Salt range, Jammu & Kashmir and Spiti - Age of Saline series. Gondwana Supergroup – Climate and Sedimentation – Classification – Lithology – Fossil contents – Distribution of Coal deposits.	12	CO3
UNIT IV	General characteristics and descriptive study of Mesozoic rocks - Triassic of Spiti, Jurassic of Kutch, Cretaceous of Trichinopoly and its equivalents. General characteristics and descriptive study of Cenozoic rocks. Deccan traps – Age – Distribution – Petrology – Lameta beds – Infra-trappean and Inter-trappean beds. Marine beds.	12	CO4
UNIT V	General characteristics and descriptive study of Tertiary	12	CO5

	rocks of Assam and Tamilnadu; Siwalik Supergroup; Varkala and Quilon beds of Kerala; Tertiary formations of Cambay and Karewa. General characteristics and descriptive study of Quaternary formations – Indo-Gangetic alluvium and Laterite.		
	Total	**60**	

The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquaint once he completes that particular unit. There will be equal number of Course objectives and Course outcomes.
The blooms taxonomy verbs will be given as a separate annexure for your reference.
Each course outcome should be mapped with the POs.
The mapping of each CO can be done with any number of POs.

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Understand the basics & purpose of studying stratigraphy and Understand the basements rocks in peninsular India.	PO1
CO2	Understand the Occurrences of large scale sedimentary basin and its rock formation	PO1, PO2
CO3	.Understand the evolution of Extra-Peninsular India.	PO4, PO6
CO4	Understand the various marine rocks of Extra-Peninsular India.	PO4, PO5, PO6
CO5	Understand the distribution of Cenozoic sediments.	PO3, PO8

Text Books

1.	Geology of India and Burma M.S. Krishnan, (2010), 6th Edi., C.B.S publishers and Distributors, Delhi
2.	Geology of India, D.N. Wadia, (1966), McMillan company, London
3.	Vaidyanadhan.R&M.Ramakrishnan, Geology of India. Geological Society of India. Bangalore(2008)
4.	MehdirattaR.C,Geology of India, Pakisthan, Bangladesh and Burma. Atma Ram &Sons.Delhi(1974)
5.	Geology& Mineral Resources of the States of India. Misc Pub.No.30.Geological Survey of India. Kolkota. (Several individual volumes available online at GSI portal) GSI(2005).

References Books

1.	Fundamentals of Historical Geology and Stratigraphy of India, Ravindrakumar (1985), Wiley Eastern ltd, New Delhi.
2.	Principle of Stratigraphy, Dunbar and Roggers, (1964), John Wiley and co, New York
3.	An Introduction in Stratigraphy, Stamp L.D, (1964), Thomas Murby, Museum St, WCI, London.
4.	Stratigraphic Principles and Practices, Weller, J.M, (1962), Harper & Bros, New York
5.	Kumar R,Fundamentals of Historical Geology and Stratigraphy of India,WiIey.New Delhi (1988).

Web Resources

1.	https://stratigraphy.org/
2.	https://www.sepm.org/
3.	https://www.geosocindia.org/

4.	https://www.moes.gov.in/
5.	https://isegindia.org/

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Level**

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

S-Strong(3) M-Medium (2) L-Low (1)

SEMESTER III

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE3C1	**Mineralogy**	Core	Y	T	-	-	3	3	25	75	100

Course objectives	
CO1	To understand the basics of mineral chemistry and their physical properties
CO2	To study the properties of light
CO3	To know different optical properties of minerals.
CO4	To study the descriptive mineralogy of different groups
CO5	To know the descriptive characters certain minerals

UNIT	Details	No. of Hours	Course objectives
I	Definition of mineral – General principles of chemistry as applied to minerals. Atoms, Molecules, Atomic Number, Valence, Ionic Radii, Coordinating Number, Bonding – Isomorphism, Polymorphism, Pseudomorphism. Physical properties of minerals depending upon Cohesion and Elasticity, Specific Gravity, Light, Heat, Electricity, Magnetism and of the Senses.	12	CO1
II	Nature of light – ordinary and polarized light – monochromatic light – Refraction and Reflection – Refractive Index – Critical Angle and Total reflection – Single refraction - Double refraction – Nicol Prism. Petrological Microscope and its parts – Behavior of light in its passage through a petrological microscope – Uses of quartz wedge, gypsum plate and mica plate - Classification of minerals into Isotropic and Anisotropic.	12	CO2
III	Uniaxial and Biaxial minerals – Uniaxial and Biaxial indicatrices – Dichroism and Pleochroism – Types of Extinction – straight or parallel, symmetrical and inclined – Extinction angle – Determination of extinction angle - A brief account of Silicate structure	12	CO3
IV	Descriptive mineralogy of the following essential rock forming minerals:- Quartz and its varieties – Families of Feldspar and Feldspathoids - Olivine and Garnet groups- Epidote, Beryl & Tourmaline	12	CO4
V	Descriptive mineralogy of the following rock forming mineral groups: Amphibole and Pyroxene. Mica and Chlorite groups – Serpentine – Kaolin- Talc and Steatite - Zircon – Sphene – Topaz – Andalusite – Sillimanite –	12	CO5

	Kyanite – Staurolite - Rutile – Calcite – Dolomite – Apatite – Fluorite.		
	Total	**60**	

Course outcomes		
Course outcomes	On completion of this course, students will	
CO1	Be able to identify the minerals based on their physical properties	PO1
CO2	Be able to appreciate the relationship between crystal structure and the optical properties of minerals	PO1, PO2
CO3	Understand the classification of minerals based on optical properties	PO4, PO6
CO4	Understand the descriptive mineralogy of different groups	PO4, PO5, PO6
CO5	Understand the descriptive characters important minerals	PO3, PO8

References Books	
1.	Berry, L. G., Mason, B., & Dietrich, R. V. (1985). *Mineralogy*. CBS.
2.	Dana, E. S. (2000). *A textbook of mineralogy*. CBS Publishers & Distributors.
3.	Deer, W. A., Howie, R. A., & Zussman, J. (1982). *An introduction to rock-forming minerals* (2nd ed.). Orient Longman.
4.	Deer, W. A., Howie, R. A., & Zussman, J. (1992). *An introduction to the rock-forming minerals*. ELBS.
5.	Gribble, C. D. (1991). *Rutley's elements of mineralogy*. CBS Publishers and Distributors.
6.	Haidar, S. K., & Tisjlar, J. (2014). *Introduction to mineralogy and petrology*. Elsevier.
7.	Hurlbut, C. (1993). *Dana's manual of mineralogy*. John Wiley & Sons.
8.	Kerr, P. F. (1959). *Optical mineralogy*. McGraw Hill Book Company.
9.	Perkins, D. (2010). *Mineralogy* (3rd ed.). Prentice Hall India.
10.	Wenk, H. R., & Bulakh, A. (2006). *Minerals*. Cambridge University Press.
Web Resources	
1.	https://en.m.wikipedia.org/wiki/mineral
2.	https://britannica.com/science/chlorite-mineral
3.	https://mineralseducationcoalition.org/minerals-database/zeolite
4.	https://www.britannica.com/science/epidote
5.	https://www.abracom.es

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE3C2	**Crystallography**	Core	Y	T	-	-	3	3	25	75	100
	Course objectives										
CO1	To understand the basic concept of geometric crystallography.										
CO2	To study various symmetry elements and forms of different classes in Isometric and Tetragonal system with suitable examples.										
CO3	To study various symmetry elements and forms of different classes in Hexagonal and Rhombohedral divisions with suitable examples.										
CO4	To study various symmetry elements and forms of different classes in Orthorhombic, Monoclinic systems with suitable examples.										
CO5	To study various symmetry elements and forms of different classes in Triclinic system with suitable examples; To acquire knowledge on crystal irregularities and methods of studying crystal.										

UNIT	Details	No. of Hours	Course objectives
I	Definition of crystal – Unit cell, Bravais Lattices, Plane groups, Point groups & Space groups - Crystallographic axes – Symmetry Elements – Division of crystals into systems and Point groups – Axial Ratio – Parameters – Indices – Miller Indices – Symbol – Hermann Mauguin notations –Law of Rational Indices – Forms – simple – combination – open – closed – unit – holohedral – hemihedral – tetrahedral – hemimorphic – enantiomorphous forms – Interfacial angle and its measurement with Contact Goniometer. Types of Goniometers- An introduction to stereographic projection.	12	CO1
II	Study of common forms and combinations of the following systems and classes: Isometric System: Hexoctahedral, Diploidal, Hextetrahedral – Tetragonal System: Ditetragonal bipyramidal, Tetragonal bipyramidal, Tetragonal Pyramidal, Tetragonal Sphenoidal	12	CO2
III	Hexagonal System: Dihexagonal Bipyramidal, Hexagonal Bipyramidal Trigonal System – Ditrigonal Scalenohedral - Ditrigonal pyramidal, Trirhombohedral, Trigonal trapezohedral.	12	CO3
IV	Study of common forms and combinations of the following systems and classes: Orthorhombic System: Rhombic Bipyramidal, Rhombic pyramidal, Rhombic Disphenoidal – Monoclinic System: Prismatic	12	CO4
V	Triclinic System: Pinacoidal – Twinning in crystals – laws of twinning – types: contact, interpenetration, polysynthetic, repeated – important examples from six systems – Irregularities of crystals.	12	CO5

	Total	60	
Course outcomes			
Course outcomes	On completion of this course, students will		
CO1	Understand the nature of solids with respect to minerals.	PO1	
CO2	Obtain knowledge on type minerals of Isometric & Tetragonal systems, and their respective geometrical crystal study.	PO1, PO2	
CO3	Obtain knowledge on type minerals of Hexagonal & Rhombohedral divisions in Hexagonal system, and their respective geometrical crystal study.	PO4, PO6	
CO4	Obtain knowledge on type minerals of Orthorhombic & Monoclinic systems, and their respective geometrical crystal study.	PO4, PO5, PO6	
CO5	Obtain knowledge on type minerals of Triclinic system, and their respective geometrical crystal study; understand the difference in the nature of crystallization.	PO3, PO8	
References Books			
1.	Dana, E. S. (1949). *A textbook of mineralogy*. Asia Publishing House.		
2.	Perkins, D. (2014). *Mineralogy* (3rd ed.). Pearson New International Edition.		
3.	Phillips, P. C. (1963). *An introduction to crystallography*. Longmans Green & Co.		
4.	Sharma, R. S., & Sharma, A. (2013). *Crystallography and mineralogy – Concepts and methods*. Geological Society of India Publication.		
5.	Tilley, R. J. D. (2006). *Crystals and crystal structures*. John Wiley & Sons.		
6.	Wade, F. A., & Mattox, R. B. (1960). *Elements of crystallography and mineralogy*. Harper & Bros.		
Web Resources			
1.	*"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005.* Retrieved 2006-01-10.		
2.	*Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.*		
3.	Geo.libretexts.org		
4.	www.nationalgeographic.org		
5.	Solarsysytem.nasa.gov		

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE3P1	**Practical II -Crystallography**	Core	Y	-	P	-	3	3	25	75	100

Course objectives

CO1	To describe 1. The axial characters, symmetry elements and forms present in various crystal systems. 2. The twin axis, twin plane, type of twinning and twin laws in twinned crystals.
CO2	
CO3	
CO4	
CO5	

UNIT	Details	No. of Hours	Course objectives
I	Isometric System: Normal Class – Galena, Fluorite, Magnetite, Garnet, and Leucite, Copper- Pyritohedral class – Pyrite, Tetrahedral Class – Tetrahedrite.	12	CO1
II	Tetragonal System: Normal Class – Zircon, Vesuvianite, Cassiterite, and Rutile. Tripyramidal – Scheelite, MeioniteSphenidal Class – Chalcopyrite.	12	CO2
III	Hexagonal System: Normal Class – Beryl, Tripyramidal – Apatite, Hemimorphic – Zincite, Rhombohedral Normal – Calcite, Trapezohedral Class – Quartz.	12	CO3
IV	Orthorhombic System: Normal – Barite, Sulphur, Stibnite, Topaz, Staurolite, and Aragonite. Hemimorphic – Calymene, Sphenoidal Class – Epsomite. Monoclinic System: Normal – Gypsum, Pyroxenes and Amphiboles.	12	CO4
V	Triclinic System: Normal – Axinite, Albite, and Rhodonite. Twin Crystals: Contact and Penetration twins of Fluorite, Iron Cross Twin of Pyrite, Knee type twin of Cassiterite, Polysynthetic twin of Aragonite, Cyclic twin of Cerussite, Gypsum, Twins of Carlsbad, Baveno, Manebach, Albite law of Albite.	12	CO5
	Total	**60**	

Course outcomes

Course outcomes	On completion of this course, students will	
CO1	Be able to locate the position of crystal axis, describe the axial character, symmetry elements and forms present in each crystal.	PO1
CO2		PO1, PO2
CO3		PO4, PO6
CO4		PO4, PO5, PO6
CO5		PO3, PO8

References Books

1.	Dana, E. B. (2006). *A textbook of mineralogy* (4th ed.). Wiley Eastern Ltd.
2.	Hota, R. N. (2017). *Practical approach to crystallography and mineralogy* (2nd ed.).

	CBS Publishers & Distributors.
3.	Rabindra Nath Hota, (2017). Practical Approach to Crystallography and Mineralogy, 2nd ed., CBS Publishers &Distributors.
Web Resources	
1.	*"Age of the Earth". U.S. Geological Survey. 1997. Archived from the original on 23 December 2005.* Retrieved 2006-01-10.
2.	*Dalrymple, G. Brent (2001). "The age of the Earth in the twentieth century: a problem (mostly) solved". Special Publications, Geological Society of London.*
3.	Digitalatlas.cose.ISU.edu>geo>basics>fossil
4.	www.sciencedirect.com>topic>hemichordata
5.	w.qm.qid.au>biodiscovery>corals

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE3S1	**Geo-Heritage and Geo-Tourism**	SEC-III	Y	T	-	-	2	2	25	75	100

Course objectives	
CO1	To understand the importance of Geological Heritage.
CO2	To know about the locations of geological sites
CO3	To know the geo-tourisms in India.
CO4	To understand the importance of field visits to geological sites.
CO5	To know the both geological and geomorphological heritage in India.

UNIT	**Details**	**No. of Hours**	**Course objectives**
UNIT I	Introduction, importance and history of concepts of Geoheritage, Geodiversity, Geoconservation, Geoparks and Geotourism. Geoparks: Creation, management and socio-economic benefits.	**3h/week**	CO1
UNIT II	Geological outcrops and society: Threats to geodiversity. Conservation, protection, maintenance of geological sites and related features of National importance. Conservation of geosites as a tool to protect geoheritage.	**3h/week**	CO2
UNIT III	UNESCO geoparks. Potential geoparks and geosites in India – I : Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Telangana, Maharashtra, Madhya Pradesh, Chattishgarh, Odisha, Gujarat and Rajasthan	**3h/week**	CO3
UNIT IV	Potential geoparks and geosites in India – II : Jarkhand, West Bengal, Uttarpradesh, Uttrakhand, Himachal Pradesh, Jammu Kashmir, Assam, Nagaland, Meghalaya, Sikkim, and Arunachal Pradesh.	**3h/week**	CO4
UNIT V	Guidelines for selection of Geosites. Role of local, state and national governments. Current status of Geoheritage protection and laws in the country.	**3h/week**	CO5

Course outcomes		
Course outcomes	On completion of this course, students will;	
CO1	Students gain knowledge of the geological importance of the various places.	PO1
CO2	Students understand geo-heritage and geo-tourism	PO1, PO2

	concepts.	
CO3	Students understand the importance of field visits to geological monuments.	PO4, PO6
CO4	Students gain awareness on the conservation and management of geosites	PO4, PO5, PO6
CO5	Students acquire knowledge on the laws that protect the national monuments.	PO3, PO8
References Books		
1.	Ezzoura Errami, & Brocx, M. (Eds.). (2009). *Geoheritage, geoparks and geotourism* (Conservation and Management Series). Springer.	
2.	Geotourism: Hotspots of Indian sub-continent. (2016). 36th International Geological Congress (IGC) Secretariat. C/o Geological Survey of India, C-II Pushpa Bhawan, New Delhi 110062.	
3.	Indian National Trust for Art and Cultural Heritage, Natural Heritage Division. (Year). *A monograph on national geoheritage monuments of India*. New Delhi.	
4.	Ranawat, P. S., & George, S. (2016). Potential geoheritage & geotourism sites in India. *International Journal of Scientific and Research Publications*, 9(6), Article 123.	
	Web Resources	
1.	Geologicalworldheritage(2005):Aglobalframework-PaulDingwall,TonyWeighellandTimBadman	
2.	AmonographonNationalGeoheritagemonumentsofIndia(2016)-INTACH,NaturalHeritagedivision,NewDelhi.	

Mapping with Programme Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**1**	**1**	**2**	**2**	**3**
CO2	**2**	**3**	**3**	**2**	**2**
CO3	**1**	**2**	**2**	**3**	**3**
CO4	**2**	**3**	**2**	**3**	**2**
CO5	**1**	**2**	**3**	**2**	**3**

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

SEMESTER IV

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE4C1	**Structural Geology**	Core	Y	T	-	-	4	4	25	75	100

Course objectives	
CO1	To study maps;learn and to measure attitude of beds
CO2	To understand the mechanism, types and recognition offold
CO3	To understand the genetic and geometric classification, and recognition of fault
CO4	To study joints and their types
CO5	To study unconformity and its types; learn to recognise in the filed

UNIT	Details	No. of Hours	Course objectives
I	Definition and scope of structural geology – topographic forms – topographic map – geological map – contour lines – stratum contours – outcrops and exposures. Attitude of beds – dip and strike – slope – Clinometer, Brunton compass, GPS and their parts, functions and uses.	12	CO1
II	Definition of stress and strain, compressive and tensile stress, shearing stress, couple, three stages of deformations. Fold: Definition and parts of fold; classification of folds. Recognition of fold in the field. Description and origin of foliation and lineation.	12	CO2
III	Fault: Fault terminology – Geometrical and genetic classification of faults – Horst – Graben – overthrust. Criteria for recognition of faults.	12	CO3
IV	Joints: Joint sets and systems – joint surface - relations of joints to other structures - geometric and genetic classifications. Repetition of outcrops due to erosion, folding and faulting. Inliers and outliers - Nappe – Klippe and Fenster.	12	CO4
V	Unconformities: General Characteristics - Kinds of Unconformities - Criteria for recognition – overlap and off lap. Criteria to distinguish unconformities from faults.	12	CO5
	Total	**60**	

Course outcomes		
Course outcome	On completion of this course, students will	
CO1	Learn to read toposheets and geological maps. Also, to measure strike and dip of formations.	PO1
CO2	Understand the mechanism of folds, their types and recognitionin the field	PO1, PO2

CO3	Know various modes of classification of faults and their recognition	PO4, PO6
CO4	Aware of various types joints and their significance in mining and engineering projects.	PO4, PO5, PO6
CO5	Aware of different types of unconformity andtheir recognition.	PO3, PO8

References Books	
1.	An outline of Structural Geology, Hobbs, B. E., Means, W. D., & Williams, P. F. (1976). *John Wiley*.
2.	Aerial Photographic Interpretation, Lueder, D. R. (1959). *McGraw Hill*.
3.	Basic Problems of Geotectonics, Belousov, V. V. (1962). *McGraw Hill*.
4.	Billing, M. P. (1974). *Structural geology*. Prentice Hall.
5.	Curran, P. B. (1985). *Principles of remote sensing*. ELBS.
6.	Elements of Structural Geology, Hill, E. S. (1972). *John Wiley*.
7.	Lillisand, T. M., & Kiefer, R. W. (2000). *Remote sensing and image interpretation*. Wiley.
8.	Principles of Remote Sensing and GIS, Reddy, A. (2010). *CBS*.
9.	Remote Sensing Principles and Interpretation, Sabins, F. F. (1974). *Freeman*.
10.	Structural Geology, De Sitter, L. U. (1956). *McGraw Hill*.
Web Resources	
1.	https://stratigraphy.org/
2.	https://www.sepm.org/
3.	https://www.geosocindia.org/
4.	https://www.moes.gov.in/
5.	https://isegindia.org/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**2**
CO 2	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO 3	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**1**
CO 4	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**1**
CO 5	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE4P1	**Practical III - Mineralogy**	Core	Y	-	P	-	3	3	25	75	100

Course objective

- To identify physical and optical properties of minerals of various groups in hand specimen and under thin section

I Silica Group

Quartz and its macro crystalline varieties: Rock crystal, Milky, Crystalline Quartz, Transparent Rose, Smoky, Rutilated Drusy Quartz Amethyst Crypto-crystallinevarieties: Chalcedony, Bloodstone, Agate, Moss agate, Silicified wood, Flint, Chert, Banded Jasper, Tiger eye.

Amorphous Varities: Opal-wood and milky varieties.

Feldspar Group: Sanidine, Microcline, Amazonstone, Orthoclase, Moonstone and Perthite. Plagioclase Feldspars – Albite Oligoclase and Labradorite and Anorthite.

Felspathoid Group: Leucite, Nepheline, Nepheline(Eliolite) Lazurite and Sodalite.

Zeolite group: Stilbite, Heulandite, Natrolite, Analcime, Chabazite and Apophyllite.

Mica group: Muscovite, Phlogophite, Biotite.

II Amphibole Group: Anthophyllite, Tremolite, Actinolite, Hornblende, Glaucophane Nephrite, Crocidolite and, Riebeckite.

Pyroxene Group: Enstatite, Bronzite, Hypersthene, Diopside, Augite and Spodumene.

Pyroxenoid Group: Rhodonite.

III Aluminium Silicate Group: Anadalusite, Silimanite, Kyanite, Staurolite, Topaz and Tourmaline.

Clay Mineral: Kaolin

Other minerals: Beryl, Cordierite, Epidote, Olivine, Garnet, Zircon, Talc, Chlorite, Calcite, Apatite Corundum, Magnetite, Scapolite Serpentine and Fluorite.

IV Thin Section: Quartz, Microcline, Orthoclase, Albite, Oligoclase Labradorite and Anorthite. Leucite, Nepheline Sodalite. Stilbite, Muscovite, Biotite.

Anthophyllite, Tremolite, Actinolite, Hornblende, Enstatite,

Hypersthene, Diopside, Augite

V Thin Section:

Anadalusite, Sillimanite, Kyanite, Staurolite, Topaz, Tourmaline, Beryl, Cordierite, Epidote, Olivine, Garnet, Zircon, Talc, Chlorite, Calcite, Apatite.

Course outcome

- Learners will be able to distinguish minerals of different groups based on their physical and optical properties.

Reference Books

1. Berry, L., Mason, B., & Deitrich, R. (2004). *Mineralogy* (2nd ed.). CBS Publishers & Distributors.
2. Dana, E. B. (2006). *A textbook of mineralogy* (4th ed.). Wiley Eastern Ltd.
3. Hota, R. (2012). *Practical approach to crystallography and mineralogy* (2nd ed.). CBS Publishers & Distributors.
4. Kirwan, R. (2002). *Elements of mineralogy*. Hard Press Publishing.
5. Nesse, W. D. (2000). *Introduction to mineralogy* (Paperback). Oxford University Press.
6. Perkins, D. (2003). *Mineralogy* (3rd ed.). Prentice-Hall.
7. Read, H. H. (2005). *Rutley's elements of mineralogy* (27th ed.). Murby and Co.

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE4S1	**Field Geology**	SEC -IV	Y	T	-	-	2	2	25	75	100

Course objectives	
CO1	To understand the role of Geologist in various branches of geology.
CO2	To understand the topography, its importance and methods to represent on a map
CO3	To estimate the thickness and learn its measurement from the field and map data
CO4	To know various sampling procedures in geological research.
CO5	To study the toposheet;learn to prepare Geological map and Geological report

UNIT	Details	No. of Hours	Course objectives
I	Importance of field geology – tasks of field geologist – field equipment – places of importance for the field geologist – where to look for outcrops, fossils & other geological features. Pitting & trenching of the ore bodies, Drilling- types and uses, estimation of ore reserves.	12	CO1
II	Topographic features, methods of representing topography on maps – Clinometer compass & Brunton Compass, their uses - detailed study of contouring – dip – true dip and apparent dip, their relationship – strike. Influence of dip and ground slope on outcrops.	12	CO2
III	True thickness & Vertical thickness of beds, their measurement in the field, relationships between true thickness and vertical thickness their calculation from field data. Conditions that bring about repetition of outcrops.	12	CO3
IV	Sampling – definition of a sample – sample requirement as to the size, purity contamination, packing etc. Important methods of sampling – Car samples, muck samples, channel samples, grit samples, chip samples, drill hole sampling or core sampling. Conning and quartering.	12	CO4
V	Topographic map – details, printed on the map, cardinal points (directions) conventional signs, scale of map, map references (indexing), orienting the map, locating the position of outcrops on a map, plotting attitude of beds, symbols used for rock types & various structural features – an outline of preparation of geological map and report.	12	CO5
	Total	**60**	

Course outcomes		
Course outcomes	On completion of this course, students will	
CO1	Understand the tasks of Geologist during fieldworks.	PO1

CO2	Learn to understand the topography and its representation methods on a map	PO1, PO2
CO3	Understand what is thickness of the formation, its types, its measurement from field and map data	PO4, PO6
CO4	Learn to apply suitable sampling technique for geological research.	PO4, PO5, PO6
CO5	Understand how to read toposheet and to prepare Geological map & Geological report	PO3, PO8

References Books	
1.	Chiplonker, G. W. (1960). *Geological Maps*. Dastane Bros., Pune.
2.	Compton, R. R. (1962). *Field Geology*. Wiley.
3.	Dake, C. L., & Brown, C. S. (1957). *Interpretation of Topographic Maps*.
4.	Foresten, J. D. (1946). *Principles of Field and Mining Geology*. Wiley.
5.	Geikie, J. (1912). *Structural and Field Geology*. Oliver and Boyd Publishers.
6.	Gokhale, N. W. (1987). *Manual of Geological Maps*. CBS Publishers and Distributors.
7.	Himus, G. W., & Sweeting, G. S. (1951). *Elements of Field Geology*. University Tutorial Press.
8.	Lahee, F. H. (1916). *Field Geology*. McGraw Hill.
9.	Low, J. W. (1957). *Geological Field Methods*. Harper & Brothers.
10.	Mikhailar, A. Ye. (1987). *Structural Geology and Geological Mapping*. Mir Publishers.
11.	Thomas, J. A. G. (1986). *Interpretation to Geological Maps*. Murby Publishers.
12.	Upton, W. B. (1986). *Landforms and Topographic Maps*. John Wiley & Sons.

Web Resources	
1.	https://stratigraphy.org/
2.	https://www.sepm.org/
3.	https://www.geosocindia.org/
4.	https://www.moes.gov.in/
5.	https://isegindia.org/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

SEMESTER V

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
23BGE5C1	**Igneous Petrology**	Core	Y	T	-	-	4	5	25	75	100

Course objectives	
CO1	To know kinds of rocks; various structures of igneous rocks
CO2	To study the textures and micro-structures of igneous rock
CO3	To study composition of magma and various systems of rock formation
CO4	To describe petrographical characters of important igneous rocks
CO5	To analyse the origin of various igneous rock types

UNIT	**Details**	**No. of Hours**	**Course objectives**
I	Rocks – Classification into Igneous, Sedimentary and Metamorphic groups. Distribution of elements in the crust – Divisions of igneous rocks as plutonic, hypabyssal and volcanic – Intrusive and extrusive forms – Structures.	12	CO1
II	Textures and Microstructures – Classification of Igneous rocks - Principles and parameters in the classification of igneous rocks – megascopic classification, Shands saturation principles. Outlines of classification of C.I.P.W and Tabular Classification of Tyrrel	12	CO2
III	Composition and constitution of magma – Study of unicomponent magma – Binary system: Diopside and Anorthite, Albite and Anorthite, and Forsterite and Silica systems – Ternary System represented by Albite – Anorthite – Diopside – Bowen‘s reaction principle	12	CO3
IV	Petrographic characters of Granite, Diorite, Syenite, Gabbro, Dolerite, Basalt, Pegmatite, Aplite and Lamprophyre.	12	CO4
V	Origin of igneous rocks - Diversity of igneous rocks in space and time – evidence and theories of differentiation. Assimilation. Elementary treatment of variation diagrams and petrographic provinces. - Petrography of special rock types: Anorthosite and Carbonatite.	12	CO5
	Total	**60**	

Course outcomes		
Course outcomes	On completion of this course, students will	
CO1	Understand the basic classification of rocks and various	PO1

	forms in which igneous rocks are found.	
CO2	Aware of various textures and micro-structures and their genetic relationship with the rock	PO1, PO2
CO3	Understand the compositional differences in the magma, and various systems of rock formation	PO4, PO6
CO4	Learn to describe the petrographical characters of igneous rocks	PO4, PO5, PO6
CO5	Be able to critically analyse the diversification of igneous rocks and their origin.	PO3, PO8

References Books

1.	Best, M. G. (2003). *Igneous and metamorphic petrology*. Wiley.
2.	Best, M. G. (2005). *Igneous petrology*. Wiley.
3.	Blatt, H., & Tracy, R. J. (2020). *Petrology: Igneous, sedimentary, and metamorphic* (4th ed.). W. H. Freeman.
4.	Deer, W. A., Howie, R. A., & Zussman, J. (2013). *An introduction to the rock-forming minerals* (3rd ed.). Mineralogical Society of Great Britain and Ireland.
5.	Hatch, F. H., Wells, A. K., & Wells, M. K. (1988). *Petrology of the igneous rocks* (13th ed.). CBS.
6.	Huang, W. T. (1962). *Petrology*. McGraw-Hill.
7.	Hyndman, D. W. (1985). *Petrology of the igneous and metamorphic rocks*. McGraw-Hill.
8.	MacKenzie, W. S., & Adams, A. E. (2011). *A colour atlas of rocks and minerals in thin section* (2nd ed.). CRC Press.
9.	McBirney, A. R. (1993). *Igneous petrology*. CBS.
10.	Middlemost, E. A. K. (1985). *Magmas and magmatic rocks*. Longman.
11.	Nesse, W. D. (2016). *Introduction to optical mineralogy* (4th ed.). Oxford University Press.
12.	Shelley, D. (2014). *Igneous and metamorphic rocks under the microscope*. Chapman and Hall.
13.	Tyrrell, G. W. (1958). *Principles of petrology*. B.I. Publications.
14.	Winter, J. D. (2010). *Principles of igneous and metamorphic petrology*. Pearson.
15.	Yardley, B. W. D. (2021). *Introduction to metamorphic petrology* (3rd ed.). Cambridge University Press.

Web Resources

1.	https://minerva.union.edu/hollochk/c-petrology/resources.html
2.	https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html
3.	https://geology.com/rocks/igneous-rocks.shtml
4.	https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/
5.	https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	**1**	**1**	**2**	**2**	**3**

CO2	**2**	**3**	**3**	**2**	**2**
CO3	**1**	**2**	**2**	**3**	**3**
CO4	**2**	**3**	**2**	**3**	**2**
CO5	**1**	**2**	**3**	**2**	**3**

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE5C2	**Sedimentary and Metamorphic Petrology**	Core	Y	T	-	-	4	5	25	75	100

Course objectives	
CO1	To study various kinds of sedimentary rocks, and their textures and structures
CO2	To gain adequate knowledge on residual and rudaceous deposits
CO3	To study and describe deposits of chemical and organic origin
CO4	To know the basics of metamorphism, and textures and structures of metamorphic rocks.
CO5	To study and describe the products of various kinds of metamorphism.

UNIT	**Details**	**No. of Hours**	**Course objectives**
I	Sedimentary process – disintegration and decomposition of rocks – transportation deposition – diagenesis – a broad outline of classification of sedimentary rocks into residual, mechanical, chemical and organic groups – clastic and non-clastic textures of sedimentary rocks - mechanical, chemical and organic structures of sedimentary rocks	12	CO1
II	Residual deposits – clay, laterite, terrarosa and soils, their mode of formation. Characteristics of important types of clastic deposits: Rudaceous, Arenaceous and Argilaceous groups, their classification, mineral composition and texture – Descriptive study of Conglomerate, Breccia, Sandstone and Shale.	12	CO2
III	Chemical deposits: siliceous, calcareous, ferruginous and organic and salt deposits. Organic deposits: calcareous, siliceous, phosphatic, ferruginous and carbonaceous origin. A brief study of flint, chert, siderite, gypsum, rock salt, caliche and guano.	12	CO3
IV	Definition, agents and kinds of metamorphism. Facies, grades and zones of metamorphism. Metamorphic textures and structures – A short account on anatexis and palingenesis. Cataclastic metamorphism and its products – Thermal metamorphism and its products	12	CO4
V	Dynamo thermal metamorphism and its products – Plutonic metamorphism and its products – Metasomatism and metasomatic processes: Pneumatolyitc metamorphism – Injection metamorphism and Auto metamorphism. Petrographic description of quartzite, slate, schist, gneiss, marble, hornfels, migmatite and charnockite.	12	CO5
	Total	**60**	

Course outcomes	
Course outcomes	On completion of this course, students will;

CO1	Aware of different types of sedimentary rocks and associated textures and structures	PO1
CO2	Will be able to describe and distinguish rocks of residual and rudaceous origin	PO1, PO2
CO3	Will be able to describe and distinguish rocks of chemical and organic origin	PO4, PO6
CO4	Acquire knowledge on the process of metamorphism its agents, kinds, grades and facies. Also, learn about various textures and structures and the role of pressure and temperature in creating them in different metamorphic rocks.	PO4, PO5, PO6
CO5	Will be able to describe and distinguish rocks of various metamorphic grades	PO3, PO8

References Books

1.	Best, M. G. (2003). *Igneous and metamorphic petrology*. C.B.S. Publication.
2.	Blatt, H. (1972). *Origin of sedimentary rocks*. Prentice Hall.
3.	Bahaskar Rao, B. (1986). *Metamorphic petrology*. Oxford & IBH Publishing Company Pvt. Ltd.
4.	Huang, W. T. (1962). *Petrology*. McGraw Hill Book Company.
5.	Jackson, K. C. (1970). *Textbook of lithology*. McGraw Hill.
6.	Mason, R. (1984). *Petrology of the metamorphic rocks*. C.B.S Publishers & Distributors.
7.	Nockolds, S. R., Knox, R. W. O. B., & Chinner, G. A. (1979). *Petrology for students*. Cambridge University Press.
8.	Pettijohn, F. J. (2004). *Sedimentary rocks*. Harper and Row.
9.	Philpotts, A. R. (1990). *Principles of igneous and metamorphic petrology*. Prentice Hall.
10.	Pirsson, L. V., & Knopf, A. (1969). *Rocks and rock minerals*. John Wiley & Sons.
11.	Sengupta, S. M. (1994). *Introduction to sedimentology*. CBS Publishers & Distributors.
12.	Tyrrell, G. W. (2013). *The principles of petrology*. C.G.S. Publishers and Distributors.
13.	Turner, F. J., & Verhoogen, J. (2004). *Igneous and metamorphic petrology*. C.B.S. Publishers and Distributors.
14.	Winkler, H. G. F. (1976). *Petrogenesis of metamorphic rocks*. Narosa Publishing House.

Web Resources

1.	http://rst.gsfc.nasa.gov/
2.	http://www.ccrs.nrcan.gc.ca/ccrs/homepg.pl?e
3.	https://www.geosocindia.org/
4.	http://www.npagroup.com/
5.	http://edc.usgs.gov/

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE5C3	**Photogeology, Remote Sensing and GIS**	Core	Y	T	-	-	4	4	25	75	100

Course objectives	
CO1	To learn basics of aerial photographs
CO2	To gain adequate knowledge on aerial photogrammetry
CO3	To understand the basics of satellite remote sensing
CO4	To understand types of satellites and sensors
CO5	To understand the concepts, components, software and hardware of GIS and its application.

UNIT	Details	No. of Hours	Course objectives
I	Photo Geology- definition, history and scope of aerial remote sensing. Geometry - types of aerial photographs. Scale - causes for the variation of scale. Flight procedure, overlap and side lap. Factors affecting results. Annotation of photographs. Mosaics - types of mosaics. Aerial cameras - types of films and filters.	12	CO1
II	Photogrammetry- definition. Stereoscopy and stereovision, photographic instruments - pocket stereoscope - mirror stereoscope - area measurement - relief displacement and parallax. Vertical exaggeration - factors affecting vertical exaggeration. Fundamentals of aerial photo interpretation - interpretation elements. An account on applications of aerial photography in geological studies.	12	CO2
III	Fundamentals of Remote Sensing – definition and types. Electromagnetic spectrum - EMR interaction with atmosphere and earth surface features. Remote sensing platforms – sensors - multispectral scanning, Indian remote sensing satellites (IRS). Pixel, path, row and swath. Ideal and real remote sensing system.	12	CO3
IV	Types of satellites - Scanning systems and detectors. Across-track and along track scanning systems - FOV & IFOV - charge couple devices. Sensors and their resolutions - spatial, spectral, radiometric and temporal. Data products - photographic and digital. Indian space programme - past, present and future.	12	CO4
V	Basic principles of GIS. Elements - concepts and usefulness of GIS. Components of GIS - Hardware and Software. Data source - spatial data - Raster and Vector data. Topology - Data analysis and manipulation in GIS. Global Positioning System. An account on applications	12	CO5

	of remote sensing and GIS in geological studies.		
	Total	**60**	

Course outcomes		
Course outcomes	On completion of this course, students will	
CO1	Understand the basics of aerial photograph and aerial remote sensing	PO1
CO2	Be able to use photogrammetric instrument for photogrammetric analysis	PO1, PO2
CO3	Understand the basics of satellite remote sensing	PO4, PO6
CO4	Acquire skills on how to use remote sensing data for various thematic mapping.	PO4, PO5, PO6
CO5	understood the concepts, components of GIS; its application in image interpretation, data analysis and management.	PO3, PO8

Reference Books

1.	Agarwal, C. S., & Garg, P. K. (2000). *Textbook on remote sensing in natural resources monitoring and management*. Wheeler Publishing Company Ltd., New Delhi.
2.	Allum, J. A. E. (1978). *Photogeology and regional mapping*. Pergamon Press Ltd., Oxford.
3.	American Society of Photogrammetry. (1983). *Manual of remote sensing* (2nd volume). ASP, Falls Church, Virginia.
4.	Barrett, E. C., & Curtis, C. F. (1982). *Introduction to environmental remote sensing*. Chapman & Hall Publishers.
5.	Bernhardsen, T. (2002). *Geographic information system*. John Wiley and Sons.
6.	Clarke, K. C., et al. (Eds.). *Geographical information systems and environmental modeling*. PHI Learning Pvt. Ltd.
7.	Curran, P. B. (1985). *Principles of remote sensing*. ELBS, London.
8.	Hand, L., Radke, J., & Tateosian, L. (2006). *Geographic information systems and science* (2nd ed.). John Wiley & Sons.
9.	Lillisand, T. M., & Kiefer, R. W. (2000). *Remote sensing and image interpretation*. Wiley.
10.	Lox, C. P., & Yeh, A. K. W. (2002). *Concepts and techniques of GIS*. Prentice Hall of India Pvt. Ltd.
11.	Marcolongo, B., & Mantovani, F. (1997). *Photogeology – Remote sensing applications in earth sciences*. Oxford & IBH Publishers Co. Pvt. Ltd., New Delhi.
12.	Narayan, L. R. A. (1999). *Remote sensing and its application*. Universities Press Ltd., Hyderabad.
13.	Rampal, K. K. (1999). *Handbook of aerial photography and interpretation*. Concept Publishers Company, New Delhi.
14.	Reddy, A. (2010). *Principles of remote sensing and GIS*. CBS, Delhi.
15.	Sabins, F. F. (1974). *Remote sensing principles and interpretation*. Freeman.
16.	Scanvic, J. Y. (1997). *Aerospatial remote sensing in geology*. Oxford & IBH Publishers Co. Pvt. Ltd.
17.	Skidmore, A. K. (2002). *Environmental modelling with GIS and remote sensing*. Taylor & Francis.
18.	Tor Bernhardsen. (2002). *Geographic information system*. John Willey and sons.
19.	W. T. Huang. (Year). *Aerial photographic interpretation*. McGraw Hill, New York.

20.	W. T. Huang. (Year). *Petrology*. McGraw Hill Book Company.
Web Resources	
1.	http://rst.gsfc.nasa.gov/
2.	http://www.ccrs.nrcan.gc.ca/ccrs/homepg.pl?e
3.	https://www.geosocindia.org/
4.	http://www.npagroup.com/
5.	http://edc.usgs.gov/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE5P1	**Practical IV - Structural Geology and Survey**	Core	Y	-	P	-	4	4	25	75	100

Course objectives	
CO1	To teach contour maps and their interpretation.
CO2	To predict the trends of the outcrop with respect to topography
CO3	To decipher dip and strike of the outcrops
CO4	To construct a geological map, cross section and vertical thickness of formations
CO5	To provide a comprehensive overview of geological survey methods and essential tools, focusing on practical skills necessary for accurate geological data collection and analysis.

Structural Geology Map Exercises:

Tracing of outcrops, three-point problems, measurement of dip and strike, bore hole problems, drawing simple sections and interpretation of geological maps.

Survey:

Introduction to the goals and methodologies of geological surveys. Importance of geological surveys in various applications.

Use of the Compass, Clinometer and Levelling instruments in topographic surveying.

Reference books

1.	Foresten, J. D. (1940). *Principles of field and mining geology*. Wiley Publishers.
2.	Geikie, J. (1952). *Structural and field geology*. Oliver and Boyd Publishers.
3.	Gokhale, N. W. (2017). *Manual of geological maps*. CBS Publishers and Distributors.
4.	Himus, G. W., & Sweeting, G. S. (1972). *Elements of field geology*. University Tutorial Press.
5.	Jain, A. K. (2014). *An introduction to structural geology*. Geological Survey of India.
6.	Lahee, F. H. (2002). *Field geology* (6th ed.). McGraw Hill.
7.	Low, J. W. (1957). *Geological field methods*. Harper & Brothers Publishers.
8.	Mikhailar, A. Ye. (1987). *Structural geology and geological mapping*. Mir Publishers.
9.	Thomas, J. A. G. (1980). *Interpretation to geological maps*. Murby Publishers.
10.	Upton, W. B. (1986). *Landforms and topographic maps*. John Wiley Publishers.
11.	Foresten, J. D. (1940). *Principles of field and mining geology*. Wiley Publishers.
12.	Geikie, J. (1952). *Structural and field geology*. Oliver and Boyd Publishers.

13.	Gokhale, N. W. (2017). *Manual of geological maps*. CBS Publishers and Distributors.
Learning outcome	Students gain hands-on experience related to geological structures. They learn to measure attitude of beds (dip and strike) from geological cross sections. Students calculate the true thickness of rock layers by considering their orientation and apparent thickness at the surface. By studying geological maps, students learn to interpret patterns in rock formations. This includes identifying folds, faults, and other structural features. By creating cross-section profiles from geological maps, they can visualize subsurface structures based on surface observations. Understanding topography from contour maps is essential. Students learn to interpret elevation changes and landscape features.

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE5E1	**Regional Geology**	DSE-I	Y	T	-	-	3	4	25	75	100

Course objectives	
CO1	To study various Geological structures and formations at regional scale
CO2	To know the important regional stratigraphic landforms
CO3	To know various economic importance of geologic deposits at regional level
CO4	To know the distribution of precious and semi-precious minerals in Tamil Nadu
CO5	To know the mode of occurrence and uses of minerals occur in Tamil Nadu

UNIT	**Details**	**No. of Hours**	**Course objectives**
I	Geomorphology: Tectonic and Shear Zones of Tamil Nadu -Physiography – The Western and Eastern Ghats of Tamilnadu and their structural aspects. The Cauvery and Tambraparani Rivers – Soil types of Tamil Nadu.	12	CO1
II	Archaean Group – Anorthosites of Sittampoondi, Kadavur and Oddanchatram – Alkali Rocks of Sivanmalai, Cordierite Sillimanite rocks of Trichy and Madurai, Charnockites of Pallavaram-Thiruthani Dyke swarms.	12	CO2
III	Gondwana Supergroup – Sriperumbudur beds and Therany clay beds - Cretaceous of Trichy District – Cenomanian Marine transgression –Tertiary group of Cauvery basins. Distribution of petroleum and natural gas in Tamil Nadu.	12	CO3
IV	Cuddalore Sandstone, Neyveli Lignite Deposits - Mode of occurrence & distribution of precious and Semi-precious stones in Tamil Nadu. Distribution of commercial granites, Heavy mineral sands and Thorium deposits of Manavalakurichi in Tamil Nadu.	12	CO4
V	Mode of occurrence uses origin, and distribution in Tamil Nadu of the following mineral deposit: Iron ores of Kanjamalai, Kavuthimalai; Magnesite deposits of Chalk hills; Bauxite deposits of Shaveroy hill; Graphite beds of Sivaganga- Silica Sands of coastal areas in Kanchipuram, Thiruvallur, Cuddalore and Nagapattinam districts- River sand deposits of TamilNadu. Beach placer deposits of southern Tamil Nadu.	12	CO5
	Total	**60**	

Course outcomes	
Course	On completion of this course, students will

outcomes		
CO1	Have a comprehensive idea of geological structures and formations in places close to them.	PO1
CO2	Obtain an exhaustive knowledge about the stratigraphic systems around them.	PO1, PO2
CO3	Come to know the economic importance of various geologic formations that occur near to them.	PO4, PO6
CO4	Know how and where to search for precious and semi-precious minerals in Tamil Nadu.	PO4, PO5, PO6
CO5	Know the mode of occurrence and uses of minerals occur in Tamil Nadu	PO3, PO8

References Books

1.	Dunbar, C. O., & Rodgers, J. (1964). *Principle of Stratigraphy*. John Wiley & Sons.
2.	Geological Survey of India. (2005). *Geology and Mineral Resources of the States of India* (Miscellaneous Publication No. 30). Geological Survey of India.
3.	Gupta, A., & Mukherjee, S. (Eds.). (2020). *Advances in Asian Tectonics: IGCP 516*. Springer.
4.	Kumar, R. (1988). *Fundamentals of Historical Geology and Stratigraphy of India*. Wiley.
5.	Krishnan, M. S. (2010). *Geology of India and Burma* (6th ed.). CBS Publishers and Distributors.
6.	Mukherjee, S., Misra, A. A., Calvès, G., & Nemčok, M. (Eds.). (2017). *Tectonics of the Deccan Large Igneous Province*. Geological Society of London.
7.	Ravindrakumar. (1985). *Fundamentals of Historical Geology and Stratigraphy of India*. Wiley Eastern Ltd.
8.	Ravindra Kumar, G. R. (2020). *Introduction to the Geology of India*. Springer.
9.	Ray, J. S., Subramanyam, K. S. V., & Tiwari, V. M. (Eds.). (2013). *Crustal Architecture and Evolution of the Himalaya-Karakoram-Tibet Orogen*. Geological Society of India.
10.	Reddy, S. M., Mazumder, R., Evans, D. A. D., & Collins, A. S. (Eds.). (2017). *Precambrian Basins of India: Stratigraphic and Tectonic Context*. Geological Society of London.
11.	Sinha, R., & Friend, P. F. (Eds.). (2012). *Sedimentology of Coal and Coal-Bearing Sequences*. Geological Society of London.
12.	Srivastava, R. K., Sivaji, C., & Chalapathi Rao, N. V. (Eds.). (2009). *Indian Dykes: Geochemistry, Geophysics and Geochronology*. Narosa Publishing House.
13.	Stamp, L. D. (1964). *An Introduction to Stratigraphy*. Thomas Murby.
14.	Valdiya, K. S. (2010). *The Making of India: Geodynamic Evolution*. Springer.
15.	Vaidyanadhan, R., & Ramakrishnan, M. (2008). *Geology of India* (Vol. 1 & 2). Geological Society of India.
16.	Wadia, D. N. (1953). *Geology of India*. McMillan India.
17.	Weller, J. M. (1962). *Stratigraphic Principles and Practices*. Harper & Brothers.

Web Resources

1.	https://stratigraphy.org/
2.	https://www.sepm.org/
3.	https://www.geosocindia.org/
4.	https://www.moes.gov.in/

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE5E2	**Mineral Economics and Industrial Minerals**	DSE -II	Y	T	-	-	3	4	25	75	100

Course objectives	
CO1	To understand the basics of mineral economics
CO2	To know the mines and minerals legislations
CO3	To study the importance of building stones
CO4	To know the physical and chemical characteristics of industrial minerals
CO5	To know about resource estimation, mining techniques and marketing of granite deposits

UNIT	Details	No. of Hours	Course objectives
I	**Mineral Economics:** Definition and scope – Significance of minerals in National economy, peculiarities inherent in mineral industry, tenor, grade and specification for minerals. Strategic, Critical and essential minerals with reference to India.	12	CO1
II	Mines and Minerals legislation of India. India's national mineral policy. Mineral conservation and substitution. Ore reserve estimation techniques.	12	CO2
III	**Industrial Minerals:** Building stones properties, Important building stones, physical and chemical properties and uses of granite, marble, limestone, sandstone, slate. Classification of commercial granites in pre-Cambrian terrain of south India.	12	CO3
IV	Physical properties, chemical composition, mode of occurrence and distribution in India of minerals required for the following industries: – Abrasives, fertilizers, refractory, ceramic, glass, cement, paint and pigments.	12	CO4
V	Granite Industry - Granite blocks - Resource estimation - Quarrying techniques – pre quarrying phase – operational phase – quarrying in earlier and recent times – blasting methodology – primary and secondary cutting – supporting machineries – problems encountered in granite mining. Granite trade and marketability.	12	CO5
	Total	**60**	

Course outcomes	
Course outcomes	On completion of this course, students will

CO1	Understand the basics of mineral economics	PO1
CO2	Learn about mineral legislation in India	PO1, PO2
CO3	Understand the importance of building stones	PO4, PO6
CO4	Aware of physical and chemical characteristics of minerals needed for various industries	PO4, PO5, PO6
CO5	Learn to estimate the granite reserves; learn mining techniques and marketing strategy of granite deposits.	PO3, PO8

References Books	
1.	Aiyengar, N. K. N. (1964). *Minerals of Madras*. Department of Industries & Commerce, Guindy, Madras.
2.	Bateman, A. N. (1981). *Economic Mineral Deposits*. Asian Publishers House.
3.	Craig, R. C., & Vaughan, D. V. (1985). *Ore microscopy and ore petrography*. Wiley.
4.	Krishnasamy, S., & Sinha, R. K. (1986). *India's Mineral Resources* (3rd ed.). Oxford & IBH Publishing Co.
5.	Prasad, U. (2003). *Economic Mineral Deposits*. CBS Publishers & Distributors.
6.	Sharma, N. L., & Sinha, R. K. (1985). *Mineral Economics*. Oxford & IBH Publishing Co.
7.	Sharma, N. L., & Ram, K. S. V. (1970). *Introduction to Indian Economic Minerals*. Dhanbad Publications.
8.	Sinha, R. K. (1986). *Industrial Minerals*. Oxford & IBH Publishing Co., New Delhi.
9.	Umeshwar Prasad. (2010). *Economic Geology – Economic Mineral Deposits*. CBS Publishers & Distributors.
Web Resources	
1.	https://www.britannica.com/topic/economic-geology
2.	https://en.m.wikipedia.org/wiki/supergene-(geology)
3.	https://energymining.sa.gov.au/minerals/mineral-commodities
4.	https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology
5.	https://link.spring.com/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

SEMESTER VI

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE6C1	**Economic Geology**	Core	Y	T	-	-	4	5	25	75	100

Course objectives	
CO1	To understand ore deposits, their classification and controls
CO2	To gain knowledge on different processes of mineral formation
CO3	To study the important ores: their occurrence, uses and distribution in India.
CO4	To study the occurrence, uses and distribution of ore deposits.
CO5	To know the origin, occurrence and Indian distribution of coal and petroleum

UNIT	**Details**	**No. of Hours**	**Course objectives**
I	Definition of ore, tenor, grade and metallic and non-metallic minerals. Controls of Ore localization – structural, stratigraphic, physical and chemical; Metallogenetic epochs and provinces; Geologic thermometry; Classification of ore deposits -Lindgren and Bateman.	12	CO1
II	Process of mineral formations – magmatic concentration – sublimation, contact metasomatism- Hydrothermal process – sedimentation – evaporation. Residual and mechanical concentration – Oxidation and supergene sulphide enrichment – metamorphism.	12	CO2
III	Important ores, their composition, mode of occurrence, uses and distribution in India of the following metals: gold, silver, magnesium, uranium, thorium, titanium, beryllium and zirconium.	12	CO3
IV	Important ores, their composition, mode of occurrence, uses and distribution in India of the following metals: Iron, manganese,copper, lead and zinc, aluminum, chromite	12	CO4
V	Coal deposits: Use, origin, mode of occurrence, distribution in India. Petroleum deposits: Origin and distribution in India.	12	CO5
	Total	**60**	

Course outcomes		
Course outcomes	On completion of this course, students will	
CO1	Understand how the ore deposits are classified and their distribution is controlled by various factors.	PO1

CO2	Gain knowledge on different processes of mineral formation	PO1, PO2
CO3	Know the occurrence and use of ore deposits, and their distribution in India.	PO4, PO6
CO4	Know the occurrence and use of ore deposits, and their distribution in India.	PO4, PO5, PO6
CO5	Understand the origin and occurrence of coal and petroleum	PO3, PO8

References Books

1.	Aiyengar, N. K. N. (1964). *Minerals of Madras*. Department of Industries & Commerce, Guindy, Madras.
2.	Bateman, A. N. (1981). *Economic Mineral Deposits*. Asian Publishers House.
3.	Craig, R. C., & Vaughan, D. V. (1985). *Ore microscopy and ore petrography*. Wiley.
4.	Krishnasamy, S., & Sinha, R. K. (1986). *India's Mineral Resources* (3rd ed.). Oxford & IBH Publishing Co.
5.	Prasad, U. (2003). *Economic Mineral Deposits*. CBS Publishers & Distributors.
6.	Sharma, N. L., & Sinha, R. K. (1985). *Mineral Economics*. Oxford & IBH Publishing Co.
7.	Sharma, N. L., & Ram, K. S. V. (1970). *Introduction to Indian Economic Minerals*. Dhanbad Publications.
8.	Sinha, R. K. (1986). *Industrial Minerals*. Oxford & IBH Publishing Co., New Delhi.
9.	Umeshwar Prasad. (2010). *Economic Geology – Economic Mineral Deposits*. CBS Publishers & Distributors.
10.	Deb, L. (1980). *Industrial Minerals and Rocks*. Allied Publishers Pvt. Ltd.

Web Resources

1.	https://www.britannica.com/topic/economic-geology
2.	https://en.m.wikipedia.org/wiki/supergene-(geology)
3.	https://energymining.sa.gov.au/minerals/mineral-commodities
4.	https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology
5.	https://link.spring.com/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE6P1	**Practical V - Petrology**	Core	Y	-	P	-	4	6	25	75	100

Course objectives	
CO1	To impart practical knowledge on the identification of igneous, sedimentary and metamorphic rocksin hand specimen
CO2	
CO3	
CO4	To impart practical knowledge on the identification of igneous, sedimentary and metamorphic rocksin thin section.
CO5	

UNIT	Details	No. of Hours	Course objectives
I	**Megascopic identification and description of the following Igneous rocks:** granite, graphic granite, pegmatite, aplite, orbicular granite, schorl rock, granite porphyry, Syenite, dolerite, gabbro, anorthosite, olivine, ~~gabbro~~, dunite, pyroxenite, norite, dolerite porphyry, basalt, trachyte, rhyolite, Vitrophyre, obsidian, pumice, scoria, pitchstone, volcanic tuff and volcanic breccia.	12	CO1
II	**Megascopic identification and description of the following Sedimentary Rocks:** conglomerate, breccia, laterite, sandstone, arkose, greywacke, grit, shales, limestones, chert, flint, peat, bituminous coal, anthracite, lignite, chalk,	12	CO2
III	**Megascopic identification and description of the following Metamorphic Rocks:** gneisses, schist, phyllite, slates, quartzite, marble, quartz-magnetite rock, amphibolite, eclogite, leptynite, khondalite, kodurite, gondite, charnockite, calc granulite and basic granulite.	12	CO3
IV	**Microscopic identification and description of the following**: **Igneous Rocks:** Muscovite-Biotite Granite, Hornblende granite, Alkali granite, Tourmaline granite, Pegmatite, Aplite, Hornblende syenite, Pyroxene syenite, Nepheline syenite, Mica syenite, Quartz diorite, Gabbro, Olivine – gabbro, Norite, Dunite, Peridotite, Pyroxenite, Granite Porphyry, Syenite Porphyry, Diorite porphyry, Dolerite, Rhyolite, Trachyte, Phonolite, Andesite, Basalt, Olivine Basalt, Obsidian and Pitchstone.	12	CO4

V	**Microscopic identification and description of the following**: **Sedimentary Rocks:** Conglomerate, Breccia, Sandstone, Arkose, Grit, Shale, Laterite, Limestone, Oolitic limestone, Shell limestone, Clay, Chalk, Flint, Chert and Coal. **Metamorphic Rocks:** Mica schist, chlorite schist, hornblende schist, staurolite schist, Actinolite Schist, Tremolite schist, garnetiferous mica schist, chiastolite slate, mica gneiss, pyroxene gneiss, charnockite, marble, eclogite, amphibolite, khondalite and cordierite sillimanite gneiss.	12	CO5
	Total	**60**	

Course outcomes		
Course outcomes	On completion of this course, students will	
CO1	Be able to identify and distinguish between rocks in hand specimen based on the physical properties.	PO1
CO2		PO1, PO2
CO3		PO4, PO6
CO4	Be able to identify and distinguish between rocks in thin section based on the optical properties.	PO4, PO5, PO6
CO5		PO3, PO8

References Books

1.	Blatt, H., & Tracy, R. J. (2020). *Petrology: Igneous, Sedimentary, and Metamorphic* (4th ed.). W. H. Freeman.
2.	Bowen, N. L. (1956). *The Evolution of Igneous Rocks*. Dover Publications.
3.	Deer, W. A., Howie, R. A., & Zussman, J. (2013). *An Introduction to the Rock-Forming Minerals* (3rd ed.). Mineralogical Society of Great Britain and Ireland.
4.	Ehlers, E. G., & Blatt, H. (1999). *Petrology: Igneous, Sedimentary & Metamorphic*. CBS Publishers & Distributors.
5.	Frost, R. B., & Frost, C. D. (2019). *Essentials of Igneous and Metamorphic Petrology*. Cambridge University Press.
6.	Gautam Sen. (2014). *Petrology: Principles and Practice*. Springer.
7.	Hatch, F. H., Wells, A. K., & Wells, M. K. (1949). *Petrology of Igneous Rocks*. Thomas Murby.
8.	Johannsen, A. (1962). *Descriptive Petrology of Igneous Rocks*. Allied Pacific.
9.	MacKenzie, W. S., & Adams, A. E. (2011). *A Colour Atlas of Rocks and Minerals in Thin Section* (2nd ed.). CRC Press.
10.	Myron, G. Best. (1986). *Igneous and Metamorphic Petrology*. New Delhi.
11.	Nesse, W. D. (2016). *Introduction to Optical Mineralogy* (4th ed.). Oxford University Press.
12.	Shand, S. H. J. (1990). *Eruptive Rocks*. John Wiley & Sons.
13.	Shelley, D. (2014). *Igneous and Metamorphic Rocks Under the Microscope*. Chapman and Hall.
14.	Turner, F. J., & Verhoogen, J. (1951). *Igneous and Metamorphic Petrology*. McGraw Hill.
15.	Vernon, R. H. (2004). *A Practical Guide to Rock Microstructure*. Cambridge University Press.
16.	Yardley, B. W. D. (2021). *Introduction to Metamorphic Petrology* (3rd ed.). Cambridge University Press.

Web Resources

1.	https://minerva.union.edu/hollochk/c-petrology/resources.html
2.	https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html
3.	https://geology.com/rocks/igneous-rocks.shtml
4.	https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/
5.	https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE6P2	**Practical VI - Economic Geology**	Core	Y	-	P	-	4	5	25	75	100

Course objectives	
CO1	To impart practical knowledge on the identification of economic minerals in hand specimen
CO2	
CO3	
CO4	
CO5	

UNIT	Details	No. of Hours	Course objectives
I	Identify and describe the economic minerals given in Units I -V: **Sulphide** : Chalcopyrite, chalcocite, bornite, pyrite, galena, sphalerite, cinnabar, molybdenite, stibnite, orpiment, arsenopyrite, niccolite, marcasite and realgar.	06	CO1
II	**Sulphate** : Barite, celestite, gypsum, anhydrite.	06	CO2
III	**Oxide** : Corundum, haematite, magnetite, franklinite, chromite, rutile, cassiterite.	06	CO3
IV	**Oxide** : Pyrolusite, psilomelane, yellow ochre, red ochre, wulframite, cuprite, ilmenite, bauxite and samarskite.	06	CO4
V	**Carbonate** : Calcite, magnesite, strontionite, malachite, rhodochrosite, graphite, apatite, phosphatic nodules.	06	CO5
	Total	**30**	

Course outcomes

Course outcomes	On completion of this course, students will	
CO1	Be able to identify, describe and distinguish various economic minerals based on their physical and chemical properties	PO1
CO2		PO1, PO2
CO3		PO4, PO6
CO4		PO4, PO5, PO6
CO5		PO3, PO8

References Books

1.	Aiyengar, N. K. N. (1964). *Minerals of Madras*. Department of Industries & Commerce, Guindy, Madras.
2.	Bateman, A. N. (1981). *Economic Mineral Deposits*. Asian Publishers House, New Delhi.
3.	Craig, R. C., & Vaughan, D. V. (1985). *Ore Microscopy and Ore Petrography*. Wiley, New York.
4.	Krishnasamy, S. (1988). *India's Mineral Resources*. Oxford & IBH, Delhi.
5.	Levorsen, A. I. (2004). *Geology of Petroleum*. CBS Publishers and Distributors Pvt Ltd.
6.	Prasad, U. (2003). *Economic Mineral Deposits*. CBS, Delhi.
7.	Prasad, Umeshwar. (2010). *Economic Geology – Economic Mineral Deposits*. CBS

	Pub. & Distributors, New Delhi.
8.	Shand, S. H. J. (1990). *Eruptive Rocks*. John Wiley & Sons.
9.	Sharma, N. L., & Sinha, R. K. (1985). *Mineral Economics*. Oxford & IBH, Delhi.
10.	Sharma, N. L., & Ram, K. S. V. (1970). *Introduction to Indian Economic Minerals*. Dhanbad Publications, Dhanbad.
11.	Sinha, R. K. (1986). *Industrial Minerals*. Oxford & IBH Publishing Co., New Delhi.
12.	Yardley, B. W. D. (2021). *Introduction to Metamorphic Petrology* (3rd ed.). Cambridge University Press.
Web Resources	
1.	https://www.britannica.com/topic/economic-geology
2.	https://en.m.wikipedia.org/wiki/supergene-(geology)
3.	https://energymining.sa.gov.au/minerals/mineral-commodities
4.	https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology
5.	https://link.spring.com/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE6E1	**Hydrogeology**	DSE -III	Y	T	-	-	3	5	25	75	100

Course objectives	
CO1	To understand Hydrological Cycle and various water bearing formations
CO2	To know various hydrological parameters
CO3	To know the qualities of ground water and recharge methods
CO4	To learn surface and sub-surface exploration methods for water.
CO5	To study river basins and sources of water pollution

UNIT	Details	No. of Hours	Course objectives
I	**Hydrogeology:** Definition of hydrogeology and groundwater. Hydrologic cycle. origin of water - definitions of meteoric water, connate water and Juvenile water. Vertical distribution of ground water - zone of aeration, zone of saturation and water table. Springs: types, geological conditions favoring development of springs. Definition of aquifer, aquitard and aquiclude - Types of Aquifers: unconfined, semi-confined, confined and perched - Artesian wells, peizometric surface.	12	CO1
II	Rock properties affecting ground water. Openings in rocks - types of openings – primary openings – secondary openings. Porosity, specific yield, specific retention and permeability. Ground water movement – forces causing ground water movement - seepage, capillary movement, laminar flow, turbulent flow, Darcy's law.	12	CO2
III	Physical, chemical and biological qualities of groundwater. Water standards: Parameters considered for assessing groundwater quality suitability for drinking and irrigation purposes - BIS and WHO. Ground water recharge – natural and artificial recharge - Recharge methods: Basin method, Stream channel method, Ditch or Furrow method, Flooding method, Irrigation method, Pit method, Recharge well method. Rainwater Harvesting systems.	12	CO3
IV	Methods of groundwater exploration. Surface and Subsurface methods. Geophysical Methods-Electrical resistivity method – Wenner Method – Schlumberger Method. Outline of dug wells, tube wells, jetted wells, infiltration galleries and collector wells - Well design and development - Fluctuations of groundwater.	12	CO4

V	Concepts of drainage basin and ground water provinces of India. A short account of ground water basins in Tamil Nadu. Effects of urbanization on surface and subsurface water-causes for ground water pollution-Sea water intrusion: causes, consequences, preventive and control measures.	12	CO5
	Total	**60**	

Course outcomes		
Course outcomes	On completion of this course, students will	
CO1	Understand the concept of Hydrological Cycle and various geological formations with regard to water bearing potential.	PO1
CO2	Understand porosity, permeability and hydraulic conductivity of the formations	PO1, PO2
CO3	Know the physical and chemical qualities of water and various recharge methods of ground water	PO4, PO6
CO4	Know the application of Geological and Geophysical methods in groundwater investigations	PO4, PO5, PO6
CO5	Understand the concepts of river basin and different sources of ground water pollution.	PO3, PO8

References Books

1.	Davis, S. N., & DeWiest, R. J. M. (1966). *Hydrogeology*. John Wiley & Sons.
2.	Handa, O. P. (1984). *Groundwater Drilling*. Oxford & IBH Publishing Co.
3.	Karanth, K. R. (1987). *Groundwater Assessment Development and Management*. Tata McGraw Hill Publishing Company, Ltd.
4.	Linsley, R. K., Kohler, M. A., & Paulhus, J. L. H. (1982). *Hydrology for Engineers*. McGraw-Hill International Co.
5.	Raghunath, H. M. (1987). *Groundwater* (2nd ed.). Wiley Eastern Ltd.
6.	Ramachandra Rao, M. B. (1975). *Outlines of Geophysical Prospecting - A manual for geologists*. Prasaranga, University of Mysore, Mysore.
7.	Ramakrishnan, S. (1998). *Groundwater*. K.G. Graph Arts, Chennai.
8.	Todd, D. K. (2000). *Groundwater Hydrology*. John Wiley & Sons.
9.	Todd, D.K and L.W. Mays (2004). *Groundwater Hydrology*. John Wiley & Sons, 656p
10.	Tolman, G. F. (1962). *Groundwater*. McGraw-Hill.

Web Resources

1.	https://nihroorkee.gov.in
2.	https://indiawris.gov.in
3.	https://www.nhp.mowr.gov.in
4.	https://jalshakti-dowr.gov.in
5.	https://iitr.ac.in

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE6E2	**Engineering and Mining Geology**	DSE -IV	Y	T	-	-	3	5	25	75	100

Course objectives	
CO1	To know the engineering and geological properties of rocks
CO2	To gain knowledge on geological investigations pertaining to bridges, buildings, roads and railways.
CO3	To understand geological considerations in the construction of tunnels and dams.
CO4	To make students gain knowledge on sampling techniques and drilling methods
CO5	To make students familiar with mining methods and reserve estimation

UNIT	Details	No. of Hours	Course objectives
I	Engineering Geology: The role of Geology in Civil Engineering. Engineering properties of rocks-strength and mechanical behavior of rocks, porosity, density, abrasive resistance, frost and fire resistance etc. Geological characters – mineralogical composition, texture and structure, resistance to weathering (durability) etc. General characters – cost, colour etc.	12	CO1
II	Rocks: Site of construction and material of construction, properties of building stones, selection of rocks based on requirements. Types of earth movements–Landslides, their causes and preventive measures. Geological investigations pertaining to the foundation of bridges, building foundations, highways and hilly roads and railways.	12	CO2
III	Dam-definition and types, geological investigations for dam site and reservoir. Tunnels-definition and types. Geological investigations for tunneling. Problems related to tunneling in hard and soft grounds and remedial measures. Coastal erosion and preventive measures.	12	CO3
IV	**Mining Geology:** Role of geology in mining industry. Definitions of Mining terms and their descriptions. Sampling – Principles, types, collection and preparation of samples; Drilling: Types of drills – methods of drilling.	12	CO4
V	Classification of mining methods – with a brief account on open cast mining, underground mining and factors which decide the choice. An outline on problems encountered during mining operations. Environmental	12	CO5

	impacts due to mining and mineral processing.		
	Total	**60**	

Course outcomes		
Course outcomes	On completion of this course, students will	
CO1	Gain knowledge on the engineering and geological properties of rocks	PO1
CO2	Obtain information on geological investigations pertaining to bridges, buildings, roads and railways.	PO1, PO2
CO3	Understood geological considerations in the construction of tunnels and dams.	PO4, PO6
CO4	Aware of various sampling and drilling methods	PO4, PO5, PO6
CO5	Be familiar with mining methods and reserve estimation	PO3, PO8

References Books	
1.	Arogyaswamy, R. N. P. (1973). *Courses in Mining Geology*. Oxford & IBH.
2.	Bell, F. G. (2006). *Engineering Geology*. Butterworth-Heinemann.
3.	Dugal, S. K., Pandey, H. K., & Rawal, N. (2017). *Engineering Geology*. McGraw Hill Education.
4.	Legget, R. F. (1962). *Geology and Engineering*. McGraw Hill.
5.	McKinstry. (1962). *Mining Geology*. Asia Publishing House.
6.	Parbinsingh. (2013). *Engineering and General Geology*. S.K. Kataria & Sons.
7.	Peters, W. C. (1978). *Exploration and Mining Geology* (2nd ed.). John Wiley & Sons.
8.	Subramanya, K. (1994). *Engineering Hydrology*. Tata McGraw Hill.
9.	Thomas, R. T. (1986). *Introduction to Mining Methods*. McGraw Hill.
10.	Zaruba, Q., & Menci, V. (1976). *Engineering Geology*. Elsevier Scientific Publishing Co.

Web Resources	
1.	https://link.springer.com/chapter/10.1007/
2.	https://www.sciencedirect.com/sciencedirect.com/science/article/pii/
3.	https://www.google.com/ur1?sa=t&source=web&rct=j&ur1=https//mines.gov.n/
4.	https://www.ncbi.nml.gov/books/
5.	https://www.sciencedirect.com/sciencedirect.com/science/article/pii/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

Subject code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23BGE6P3	**Practical VII - Geological Field Training**	Core	Y	-	P	-	2	-	25	75	100
Course objectives	Every student has to undertake a field work every year under the guidance of Faculty members. Duration of the field trip for 1st, 2nd and final year shall not be more than 5, 7 and 15 days, respectively. Students can be taken to open cast and underground mines; National laboratories like NIO-Goa, NGRI-Hyderabad, NRSA-Hyderabad, BSIP-Lucknow, PRL, SAC-Ahmedabad, CIMFR-Dhanbad, ISRO- Bangalore,etc; and various sites of Geological interests in any parts of India. Field work includes study of geology in the natural set up, collection of samples/specimens and preparation of a geological report. Specimens collected and the reports prepared by every student should be submitted for an interim assessment by the internal and external examiners at the time of the University practical examination of the semester concerned. First and second year assessment reports ofall the students are to be placedduring university practical examination of semester VI for final assessment by the internal and external examiners.										

Reference Books

1. Billings, M. P. (2016). *Structural Geology* (3rd ed.). Prentice – Hall of India Pvt. Ltd.
2. Chiplonker, G. W. (1960). *Geological Maps*. Dastane Bros., Pune.
3. Compton, R. R. (1962). *Field Geology*. Wiley.
4. Foresten, J. D. (1940). *Principles of Field and Mining Geology*. Wiley.
5. Geikie, J. (1952). *Structural and Field Geology*. Oliver and Boyd.
6. Gokhale, N. W. (2017). *Manual of Geological Maps*. CBS Publishers and Distributors.
7. Himus, G. W., & Sweeting, G. S. (1972). *Elements of Field Geology*. University Tutorial Press.
8. Jain, A. K. (2014). *An Introduction to Structural Geology*. Geological Survey of India.
9. Lahee, F. H. (2002). *Field Geology* (6th ed.). McGraw Hill.
10. Low, J. W. (1957). *Geological Field Methods*. Harper & Brothers.
11. Mikhailar, A. Ye. (1987). *Structural Geology and Geological Mapping*. Mir Publishers.
12. Thomas, J. A. G. (1980). *Interpretation to Geological Maps*. Murby Publishers.
13. Upton, W. B. (1986). *Landforms and Topographic Maps*. John Wiley.

Learning Outcome

Geological fieldwork provides a unique learning environment (to gain first-hand experience in the geosciences) where students develop practical skills and deepen their understanding of Earth processes.

Students learn how to collect data directly from the field, including rock samples, fossils, and other relevant materials. They learn how to measure and describe the sections of geological formations accurately. By examining rock formations, faults, folds, and other structures, students gain insights into the Earth's history and tectonic processes. Students learn how to read and use the geological maps effectively during fieldwork. Fieldwork challenges students to solve real-world geologic problems. They learn to apply their knowledge to identify patterns, make connections, and draw conclusions based on field observations. Many field experiences involve group work. Students learn to collaborate with peers, share responsibilities, and communicate effectively while conducting field investigations. Fieldwork emphasizes safety protocols, risk assessment, and emergency procedures. Students learn to navigate hazards such as steep slopes, weather conditions, and wildlife. Fieldwork integrates various investigative approaches (theoretical, analytical, experimental, and modeling). Students learn to apply information from multiple sources to interpret natural phenomena.

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	3	3	2	3	3	3	2	2
CO 2	2	3	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	1
CO 4	3	3	3	3	3	2	1	1
CO 5	2	1	1	2	1	1	2	2

- **Remember and Understanding – Lower level(1)**
- **Apply and Analyze – Medium Level(2)**
- **Evaluate and Create – Strong Level (3)**

<table>
<tr><td>Title of the Course</td><td colspan="6">ESSENTIAL REASONING AND QUANTITATIVE APTITUDE</td></tr>
<tr><td>Paper Number</td><td colspan="6">Professional Competency Skill</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">PCS</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Sub. Code
23BGE6S1</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">1</td><td>1</td><td colspan="2">-</td><td>2</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">• Develop Problem solving skills for competitative examinations
• Understand the concepts of averages , simple interest , compound interest</td></tr>
<tr><td>UNIT-I:</td><td colspan="6">Quantitative Aptitude: Simplifications=averages-Concepts –problem-Problems on numbers-Short cuts- concepts –Problems</td></tr>
<tr><td>UNIT-II:</td><td colspan="6">Profit and Loss –short cuts-Concepts –Problems –Time and work - Short –uts -Concepts -Problems.</td></tr>
<tr><td>UNIT-III:</td><td colspan="6">Simple interest –compound interest- Concepts- Prolems</td></tr>
<tr><td>UNIT-IV:</td><td colspan="6">Verbal Reasoning : Analogy- coding and decoding –Directions and distance –Blood Relation</td></tr>
<tr><td>UNIT-V:</td><td colspan="6">Analytical Reasoning :Data sufficiency
Non-Verbal Reasoning : Analogy ,Classification and series</td></tr>
<tr><td></td><td colspan="6"></td></tr>
<tr><td>Skills acquired from this course</td><td colspan="6">Studnets relating the concepts of compound interest and simple interest</td></tr>
<tr><td>Recommended Text</td><td colspan="6">1.”Quantitative Aptitude” by R.S aggarwal ,S.Chand & Company Ltd 2007</td></tr>
<tr><td></td><td colspan="6"></td></tr>
<tr><td>Website and e-Learning Source</td><td colspan="6">https://nptel.ac.in</td></tr>
</table>