PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM–636011

DEGREE OF BACHELOR OF SCIENCE
(CHOICE BASED CREDIT SYSTEM)

Syllabus for

B.Sc., GEOLOGY

SEMESTER PATTERN

(For Candidates admitted in the Colleges affiliated to Periyar University from2023-2024 onward)

LIST OF CONTENTS

B.Sc., GEOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS

I. About the Programme

Periyar University offers for the affiliated colleges in B.Sc Geology programme, under Choice Based Credit System (CBCS). The CBCS enables the students to select choice of subjects as per her /his interest and requirement. Acquiring knowledge in the related discipline is advantageous to the students. The CBCS programme is framed in such a way that to impart more Knowledge in the field of Geological sciences.

II. Program Educational Objectives (PEOs)

PEO1: To demonstrate an understanding of the fundamental principles, concepts in theoretical and practical knowledge of the geological Science.

PEO2: An ability to recognize, evaluate, interpret, and understand issues and opportunities at the frontiers of geological domain.

PEO3: Ability to apply the basic knowledge of geology to real-life problems besides the use of computational and mathematical knowledge and tools.

PEO4: Work ethically and professionally alone and as part of a team, complying with applicable legislation and managing time and other resources efficiently and effectively and manage, execute their geological plans to meet desired goals realistic constraints.

PEO5: Communicate geological information concisely and accurately using written, visual, and verbal means appropriate to the situation.

III. Program Outcomes (POs)

PO1: To develop an in-depth knowledge and skills in qualitative and quantitative research methods through laboratory, field and web modes of learning.

PO2: Recognize the need for sustainable use of earth resources, and value environmental, indigenous and other community perspective on geological activities.

PO3: Apply geological knowledge and critical thinking skills to identify a problem and to describe a strategy for handling.

PO4: Synthesize geological data on arrange of spatial and temporal scales to make interpretations that allow for scientific uncertainty.

PO5: Work effectively and professionally in multidisciplinary teams as a member and a leader and be able to manage and analyze complex ethical issues.

IV. Program Specific Outcomes (PSOs)

PSO1: Learn the essential properties of earth components, including its core, mantle, asthenosphere, lithosphere, cryosphere, hydrosphere, atmosphere and biosphere

PSO2: Demonstrate mastery of the conceptual framework for understanding earth system processes and the development of earth's features over time.

PSO3: Acquiring geologic data in the field, laboratory, satellites and big data from data banks, Analyzing and interpreting the data through application of scientific method.

PSO4: Enable to apply successfully advanced and current concepts and methods of the geosciences to formulate and solve complex geological problems.

PSO5: Apply knowledge and techniques from allied fields, including chemistry, physics, biology, mathematics, and computing, to solve geological problems.

PSO6: Capable of understanding the impact of a geo-engineering solution in global and societal context.

PSO7: Students take-up a geologic problem and utilize theoretical, analytical or experimental approach to solve the problem through their project work. The students will be able to defend their project in an open forum.

PO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	✓					
PO2		✓				
PO3			✓			
PO4				✓		
PO5					✓	
PO6						✓

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V. Eligibility for Admission

Candidates for admission to the first year of the Degree of Bachelor of science,Geology course are required to have passed the Higher Secondary Examination (Academic Stream) conducted by the Government of Tamil Nadu or an examination as equivalent to 10 +2 courses including CBSE, which have been recognized by the Periyar University.

The candidates for admission to the Geology shall have passed the qualifying Examination with the subjects under **physics and chemistry as compulsory subjects**.

For admission of students in the Government/Aided/ Unaided Colleges of Arts and Science, guidelines issued by the Director of Collegiate Education, Chennai– 6may be followed.

VI. Duration of the Program

The course for the degree of B.Sc.,Geology shall consist of three academic years divided into six semesters. Each Semester consists of 90 working days.

VII. Course and study

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time.

CURRICULLUM FRAMEWORK
UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext– Min.	Total Pass Mark	Credits
		SEMESTER – 1							
I		**Part–I:**Language:Tamil I	6	25	75	100	30	40	3
II		**Part–II:** English I	6	25	75	100	30	40	3
III		**Core I:** General Geology and Crystallography	5	25	75	100	30	40	5
III		**Core II:**Geo-Statistics	5	25	75	100	30	40	5
III		**Allied - 1:**Allied Mathematics 1/ Allied Chemistry – I	4	25	75	100	30	40	3
IV		Skill Enhancement Course SEC-1 (NME)	2	25	75	100	30	40	2
IV		Foundation Course-FC: Understanding the earth	2	25	75	100	30	40	2
	Total		30						23
		SEMESTER – 2							
I		**Part–I:** Language: Tamil-II	6	25	75	100	30	40	3
II		**Part–II:** English- II	4	25	75	100	30	40	3
II	NMSDC	Language Proficiency for Employability-Overview of English Communication	2	25	75	100	-	-	2
III		**Core-3:** Palaeontology	5	25	75	100	30	40	5
III		**Core Practical I :** Crystallography and Palaeontology Practical	5	40	60	100	30	40	5
III		**Allied -2 :** Allied Chemistry II/ Allied Mathematics –II	4	25	75	100	30	40	3
IV		Skill Enhancement Course -SEC-2 (NME)	2	25	75	100	30	40	2
IV		Skill Enhancement Course -SEC-3: Basics of Earth Science	2	25	75	100	30	40	2
	Total		30						25

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext– Min.	Total Pass Mark	Credits
		SEMESTER – 3							
I		**Part–I:**Language: Tamil III	6	25	75	100	30	40	3
II		**Part–II:** English III	6	25	75	100	30	40	3
III		**Core : 4** : Mining Geology	5	25	75	100	30	40	5
III		**Core : 5** Geomorphology and Geotectonics	5	25	75	100	30	40	5
III		**Allied-3:** Allied Physics –I	4	25	75	100	30	40	3
IV		Skill Enhancement Course -SEC-4 Entrepreneurial Based-Principles of surveying.	1	25	75	100	30	40	1
IV	**NMSDC**	**Digital Skills for Employability-Digital Skills**	**2**	**25**	**75**	**100**	**30**	**40**	**2**
IV		E.V.S	1	-	-	-	-	-	-
	Total		30						22
		SEMESTER – 4							
I		**Part–I:**Language: Tamil IV	6	25	75	100	30	40	3
II		**Part–II:** English IV	6	25	75	100	30	40	3
III		**Core 6:** Structural Geology&Photogeology	5	25	75	100	30	40	5
III		**Core Practical II :** Structural Geology, Remote Sensing, Survey Practical	5	40	60	100	30	40	5
III		**Allied - 4 :** Allied Physics- II	3	25	75	100	30	40	3
IV		Skill Enhancement Course -SEC-6: Field Hydrogeology and Techniques	2	25	75	100	30	40	2

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext– Min.	Total Pass Mark	Credits
IV		Skill Enhancement Course -SEC-7 Geo-heritage and Geo-tourism	2	25	75	100	30	40	2
IV		E.V.S	1	25	75	100	30	40	2
	Total		30						25
		SEMESTER – 5							
III		**Core 7 : S**tratigraphy	5	25	75	100	30	40	4
III		**Core 8 :** Mineralogy	5	25	75	100	30	40	4
III		**Core 9 :** Igneous Petrology	5	25	75	100	30	40	4
III		**Core 10** :Sedimentary and Metamorphic Petrology	5	25	75	100	30	40	4
III		**Elective-5 Hydrogeology**	4	25	75	100	30	40	3
		Elective -6 Remotesensing &GIS	4	25	75	100	30	40	3
IV		Value Education	2	25	75	100	30	40	2
IV		Internship / Industrial Visit / Field Visit							2
	Total		30						26
		SEMESTER – 6							
III		**Core 11 :** Regional Geology	6	25	75	100	30	40	4
III		**Core 12 :** Economic Geology and Mineral Economics	6	25	75	100	30	40	4
III		**Core 13** Applied Geology	6	25	75	100	30	40	4
III		**Core Practical III M**ineralogy and Petrology practical	5	40	60	100	30	40	3
III		**Core Practical IV** Economic geology and Ore analysis practical	5	40	60	100	30	40	3
IV		Extension Activity	-						1

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext– Min.	Total Pass Mark	Credits
IV		Professional Competency Skill	2	25	75	100	30	40	2
		Total	30						21
	Overall	**Total/Credits**							**140**

COMPULSORYCOURSES

1. Value Education
2. Environmental Studies
3. Extension Activities (NSS, NCC, YRC, RRC, Green Club)

VIII. Distribution of Marks

	Internal	Exam	Total
Theory	25	75	100
Practical	40	60	100

Core practical marks 40furtherdivided as follows:-

Field visit, Collections, Report	-	10
Practical records	-	10
Attendance	-	05
Test	-	15
		40

Classification of Internal Assessment for Theory:

Test	-	15
Assignment	-	05
Attendance	-	05
Total		25

IX. Question Paper Pattern

Time: 3h. Maximum marks: 75

Part –A **(15 x 1 = 15)**Answer all questions
Each unit carry 3 multiple choice question

Part – B **(2 x 5 = 10)**Answer any 2 questions (out of five)
onequestion should be in each unit

Part –C **(5 x 10 = 50)**Answer all questions(either or type)
one question should be in each unit

X) Field Work/Training

Geological field mapping is included in the first year, second year and third year. Its participation is a mandatory requirement. The training is to be scheduled for duration of maximum 15 days. It may be guided by faculty members in any place which is geologically significant region within Tamil Nadu and India. .

XI) Subject Name with Subject code

Sl.No	Subject Name	Subject Code	Semester
01	General Geology and Crystallography	23UGECT01	I
02	Geo-statistics	23UGECT02	I
03	Foundation course- Understanding the Earth		I
04	Crystallography and Paleontology Practical-1	23UGECP01	II
05	Paleontology	23UGECT03	II
06	SEC-3 Basics of Earth Science	23UGESO01	II
07	Mining Geology	23UGECT04	III
08	Geomorphology and Geotectonics	23UGECT05	III
09	SEC-4 Principles of surveying (Entrepreneurship)	23UGESO02	III
10	SEC-5 GeoHazards	23UGESO03	III
11	Structural geology and photo geology	23UGECT06	IV
12	Structural Geology, Remote Sensing and Survey Practical-2	23UGECP02	IV
13	SEC-6 Field hydrogeology &Techniques	23UGESO04	IV
14	SEC-7 Geo-heritage and Geo-tourism	23UGESO05	IV
15	Stratigraphy	23UGECT07	V
16	Mineralogy	23UGECT08	V
17	Igneous Petrology	23UGECT09	V
18	Sedimentary and Metamorphic Petrology	23UGECT10	V
19	Elective-V Hydrogeology	23UGEEM01	V
20	Elective-VI Remote Sensing & GIS	23UGEEM02	V
21	Regional Geology	23UGECT11	VI
22	Economic Geology and Mineral Economics	23UGECT12	VI
23	Applied Geology	23UGECT13	VI
24	Mineralogy and Petrology Practical-3	23UGECP03	VI
25	Economic Geology and Ore analysis Practical-4	23UGECP04	VI
NON MAJOR ELECTIVE COURSE			

1	Gemology and Gemstone Evolution	23UGENM01	
2	Oceanography	23UGENM02	

XII-Credit Distribution for THEORY with LAB Hours

First Year

Semester-I

Part	**List of Courses**	**Credit**	**No. of Hours**
Part-1	Language-Tamil	3	6
Part -2	English	3	6
Part-3	Core: General Geology and Crystallography	5	5
	Geo-statistics	5	5
	Allied Mathematics 1/Allied Chemistry 1	3	4
Part-4	Skill Enhancement Course SEC-1 (NME)	2	2
	Foundation Course-Understanding the Earth	2	2
		23	30

Semester-II

Part	**List of Courses**	**Credit**	**No. of Hours**
Part-1	Language- Tamil	3	6
Part-2	English	3	6
Part-3	Core: Crystallography & Paleontology Practical	5	5
	Core: Palaeontology	5	5
	Allied Mathematics II/ Allied Chemistry II	3	4
Part-4	Skill Enhancement Course -SEC-2 (NME)	2	2
	Skill Enhancement Course -SEC-3 Basics of Earth Science	2	2
		23	30

Second Year

Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language	3	6
Part-2	English	3	6
Part-3	Core: Mining Geology	5	5
	Core: Geomorphology and Geotectonics	5	5
	Allied Physics – I	3	4
Part-4	Skill Enhancement Course -SEC-4-Principles of surveying (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5- Geo Hazards	2	2
	E.V.S	-	1
		22	30

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language- Tamil	3	6
Part-2	English	3	6
Part-3	Core: Structural Geology and Photo Geology	5	5
	Core: Structural Geology, Remote Sensing and Survey Practical	5	5
	Allied Physics – II	3	3
Part-4	Skill Enhancement Course -SEC-6-Field Hydrogeology &Techniques	2	2
	Skill Enhancement Course -SEC-7Geo-Heritage and Geo-Tourism	2	2
	E.V.S	2	1
		25	30

Third Year

Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Stratigraphy	4	5
	Mineralogy	4	5
	Igneous Petrology	4	5
	Sedimentary and Metamorphic Petrology	4	5
	Elective-V Hydrogeology	3	4
	Elective – VI Remote Sensing	3	4
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	-
		26	30

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Regional Geology	4	6
	Economic Geology and Mineral Economics	4	6
	Applied Geology	4	6
	Mineralogy and petrology practical	3	5
	Economic geology and ore analysis practical	3	5
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		21	30
	Total Credits – 140		

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT01	GENERAL GEOLOGY AND CRYSTALLOGRAPHY	Core	Y	-	-	-	4	5	25	75	100

Course Objectives	
CO1	The main objective of this course is to enumerate the origin of Earth.
CO2	To describe the concepts of Dating and internal structure of the Earth
CO3	To explain various components of crystals and crystallography
CO4	To study various class and forms of an crystal system.
CO5	To determine various crystallographic properties of crystals with suitable examples.

UNIT	Details	No. of Hours	Course Objectives
I	Universe – Evolution of the Universe – Stellar system – Milky Way Galaxy –Evolution of Galaxy. Solar System – Inner and outer planets – characteristics of solar system. Satellites – Asteroids – Meteors – comets. Earth – movements – revolution – rotation – solstice – equinox – time – GMT – IST. Atmosphere – Monsoon- El Nino – hydrosphere – lithosphere- Origin of the Earth – Nebular and Planetesimal hypothesis – Tidal &Vonweizacker's hypothesis – merits and demerits of the above hypotheses	12	CO1
II	Age of the Earth – old methods – new methods – Radioactivity – Half-life period – Radiometric methods – Uranium / Lead method – Rubidium / Strontium method – Lead / Lead method – Potassium/Argon - Carbon 14 method. Numerical methods in dating. Interior of the Earth – Density – Shape – Seismic waves – Composition and thickness of the crust, mantle and core. Discontinuities: Conrad Discontinuity – Mohorovicic Discontinuity – Weichert-Guttenberg Discontinuity	12	CO2
III	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	12	CO3

	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		
IV	Study of common forms and combinations of the following systems and classes: Isometric System: Hexoctahedral, Diploidal, Hextetrahedral – Tetragonal System: Ditetragonalbipyramidal, Tetragonal bipyramidal, Tetragonal Pyramidal, Tetragonal Sphenoidal – Hexagonal System: DihexagonalBipyramidal, Hexagonal BipyramidalTrigonal System – DitrigonalScalenohedral - Ditrigonal pyramidal, Trirhombohedral, Trigonaltrapezohedral.	12	CO4
V	Study of common forms and combinations of the following systems and classes: Orthorhombic System: Rhombic Bipyramidal, Rhombic pyramidal, RhombicDisphenoidal – Monoclinic System: Prismatic – Triclinic System: Pinacoidal – Twinning in crystals – laws of twinning – types: contact, interpenetration, polysynthetic, repeated – important examples from six systems – Irregularities of crystals-An introduction to stereographic projection.	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 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	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.	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 (Latest editions, and the style as given below must be strictly adhered to)		
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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT02	GEO-STATISTICS	Core	Y	-	-	-	4	5	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		
UNIT	Details	No. of Hours	Course Objectives
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
II	Measures of Central Tendency-Arithmetic Mean Median, Mode, Combined arithmetic mean-merits and demerits.	12	CO2
III	Measures of Dispersion- Absolute and Relative measures Range, Quartile deviation, Mean deviation, Standard deviation	12	CO3
IV	Cure filling by the Method of Least square-Fitting	12	CO4

	straight line of the form Y=ax+b and parabola Y= a x^2 + b x +c (Simple problems)		
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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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	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, Publicationss. Chand.
2.	Statistical Methods, Gupta, S.P. (2007): sultan Chand &sons Pvt Ltd, New Delhi, s5th 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. Chand.
3.	Statistical Methods, Gupta, S.P. (2007): sultan Chand &sons Pvt Ltd, New Delhi, 5th 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 StatisticsfromtheStanford Encyclopedia of Philosophy

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)

Part-IV_ FOUNDATION COURSE

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGE	UNDERSTANDING THE EARTH	FC	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
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
II	Internal structure: core, mantle, crust; External Structure: hydrosphere, atmosphere and biosphere. Earth's magnetic field.	12	CO2
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
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
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**	

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 Outcom	On completion of this course, students will;

es		
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	

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECP01	CRYSTALLOGRAPHY AND PALOENTOLOGY PRACTICAL	Core	Y	-	-	-	4	5	40	60	100
Course Objectives											
CO1	The main objective of this course is to enumerate the origin of Earth.										
CO2	To describe the concepts of Dating and internal structure of the Earth										
CO3	To explain various components of crystals and crystallography										
CO4	To study various class and forms of an crystal system.										
CO5	To determine various crystallographic properties of crystals with suitable examples.										
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. Tetragonal System: Normal Class – Zircon, Vesuvianite, Cassiterite, and Rutile. Tripyramidal – Scheelite, MeioniteSphenidal Class – Chalcopyrite. Hexagonal System: Normal Class – Beryl, Tripyramidal – Apatite, Hemimorphic – Zincite, Rhombohedral Normal – Calcite, Trapezohedral Class – Quartz.							12		CO1	

II	Orthorhombic System: Normal – Barite, Sulphur, Stibnite, Topaz, Staurolite, and Aragonite. Hemimorphic – Calymene, Sphenoidal Class – Epsomite. Monoclinic System: Normal – Gypsum, Pyroxenes and Amphiboles. 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, Swallow Tail of Gypsum, Twins of Carlsbad, Baveno, Manebach, Albite law of Albite.	12	CO2
III	Identification and description of the following fossils: Lamellibranchs: Arca, Meretrix, Pecten, Cardita, Lima, Allectronia, Inoceramus, Gryphaea, Exogyra, Radiolites, Ostrea, Unio, Trigonia. Gastropods: Turritella, Turbo, Cerithium, Trochus, Physa, Murex, Voluta, Helix, Euomphalus, Cyprea.	12	CO3
IV	Cephalopods: Nautilus, Orthoceras, Ceratite, Goniatite, Belemnites, Baculites, and Perisphinctes. Echinodermata: Cidaris, Holaster, Hemiaster, Stigmatophygus, Apiocrinus. Trilobites: Paradoxides, Olenus, Olenellus, Phacops, Calymene.	12	CO4
V	Corals: Calceola, Zaphrentis, Lithostrotion, Omphyma, Thecosmelia. Brachiopoda: Terebratula, Spirifer, Productus, Monograptus, Tetragraptus, Diplograptus.	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	The main objective of this course is to enumerate the fundamental aspects of Mineralogy in such a way as to stimulate the minds of the post-graduate students.	PO1

CO2	To describe the concepts of Mineralogy is essential to comprehend the concepts of Petrology.	PO1, PO2
CO3	To explain the importance of instrumentation techniques for better analysis	PO4, PO6
CO4	To compare and contrast between the fascinating plethora of colorful minerals and crystals, this discipline requires good knowledge of Chemistry, and poses several intriguing questions, leading to sustained interest in this subject	PO4, PO5, PO6
CO5	Can evaluate the accuracy and summaries the methods adapted for certain practical activities.	PO3, PO8
Text Books (Latest Editions)		
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.	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 (Latest editions, and the style as given below must be strictly adhered to)		
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.	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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT03	PALAEONTOLOGY	Core	Y	-	-	-	4	5	25	75	100
Course Objectives											
CO1	Understand the basics of Fossils										
CO2	Understand the importance of fossils in Geological studies										
CO3	Know different phulum and their species with morphological changes										
CO4	Understand and correlate fossil with various rock formations										
CO5	Understand the importance of Palaeontology in dating and evolution studies										
UNIT	Details						No. of Hours		Course Objectives		
I	Fossils –Definition-conditions required for fossilization-Modes of preservation-Uses of fossils. Geological time scale.						12		CO1		
II	The morphology and geological distribution of Mollusca- classes, Pelecypoda, gastropoda, Cephalopoda – orders - Nautiloidea, Ammonoidea, Dibranchia – Belemnites.						12		CO2		
III	Phylum – Brachiopoda, Phylum –						12		CO3		

	Coelenterata.ClassAnthozoa – Subclass Zoantharia Orders Rugosa, Tabulata and Scaleractina. Phylum – Hemichordata – Class Graptozoa, order Dendroidea, Order Graptolitoidea.		
IV	Phylum – Arthropoda Class – Trilobita Phylum – Echinodermata Class - Echinoidea Class – Crinoidea. Class: Blastoidea. Introduction to Paleobotany, Gondwana Flora.	12	CO4
V	Short account of the following Dinosaurs, Saurischian Dinosaur and Ornithistian Dinosaurs, Archaeopteryx, Elementary idea of Verterbrate fossils of India, Morphological character of Phylum – Protozoa, Order – Foraminifera.	12	CO5
	Total	60	

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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 phulum and their species with morphological changes	PO4, PO6
CO4	Understand and correlate fossil with various rock formations	PO4, PO5, PO6
CO5	Understand the importance of Palaeontology in dating and evolution studies	PO3, PO8

Text Books
(Latest Editions)

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

Subject Code	Subject Name	e g	L	T	P	S	d	H·	Marks

									CIA	External	Total
23UGESO01	**Basics of Earth Science**	SEC	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**
I	Universe – Evolution of the Universe. Solar System – Inner and outer planets – characteristics of solar system. Satellites – Asteroids – Meteors – comets. Earth – movements – revolution – rotation – solstice – equinox. Atmosphere - El Nino – hydrosphere – lithosphere- Origin of the Earth.	12	CO1
II	Age of the Earth - old methods – new methods – Radioactivity – Half-life period – Radiometric methods. Interior of the Earth – Density – Shape – Seismic waves – Composition and thickness of the crust, mantle and core. Discontinuities: Conrad Discontinuity – Mohorovicic Discontinuity.	12	CO2
III	Introduction to Geomorphology: Geological action of wind, water, glaciers and ground water. Volcanoes and earthquakes. Rock deformation: Folds, Faults, Joints, Cleavage, Unconformities, Concepts of plate tectonics, sea floor spreading and geosynclines.	12	CO3
IV	**Study of Fossils-** Introduction, Geological Record and its nature. Geological Time Scale. Introduction, Definition of Paleontology, Classification of Plants, Invertebrate and Vertebrate fossils. Fossils -Tophonomy (Burial Law), Types of Fossilization, Mode of preservation- Applications of Fossils– National fossil parks across India.	12	CO4
V	**Applications of Geology:**Environmental impacts due to mining and mineral process, Engineering Geology: Dams, Reservoirs and Tunnels, strategic, critical and essential mineral –Mineral resources of India. Fossil Fuels and Groundwater.	12	CO5
	Total	**60**	

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT04	MINING GEOLOGY	Core	Y	-	-	-	4	5	25	75	100

Course Objectives			
CO1	Understand the basics components of Structural Geology		
CO2	Know the formations of geological formations		
CO3	Basics of Aerial Photographs		
CO4	Understand the Application of Satellite science		
CO5	Analyse various physiographical features through GIS		
UNIT	Details	No. of Hours	Course Objectives
I	Mining terms and their descriptions. Sampling - Principles - Types of sampling - Collection & preparation of samples. Drilling: Types of drills and methods of drilling. Geological logging. Explosives and Blasting Methods. Rock excavations. Assaying and evaluation of ore-bodies and their extensions-ore reserve estimation	12	CO1
II	Role of geology in mining industries - definition of mining terms, shaft, Hanging wall, Adit, roof, Drive crosscut, Tunnel, Raise, Winze, Stope, Ventilation, Haulage; Surface methods of mining, Alluvial mining - pan &betea, sluicing, Hydraulicking, Drift mining and Dredging. opencast mining. Benches, Explosives, working slope,	12	CO2
III	Mining equipments - Dragline, Mine machinery-power shovel, bucket wheel excavator, conveyor and spreader Top slicing. Sublevel caving and Block caving. Coal mining (surface mining) Strip mining and Augering- transportation -cleaning -Grading - Shipping.	12	CO3
IV	Underground mining. Room and pillar method- Longwall method- hydraulicking.	12	CO4

	Mineral Economics and its concept. Role of Minerals in National Economy.. Mineral conservation and substitution		
V	Types of mining- Glory hole, Kaolin mining, Granite mining, sand mining, stripping. Ground water control -Power source roofing - Mining and environment, Mitigation of mining hazards. Factors controlling the choice of various mining methods.	12	CO5
	Total	60	

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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 components of Structural Geology	PO1
CO2	Know the formations of geological formations	PO1, PO2
CO3	Basics of Aerial Photographs	PO4, PO6
CO4	Understand the Application of Satellite science	PO4, PO5, PO6
CO5	Analyse various physiographical features through GIS	PO3, PO8

Text Books
(Latest Editions)

1.	1. Curran, P (1988). Principles of remote sensing. Corgman Publishers, London Lillesand, T.M and R.W. Kiefer (2000). Remote sensing and image interpretation.
2.	John Wiley & Miller, V.C (1961). Photogeology. McGraw-Hill Publishers, New York
3.	. Pandey, S.N (1987). Principles and applications of photogeology. Wiley Eastern Ltd.,New Delhi
4.	Sabins, F.F (1987). Remote sensing principles and interpretation. Freeman Publishers,New York
5.	Siegal, B.S and R. Gillespie (1980). Remote sensing in Geology, John Wiley &Sons,New York

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

1.	Arogyaswamy, R.N.P. Courses in Mining Geology - Oxford &IBH, New Delhi.
2.	Thamus, P.J. 1979 An introduction to mining, Methun.
3.	Mc Kinstry, H.E 1960 Mining Geology, New york.
4.	Allum, J.A.E (1978). Photogeology and regional mapping, Pergamon Press Ltd., Oxford.
5.	Anji Reddy, M (2001). Textbook of remote sensing and GIS, BSP PS Publications, New Delhi
Web Resources	
1.	
2.	
3.	
4.	
5.	

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT05	GEOMORPHOLOGY AND GEOTECTONICS	Core	Y	-	-	-	4	5	25	75	100

Course Objectives			
CO1	Know the basics of Geotectonics and landforms		
CO2	Understand the importance of various geomorphological agencies		
CO3	Process of Geomorphological features and creation of landforms		
CO4	Understand and predict Earth's Internal and external processes		
CO5	Predict the future from the past formed features		
UNIT	Details	No. of Hours	Course Objectives
I	Interpretation of fluvial cycle - Landforms developed by running water – valley development, river capture, waterfalls, meandering, river terraces, Lakes, their types and deposits. Geological work of wind and Underground water.	12	CO1
II	Glaciers – formation, movement, types and landforms due to their erosional and transportational activity. Topography of ocean floor –erosional and depositional features of oceans – Coral reefs, types, theories for the origin of coral reefs – Submarine Canyons.	12	CO2
III	Mountains – their kinds, development and important mountain building movements. Processes of weathering – types and products- Mass Movements.	12	CO3
IV	Earthquakes – types – seismographs – intensity and Magnitude scales (Richter &Mercalli) –Tsunami-Global Distribution; Volcanoes – structure, types – products – Global Distribution .	12	CO4
V	Continental drift – Wegner Concept – various evidences. Plate tectonics – concept – plate characteristics – larger and smaller plates – types of plate boundaries – causes and mechanism of plate motions.	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	Know the basics of Geotectonics and landforms	PO1
CO2	Understand the importance of various geomorphological agencies	PO1, PO2
CO3	Process of Geomorphological features and creation of landforms	PO4, PO6
CO4	Understand and predict Earth's Internal and external processes	PO4, PO5, PO6
CO5	To fit the curve using geological data.	PO3, PO8
Text Books (Latest Editions)		
1.	Worcester ,P.G.,A Text Book of Geomorphology, East West Press Ltd.Delhi.(1960)	
2.	SathyaNarayanaswami,B.S. Structural Geology. DhanpatRai& Sons. New Delhi.(1994)	
3.	GokhaIe,N.W. , Theory of Structural Geology, CBS, Delhi(1995)	
4.	. Davis,G.H, Structural Geology of Rocks and Regions. Elements of Structural geology, Wiley(1985)	
5.	Ragan D.M., Structural Geology-An Introduction to geometrical Techniques. Wiley. New York(2000)	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	HiIIs E.S., Elements of Structural Geology, Chapman &Hall. London(1963)	
2.	Mahapatra G.B. Textbook of PhysicalGeology, CBS publications, Delhi(1994).	
3.	Park,P.G., Foundations of Structural Geology, BIackie. London (1983).	
4.	Radhakrishnan V, General Geology, V.V.P. Publications, Tuticorin(1996),	
5.	Bloom A., Principles of Geomorphology (1985).	
Web Resources		
1.	http://www.labotka.net	
2.	http://www.patnasciencecollege.org	
3.	https://geomorphology.org.uk	
4.	https://gradeup.co	
5.	https://www.nps.gov>subjects>gla	

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGESO02	Principles of Surveying (Entrepreneurship)	SEC	Y	-	-	-	2	2	25	75	100

Course Objectives	
CO1	To learn about the principles of surveying, sources and errors.
CO2	To know about the components and procedures of Prismatic Compass and Traverse survey.
CO3	Know about the levelling procedures, instruments and its applications.
CO4	Understand the principles, adjustments, methods of Plane Table Survey.
CO5	To acquire the knowledge about the Total Station Survey and its merits and demerits.

UNIT	Details	No. of Hours	Course Objectives
I	Surveying: Introduction – objectives – Uses - Classification –Principle of Surveying - Units of measurements – Errors – Sources, Types of errors and their corrections – accuracy and precision, Stages of survey operations – Methods of Linear Measurement – Distance measurement devices: Ranging rod, Chain, tape.	12	CO1
II	Measurement of Angles and Directions – Definitions - Meridians – Bearings – Magnetic and True bearings – Azimuth. Prismatic Compass: Components -Adjustment of the compass: Centering, Levelling, and focusing the prism. Traverse: Types of the traverse –procedures – Control establishments –Adjustment of closing error.	12	CO2
III	Levelling and its application: Introduction to Levelling – Methods - Types of instruments –Description of Dumpy level: Temporary adjustment of level. Auto levelling: Types – Parts – Operation – Merits and demerits.	12	CO3
IV	Table Surveying: Definition - Principles – Accessories – Temporary adjustments – Setting up the Plane Table - Methods of Plane table surveying: Radiation, Intersection, Traversing & Resection methods.	12	CO4

	Advantages, disadvantages and Errors in Plane Tabling.		
V	Total Station Survey: Introduction – Features: Linear, Angle and Height measurements – Accessories – Setting-up and orientation - Types of error and error correction – Advantages and disadvantages of TSS. Introduction to Drone Survey.	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	Gain the knowledge over principles, various errors and types of surveying.	PO1
CO2	Ability to know the measurement of angles and direction using Prismatic Compass survey.	PO1, PO2
CO3	Gaining knowledge about levelling instruments and its applications.	PO4, PO6
CO4	Complete understating the Plane Table survey.	PO4, PO5, PO6
CO5	Understand the concept of recent techniques of Total Station	PO3, PO8

Outcome Mapping

	PO1	PO2	PO3	PO4	PO5	PS01	PS02	PS03	PS04	PS05	PS06	PS07
CO1	√					√	√					
CO2	√						√					
CO5			√	√							√	√

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGESO05	**GEOHAZARDS**	SEC	Y	5	-	-	2	2	25	75	100
Course Objectives											
CO1	To explain students about thephysicalandgeological processes causing geo-hazards.										
CO2	To discuss themethods forquantifying geohazards.										
CO3	To understand the possible consequences aswell as risk and disastermanagement.										
CO4	Aware the geological and physical process wereto bediscussed.										

CO5	Differenttypesofgeohazards,disaster prevention and management.		
UNIT	**Details**	**No. of Hours**	**Course Objectives**
UNIT I	NaturalHazard– Definition-Earth'sprocesses:catastrophicgeologicalhazards:study of floods,tsunamis,Landslides,Earthquakes,Volcanismandavalanches–withaviewto assessthemagnitude oftheproblem,predictionandperceptionof thehazards.Lawsand regulations towards hazard management.	**12**	CO1
UNIT II	Earthquakes-Definition–focus-epicenter-seismicwaves-intensity andmagnitude-Richter scales–Tsunami-Seismograph-seismogram-seismicity inIndianregion-Seismicgaps- mitigation measuresandmanagement. Preparationof seismic hazardmap.	**12**	CO2
UNIT III	Volcanoes-Definition-structure - types–Globaldistribution- mitigationmeasuresand management.Avalanche –Definition–types–mitigation.-Definition- causes - vulnerable zones inIndia-Mitigation measures and management.Coastal erosion– its causes-mitigation measures andmanagement.	**12**	CO3
UNIT IV	Landslides-types-slowflowage,rapidflowage,sliding andsubsidence–causesand mechanism-Vulnerable zones inIndia-mitigation measures and management. Deforestation and land degradation-Cyclone- Definition-causes - vulnerable zones inIndia- mitigation measuresandmanagement.	**12**	CO4
UNIT V	Massmovement–factorinfluencing slopestability–typesofmassmovement–hazardsof massmovement–strategiesfor their reduction andthe role ofgeology. Soilerosion– Soil formation–soilclassification–factorinfluencing soilerosion–hazardsofsoilerosion–Drought– types, mitigation measures.	**12**	CO5

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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	Explain the physical andgeological processes causing geohazards such as landslides, floods, tsunamis and earthquakes.	PO1
CO2	Describemethods forquantifyinghazard forthe individual geohazards andfactors controllingtheiruncertainty.	PO1, PO2
CO3	Explain possible consequences ofgeohazardsas wellas risk and disaster management.	PO4, PO6
CO4	Complete abasic hazardassessment forselectedgeohazards.	PO4, PO5, PO6
CO5	Gain an additional knowledgeonpossible interactions betweengeohazardsandtheir consequences	PO3, PO8

Text Books

(Latest Editions)

1.	Geology,environment,SocietyK.S.Valdiya(2004)UniversitiesPress(India)Private Limited, Hyderabad,India
2.	CopingwithnaturalhazardsIndiancontextK.S.Valdiya(2004)OrientLongmanPrivate Limited, Hyderabad,India.
3.	Engineeringandgeneral geologyParbin Singh (2003)S.K.Katariaand sons DelhiIndia

References Books

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

1.	Genaral GeologyV.Radhakrishnan(1996)V.V.P.Publishers, Tuticorin,India.
2.	Lundgren (1986).Environment Geology, RenticeHall Publishers, New Jersey.

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:

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT06	STRUCTURAL GEOLOGY AND PHOTO GEOLOGY	Core	Y	-	-	-	5	5	25	75	100

Course Objectives	
CO1	Understand the basics components of Structural Geology
CO2	Know the formations of geological formations
CO3	Basics of Aerial Photographs
CO4	Understand the Application of Satellite science
CO5	Analyse various physiographical features through GIS

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 and GPS (Global Positioning System) and its uses.	12	CO1
II	Fold: Definition and parts of fold; classification of folds. Joints: Description and classification.Description and origin of foliations and lineations.	12	CO2
III	Fault: Definition and parts of fault; classification of faults – Horst – Graben – Nappe – Fenster – Klippe – overthrust. Unconformity: Definition – types of unconformity – inlier and outlier.	12	CO3
IV	Aerial Remote Sensing: Definition and scope of photogeology - Aerial photographs – types – geometry of aerial photographs – tip and tilt – nadir point – principal point – fiducial marks – scale of photographs – vertical exaggeration – Stereoscopy – pocket lens and mirror stereoscope - mosaics – controlled and uncontrolled.	12	CO4
V	Satellite Remote Sensing –Principles of Remote Sensing – Components of remote sensing system Electro Magnetic Radiations (EMR) – Satellites – Sensors and platforms – Indian and foreign Satellites.Introduction to Geographic Information System (GIS); components of GIS;	12	CO5

	productgeneration in GIS; tools for map analysis; integration of GIS and remote sensing		
	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 components of Structural Geology	PO1
CO2	Know the formations of geological formations	PO1, PO2
CO3	Basics of Aerial Photographs	PO4, PO6
CO4	Understand the Application of Satellite science	PO4, PO5, PO6
CO5	Analyse various physiographical features through GIS	PO3, PO8

Text Books (Latest Editions)	
1.	Structural geology, Billing. M.P. (1974), Prentice Hall, New Delhi
2.	An outline of Structural Geology, Hobbs, B.E., Means, W.D. and Williams, P.F. (1976):, John Wiley, New York.
3.	Curran P.B, Principles of Remote Sensing, ELBS. London(1985).
4.	Sabins F.F, Remote Sensing Principles and Interpretation. Freeman. New York(1974)
5.	Reddy A, Principles of Remote Sensing and GIS, CBS. Delhi(2010)

References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Basic Problems of GeotectonicsBelousov.V.V. (1962):, McGraw Hill, New York
2.	Structural GeologyDe Sitter. L.U. (1956):, McGraw Hill, New York
3.	Elements of Structural GeologyHill. E.S. (1972):, John Wiley, New York
4.	Aerial Photographic InterpretationLueder.D.R. (1959):, McGraw Hill, New York.
5.	LiIlisand T.M &R.W.Kiefer, Remote Sensing and Image Interpretation, WileDelhi(2000)

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)

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
23UGECP02	**Structural Geology, Remote Sensing and Survey Practical**	Core	Y	-	-	-	4	4	40	60	100

Course Objectives	
CO1	Understand the basics components of Structural Geology
CO2	Know the formations of geological formations
CO3	Basics of Aerial Photographs
CO4	Understand the Application of Satellite science
CO5	Analyse various physiographical features through GIS

UNIT	**Details**	**No. of Hours**	**Course Objectives**
I	Contour Maps and their interpretation – Exercises to find out trend of the outcrop of horizontal, vertical, inclined beds with respect to topography – Reading of solid,	12	CO1

	conformable maps – Deciphering dip and strike of outcrops - Completion of map when three points over a bedding plane are given – Determination of vertical thickness of formations.		
II	Reading of solid fold and fault maps – Determination of throw of faults – Construction of vertical sections – Reading of unconformable solid maps – Construction of sections – Reading of solid maps of areas with more than one structure and intrusion – Writing of geological history.	12	CO2
III	Solving of dip and strike problems by trignometrical method – Determination of true thickness of beds by calculations	12	CO3
IV	Interpretation of geomorphology, lithology and geological structures on aerial photographs. Visit to nearby geological organizations	12	CO4
V	Definition – Primary divisions – classification – Chain survey – description of instruments employed – chain traverse – Compass survey – description of prismatic compass – whole circle bearings – reduced bearings – quadrantal bearings – open traverse – closed traverse – finding distance between inaccessible stations – locating the instrument station - GPS - Clinometer compass – finding dip and strike of beds – Modern Surveying	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 components of Structural Geology	PO1
CO2	Know the formations of geological formations	PO1, PO2
CO3	Basics of Aerial Photographs	PO4, PO6
CO4	Understand the Application of Satellite science	PO4, PO5, PO6

CO5	Analyse various physiographical features through GIS	PO3, PO8
Text Books (Latest Editions)		
1.	GokhaIe,N.W. , Theory of Structural Geology, CBS, Delhi(1995)	
2.	Sathya Narayanaswami,B.S. Structural Geology. Dhanpat Rai & Sons. New Delhi.(1994)	
3.	LiIIisand T.M &R.W.Kiefer, Remote Sensing and Image Interpretation, WileDelhi(2000)	
4.	Reddy A, Principles of Remote Sensing and GIS, CBS. Delhi(2010)	
5.	Subramanian, Surveying and Levelling,Oxford University Press(2nd edition)	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Park,P.G., Foundations of Structural Geology, BIackie. London (1983).	
2.	Mahapatra G.B. Textbook of PhysicalGeology, CBS publications, Delhi(1994).	
3.	Ragan D.M., Structural Geology-An Introduction to geometrical Techniques. Wiley. New York(2000)	
4.	Guptha,R.P, Remote Sensing Geology, Springer New Delhi(2003)	
5.	T.P. Kanetkarand S.V .Kulkarni, Surveying and Levelling Vol. I and Vol. II, Pune Vidyarthi GrihaPrakashan 2006	
Web Resources		
1.	http://www.labotka.net	
2.	http://www.patnasciencecollege.org	
3.	www.wamis.org	
4.	www.sciencedirect.com>earth-and-planetaryh-sciences	
5.	https://www.geo.cornell.edu	

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGESO04	**FIELDHYDROGEOLOGYANDTECHNIQUES**	SEC	Y	-	-	-	2	2	25	75	100

Course Objectives			
CO1	Toimpartknowledgeof basicfieldhydrogeologyincludinggroundwaterorigin,occurrenceanddistribution.		
CO2	Totrainstudents onbasicsofCalculationofPorosityand Permeability, PumpTestdata, CalculationofGroundwaterFluctuations.		
CO3	Totrainstudentsonbasicsofwellhydraulics,methodofexploration,waterbudgetandmanagement.		
CO4	Toimparttheoretical,practicalandfieldknowledgepertainingtoHydrogeological domain.		
CO5	Tounderstandtherelationshipinbetweenwaterandrockinteractionandsaltwaterintrusionandits remedialmeasuresinthecoastalaquifers.		
UNIT	Details	No. of Hours	Course Objectives
I	**Importance of Hydrology** – Difference between Hydrogeology and Hydrology, WaterBearingGeologicformations.Groundwater ProvincesofTamilNadu.CollectionofRainfalldata.Short accountonThiessenPolygonIsohyetalmaps.	12	CO1
II	**Hydrogeologic Parameters:** Calculation of Porosity and Permeability, PumpTest data,CalculationofGroundwaterFluctuations.	12	CO2
III	**Wells**– WellInventorySurvey:Waterlevel,WaterlevelFluctuation,Subs urfaceLayers(Soil thickness, Weathered zone, Fractured zone, Bed rock) - Wellconstruction - Welllogging -	12	CO3

	Sedimentaryaquifers:Sandstone,limestone.		
IV	**Hardrock Aquifers:** Charnockites, Gneiss, Granite formation - Field observation andMeasurementofSoilmoisture zone, ZoneofAeration, Zone ofsaturation.	12	CO4
V	**Pumping Test:** Yield, Drawdown, Recuperation, Transmissivity,Permeability. Casestudies: Rainfall in Salem district, Groundwater condition in Salem district. Rain WaterHarvesting.	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		PO1
CO2		PO1, PO2
CO3		PO4, PO6
CO4		PO4, PO5, PO6
CO5		PO3, PO8

Text Books
(Latest Editions)

1.	ATextbook ofGroundwater–2000–P. Arul,DhanamAgency,99D,BazaarStreet,Virudachalam–606001.
2.	GroundwaterHydrology–1959–DavidK.Todd–JohnWilley&Sons,NewYork.Ragunath,H.M.1987,Groundwater,WileyEastern Ltd.,NewDelhi.
3.	
4.	
5.	

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

1.	

2.	
3.	
4.	
5.	
Web Resources	
1.	
2.	
3.	
4.	
5.	

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGESO05	**GEO-HERITAGE AND GEO-TOURISM**	SEC	-	Y	-	-	2	2	25	75	100

Course Objectives	
CO1	TounderstandtheimportanceofGeological Heritage.
CO2	To know about thelocationsofgeologicalsites
CO3	Toknowthegeo-tourisms in India.
CO4	To understand theimportance of fieldvisitstogeologicalsites.
CO5	To know the both geological and geomorphological heritage in India.

UNIT	Details	No. of Hours	Course Objectives
UNIT I	IntroductiontoHeritage -Geodiversity-Geoheritage.DefinitionandintroductiontoGeotourism.Geoconservation.ImportanceofstudyingGeologicalheritage.Geoheritagesite -meaning, distribution inTamilNadu.	**3h/week**	CO1
UNIT II	Geoheritage sites in Tamil Nadu- detailed study on their location, Geology, conservation and important features-Fossil wood near Tiruvakkarai,Nationalfossilwood park Sattanur, CharnockiteSt.ThomasMount,BadlandsofKarai-Kulakkalnatham.	**3h/week**	CO2
UNIT III	Geoheritage sites in South India- detailed study on their location, Geology conservation and theirimportantfeatures-Peninsulargneiss,LalbaghBotanicalGarden;ColumnarBasalt,CoconutIsland;Pillowlavas,ChitradurgaDistrict;PyroclasticrocksKolardistrict.Varkalacliffsection,Thiruvanantha puram;Volcanogenicbeddedbarytes,Cuddapah;EparchaeanUnconformity,Chittor;	**3h/week**	CO3
UNIT IV	Geoheritage sites in other than South India- detailed study on their location, Geology,	**3h/week**	CO4

	conservationandtheirimportantfeatures-StromatoliteFossilpark,Jamarkotra;Wood Park, Jaisalmer; Plant fossil-bearing inter-trappeanbedsofRajmahalFormation;LonarLake, BuldanaDist.Maharashtra.		
UNIT V	RecognitionofGeologicalandGeomorphologicalheritagein India.ImportanceofGeologyandgeographyintourism,natural andclimaticregionsofIndia.Importantplacesofattractionfor geologicalsites.	**3h/week**	CO5

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	Studentsgainknowledgeof the geologicalimportanceofthevariousplaces.	PO1
CO2	Students understand geoheritage and geotourism concepts.	PO1, PO2
CO3	Studentsunderstandtheimportanceoffieldvisitstogeologic almonuments.	PO4, PO6
CO4	They can know ideas about fossil wood and rock types.	PO4, PO5, PO6
CO5	Students understand the importance of geology and geography in tourism.	PO3, PO8

Text Books

(Latest Editions)

1.	Geologicalworldheritage:Aglobalframework-paulDingwall,TonyWeighellandTimBadman(2005)

2.	AmonographonNationalGeoheritagemonumentsofIndia(2016)-INTACH,NaturalHeritagedivision,NewDelhi.
References Books **(Latest editions, and the style as given below must be strictly adhered to)**	
1.	Tourism Geography (1998) Philip. G. National Publisher

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:

	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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT07	STRATIGRAPHY	Core	Y	-	-	-	5	6	25	75	100
Course Objectives											
CO1	Understand the basic of Historical Geology										
CO2	Know the Important group of Stratigraphic systems										
CO3	Know various economic importance of various periods										
CO4	Understand the various rocks of different periods from the formation of Earth										
CO5	Present is the Key to the Past – Critical Analyse										
UNIT	Details						No. of Hours		Course Objectives		
I	General Stratigraphy: Principles of Stratigraphy, – Time units – Time rock units – Standard Geological Time scale. INDIAN STRATIGRAPHY: ARCHAEAN: DharwarSupergroup – Champian Gneiss – Peninsular Gneiss – Closepet Granite- Sakoli Series – Saucer Series – Bundelkhand Gneiss – Banded gneissic complex – AravalliSupergroup – Raiolo Series - Singhbhum Iron ore Series – Singhbhum copper belt shear zone – Newer Dolerite – Mineral riches of Archaean.						12		CO1		
II	PROTEROZOIC: CuddapahSupergroup – Kaladgi series – Delhi Supergroup – Erinpura Granite – Malani Igneous suite – Hazara slates – Attock slates – Dogra Slates – Mineral riches of Cuddapah–VindyanSupergroup – Kurnool Supergroup – Bhima Series – Mineral riches of Vindhyan.						12		CO2		
III	PALAEOZOIC: Cambrian of Salt range – Age of Saline series – Haimanta System – MuthQuartzites – Kanawar System – FenestellaShales – Kuling System – Everest Limestone – Panjal Volcanic Series. GondwanaSupergroup – Climate and Sedimentation – Classification – Lithology – Fossil contents – Distribution of Coal Deposits.						12		CO3		
IV	MESOZOIC: Triassic of Spiti – Succession and fossil contents Jurassic of Kutch – Succession and fossil content – Cretaceous of Tiruchirapalli and						12		CO4		

	Baghbeds.CENOZOIC: Deccan traps – Age – Distribution – Petrology – Lametabeds – Infratrappean and Intertrappean beds		
V	Tertiary of Assam and TamilnaduSiwalikSupergroup – Varkala and Quilon beds of Kerala – Tertiary of Cambay a Karewa formation – Rise of Himalayas- Pleistocene Glaciation – Indo-Gangetic alluvium – Laterite.	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 basic of Historical Geology	PO1
CO2	Know the Important group of Stratigraphic systems	PO1, PO2
CO3	Know various economic importance of various periods	PO4, PO6
CO4	Understand the various rocks of different periods from the formation of Earth	PO4, PO5, PO6
CO5	Present is the Key to the Past – Critical Analyse	PO3, PO8

Text Books
(Latest Editions)

1.	Geology of India and BurmaM.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
(Latest editions, and the style as given below must be strictly adhered to)

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT08	MINERALOGY	Core	Y	-	-	-	5	7	25	75	100
Course Objectives											
CO1	Understand the basics of Minerals										
CO2	Understand the importance of Minerals in Geological studies										
CO3	Know different group of minerals systems										
CO4	Understand the descriptive mineralogy of different groups										
CO5	Understand the importance of Minerals and mineralogical studies										

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	12	CO5

	mineral groups: - Amphibole and Pyroxene. Mica and Chlorite groups – Serpentine – Kaolin- Talc and Steatite - . Zircon – Sphene – Topaz – Andalusite – Sillimanite – Kyanite – Staurolite - Rutile – Calcite – Dolomite – Apatite – Fluorite.		
	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 Minerals	PO1
CO2	Understand the importance of Minerals in Geological studies	PO1, PO2
CO3	Know different group of minerals systems	PO4, PO6
CO4	Understand the descriptive mineralogy of different groups	PO4, PO5, PO6
CO5	Understand the importance of Minerals and mineralogical studies	PO3, PO8

Text Books(Latest Editions)

1.	A Text book of Mineralogy , E.S. Dana, (2000) CBS Publishers & Distributors, New Delhi.
2.	Rutley's Elements of Mineralogy, C.D. Gribble, (1991), CBS Publishers and Distributors, New Delhi.
3.	Wenk,H.R&A. Bulakh, Minerals, Cambridge University Press,New Delhi(2006)
4.	Perkins D, 3rd ed. Prentice Hall India, NewDelhi(2010)
5.	HaIdar,S.K.&J.Tisjlar, Introduction to Mineralogy and Petrology, Elsevier,(2014)

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

1.	Dana's Manual of Mineralogy, C. Hurlbut, John Wiley & Sons, New York
2.	Optical Mineralogy, P.F. Kerr, (1959), McGraw Hill Book company, New York.
3.	An Introduction to Rock forming Minerals, Deer, Howie and Hussmann, (1982), 2nd Edit., Orient Longman, London.
4.	Deer,W.A.,R.A.Howie&J.Zussman. An Introduction to the Rock-Forming Minerals. ELBS.London(1992)
5.	Berry L.G.,B.Mason&R.V. Dietrich, Mineralogy, CBS New Delhi (1985).

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

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT09	IGNEOUS PETROLOGY	Core	Y	-	-	-	5	6	25	75	100

Course Objectives	
CO1	Understand the basic Petrology
CO2	Know the textures and micro-structures
CO3	Know composition of magma and various system of rock formation
CO4	Understand the Petrographical characters of rocks
CO5	Analyse Origin of various rock types

UNIT	Details	No. of Hours	Course Objectives
I	UNIT 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 (Tyrell and Streikeisen).chemical classification, CIPW classification, Tabular classification	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 Granites, Diorites, Syenites, Gabbros, Dolerite, Basalt, Pegmatites, Aplites and Lamprophyres.	12	CO4
V	Origin of igneous rocks - Differentiation – Assimilation, - Petrography of special rock types, Anorthosite and Carbonatites.	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 basic Petrology	PO1
CO2	Know the textures and micro-structures	PO1, PO2
CO3	Know composition of magma and various system of rock formation	PO4, PO6
CO4	Understand the Petrographical characters of rocks	PO4, PO5, PO6
CO5	Analyse Origin of various rock types	PO3, PO8
Text Books (Latest Editions)		
1.	Best,M.G,Igneous and Metamorphic Petrology, Wiley.New Delhi(2003)	
2.	McbirneyA.R,Igneous Petrology, CBSNew Delhi(1993)	
3.	Best M.G,IgneousPetrology.Wiley.NewDelhi(2005)	
4.	Hatch,F.H. et al,Petrology of the Igneous Rooks, CBSDelhi.	
5.	Hyndman D.W, Petrology of the Igneous and Metamorphic Rocks McGrawHill.NewYork(1985)	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	TyreII,G.W,Principles of Petrology, B.I.Publications New Delhi(1958)	
2.	Haung,W.T, Petrology, McGrawHill. New York (1962)	
3.	Winter,J.D,Principles of Igneous and Metamorphic Petrology, PHI.New	
4.	Middlemost E.A.K,Magmas and Magmatic Rocks.Longman UK(1985)	
5.	Winkler,H.G.F, Petrology of the Metamorphic Rocks. Springer,New Delhi(1970)	
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	

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT10	SEDIMENTARY AND METAMORPHIC PETROLOGY	Core	Y	-	-	-	5	7	25	75	100

Course Objectives			
CO1	Understand the basic Petrology		
CO2	Know the macro and micro-structures		
CO3	Know various agents of sedimentary and metamorphic petrology		
CO4	Understand the Petrographical characters of rocks		
CO5	Analyse Origin of various rock types		
UNIT	Details	No. of Hours	Course Objectives
I	Classification (Tyrrel and Pettijohn) – Structures – Descriptive Petrography of Residual sediments.	12	CO1
II	Descriptive Petrography of clastic - Arenaceous, Argillaceous and Rudaceous - Chemical and Organic deposits.	12	CO2
III	Definition – Agents and kinds of metamorphism – structure and textures – Depth zones – A brief study of Facies and grades.	12	CO3
IV	Cataclastic metamorphism and its products, thermal and dynamothermal metamorphism on QuartzoFelspathic, argillaceous, calcareous and basic igneous rocks.	12	CO4
V	Plutonic metamorphism on Quartzo-felspathic, argillaceous, calcareous and basic igneous rocks – Charnockites – Metasomatism – A brief account of migmatites – Anatexis and palingenesis and retrogressive metamorphism.	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 basic Petrology	PO1
CO2	Know the macro and micro-structures	PO1, PO2
CO3	Know various agents of sedimentary and metamorphic petrology	PO4, PO6
CO4	Understand the Petrographical characters of rocks	PO4, PO5, PO6
CO5	Analyse Origin of various rock types	PO3, PO8
Text Books (Latest Editions)		
1.	Principles of Petrology , G.W. Tyrrel, (1985), C.B.S Publishers and Distributors, Delhi	
2.	Petrology for sediments, S.R. Nockolds, R.W.O.Knott& G.A Chinner, (1979), Cambridge University Press, London.	
3.	Green smith J.T, Petrology of the Sedimentary Rocks, CBS.Delhi(1976).	
4.	WiIliams,H. et al, Petrography, CBS.New Delhi(1982)	
5.	Haung,W.T, Petrology,McGraw Hill. New York(1962)	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Metamorphism, B. Baskar Rao, (1986), Oxford I.B.D., New Delhi.	
2.	Petrography, H.William, F.J. Turner & C.M. Gilbert, (1954) San Francisco.	
3.	Introduction to Sedimentology, Sengupta.S.M, (2007), CBS Publishers & Distributors, New Delhi.	
4.	TyreII,G.W,Principles of Petrology, B.I.Publications. NewDelhi(1958)	
5.	FoIk,R.L, Petrology of the Sedimentary Rocks. Hemphill.Texas.USA(1974)	
Web Resources		
1.	https://www.britannica.com/science/geology/sedimentary-petrology	
2.	https://limk.springer.com/chapter/10	
3.	https://www.geo.mtu.edu/UPSeis/hazards.html	
4.	https://www.omafra.gov.on.ca/english/engineer/facts/	
5.	https://geology.com/rocks/rock-salt.shtml	

- 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)

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGEEM01	Hydrogeology	Elective	Y	-	-	-	3	4	25	75	100

Course Objectives			
CO1	Understand the basics components of Structural Geology		
CO2	Know the formations of geological formations		
CO3	Basics of Aerial Photographs		
CO4	Understand the Application of Satellite science		
CO5	Analyse various physiographical features through GIS		
UNIT	Details	No. of Hours	Course Objectives
I	Origin of Water- Water resources – Categorization of water resources - Surface water resources from Dams and Lakes. Hydrologic cycle – Various components of hydrological cycle – Precipitation, Run-off, Infiltration, Evaporation and transportation - Rain gauges and their distribution.	12	CO1
II	Groundwater occurrence and movement – Aquifers –	12	CO2

	Definition and Different types of aquifer – Spring and its types. Hydrogeological Properties of rocks .Basic Principles of groundwater exploration.		
III	Rock properties affectinggroundwater. Types of Openings, Porosity, Specific yield, Specific retention and Permeability. Determination of permeability in field and lab. Groundwater movement – Darcy's law and its applications – Groundwater occurrence in Igneous, Sedimentary and Metamorphic rocks.	12	CO3
IV	Groundwater investigation-Electrical Resistivity Methods: Wenner's and Schlumberger's electrode arrangements. Wells and their types, Basic concept, Ground water potential of India and Tamil Nadu. Well design and development- Fluctuations of groundwater - Groundwater recharge methods. Suitability for drinking and irrigation purposes - Seawater intrusion: Causes, Consequences and Preventive and Control measures.	12	CO4
V	Running water – source – weathering, erosion, transportation and deposition – process and its features – Water Shed Management. Rainwater harvesting – Definition, method and their importance	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 components of Structural	PO1

	Geology	
CO2	Know the formations of geological formations	PO1, PO2
CO3	Basics of Aerial Photographs	PO4, PO6
CO4	Understand the Application of Satellite science	PO4, PO5, PO6
CO5	Analyse various physiographical features through GIS	PO3, PO8
Text Books (Latest Editions)		
1.	Alley.W.M. 1993. Regional groundwater quality – VNR- New York.	
2.	Arul P. 2000 A text book of Ground water, 1st Edition, 105 – 122	
3.	Bouwer, H., 1978, Groundwater Hydrology,McGraw-Hill Book co.,NY	
4.	Bell, F.G. (2005), Fundamentals of Engineering Geology, B.S. Publications Hyderabad.	
5.	Krynine, P.D.& W.R. Judd (1956), Principles of Engineering Geology& Geotechnics, CBS, Delhi	
6.	Legget, R.F.& A.W. Hatheway (1988), Geology and Engineering. 3rdEd. McGraw Hill, New York.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Davies, S.N., & Dewilest, R.J.M., 1966, Hydrogeology, John Wiley & Sons Inc., N	
2.	Fetter.C.W. 1990. Applied Hydrology. Merill Publishing.	
3.	Karanth.K.R. 1987. Groundwater assessments and management – Tata Mc-graw Hall	
4.	M. Raghunath 2007 Ground Water, New Age International , 520p	
5.		
Web Resources		
1.		
2.		
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4.		
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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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGEEM02	REMOTE SENSING AND GIS	Elective	Y	-	-	-	3	4	25	75	100

Course Objectives			
CO1	To impart knowledge and applications of remote sensing and GIS in Geology		
CO2	To learnbasic of aerial remote sensing and its applications.		
CO3	To understand the physics of electromagnetic spectrum and learn satellite remotesensing.		
CO4	To have training in GIS components, models and applications		
CO5			
UNIT	Details	No. of Hours	Course Objectives
I	Definition and Types: Aerial, Satellite and Radar, Development of Space Programmes - History and Organization Associated with Remote Sensing in India and in other Countries.	12	CO1
II	Remote Sensing: Sources of Energy, Electromagnetic Radiations (EMR) Atmospheric Windows, Energy Interaction with Atmosphere and Earth. Types of Platforms: Active and Passive. Remote Sensing Methods, Ideal Remote Sensing Systems.	12	CO2

III	Fundamentals of Aerial Remote Sensing: Components of Aerial Camera,Types of Aerial Photographs, Marginal Information of Aerial Photographs, Elements of Photo Interpretation.	12	CO3
IV	Fundamentals of Satellite Remote Sensing: Types of Satellites: Geo-Stationaryand Sun-Synchronous Satellites, Resolution: Spatial, Spectral, Radiometric and Temporal, Types of Data Products, Marginal Information of Satellite Images.	12	CO4
V	Geographical Information Systems (GIS) Meaning- Developments-Raster andVector Data-Data Integration-Global Positioning System (GPS) Advantages and Limitations of GIS and GPS.	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	To impart knowledge and applications of remote sensing and GIS in Geology.	PO1
CO2	To learn basic of aerial remote sensing and its applications.	PO1, PO2
CO3	To understand the physics of electromagnetic spectrum and learn satellite remotesensing.	PO4, PO6
CO4	Understand the Application of Satellite science	PO4, PO5, PO6
CO5	Analyse various physiographical features through GIS	PO3, PO8

Text Books
(Latest Editions)

1.	
2.	
3.	
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5.	
6.	
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	Curran,P.B.(1985). Principles of Remote Sensing. ELBS,London.
2.	Drury,S.D.(1993). Image Interpretation in Geology. Allen & Unwin, London.
3.	Barret, E.C. and Curtie, L.F. (1990), Introduction to Environmental Remote Sensing,Chapman and Hall, London.
4.	Cambell, James B. (1987), Introduction to Remote Sensing, The Guilford Press, NewYork.
5.	Lillesand, T. M. and Kieper (1987), Remote Sensing and Image Interpretation, JohnWillyand Sons, New York.
Web Resources	
1.	
2.	
3.	
4.	
5.	

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Internship / Industrial Visit / Field Visit		Y	-	-	-	2	-	25	75	100

Course Objectives	
CO1	The students will enhance their writing skills.
CO2	They will acquire knowledge about writing their assignments.
CO3	They will delve into unchartered territory with regard to Scientific/Technical writing of research papers/reports.
CO4	The students will understand what is Bibliography, how to cite references and how to quote them in the text.
CO5	They will be trained in how to avoid redundancies, which constitute a major problem while writing a Scientific Paper/Technical Report.

UNIT	Details	No. of Hours	Course Objectives
I	Students will be taken to various mines and mineral exploration industries across the country to gain first hand field experience on various mining methods, R&D activities in mineral exploration, interaction with subject experts in various industries and organizations involved in mineral exploration activities.	12	CO1
	Total		

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	The students will enhance their writing skills.	PO1
CO2	They will acquire knowledge about writing their assignments.	PO1, PO2
CO3	They will delve into unchartered territory with regard to	PO4, PO6

	Scientific/Technical writing of research papers/reports.	
CO4	The students will understand what is Bibliography, how to cite references and how to quote them in the text.	PO4, PO5, PO6
CO5	They will be trained in how to avoid redundancies, which constitute a major problem while writing a Scientific Paper/Technical Report.	PO3, PO8
Text Books (Latest Editions)		
1.	Best,M.G,Igneous and Metamorphic Petrology, Wiley.New Delhi(2003)	
2.	McbirneyA.R,Igneous Petrology, CBSNew Delhi(1993)	
3.	Best M.G,Igneous Petrology.Wiley.NewDelhi(2005)	
4.	Hatch,F.H. et al,Petrology of the Igneous Rooks, CBSDelhi.	
5.	Hyndman D.W, Petrology of the Igneous and Metamorphic Rocks McGrawHill.NewYork(1985)	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	TyreII,G.W,Principles of Petrology, B.I.Publications New Delhi(1958)	
2.	Haung,W.T, Petrology, McGrawHill. New York (1962)	
3.	Winter,J.D,Principles of Igneous and Metamorphic Petrology, PHI.New	
4.	Middlemost E.A.K,Magmas and Magmatic Rocks.Longman UK(1985)	
5.	Winkler,H.G.F, Petrology of the Metamorphic Rocks. Springer,New Delhi(1970)	
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	

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 - VI

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECT11	REGIONAL GEOLOGY	Core	Y	-	-	-	4	6	25	75	100

Course Objectives			
CO1	Understand various Geological formations at Regional Scale		
CO2	Know the Important Stratigraphic landforms		
CO3	Know various economic importance of regional geology		
CO4	Know the mode of occurrence and uses of minerals		
CO5	To predict mineral formations in an unknown region.		
UNIT	Details	No. of Hours	Course Objectives
I	Geomorphology: Tectonic and Shear Zones of Tamil Nadu -Physiography – The Western and Eastern Ghats of Tamil Nadu and their structural aspects. The Cauvery and Tambraparani Rivers – Soil types of Tamil Nadu.	12	CO1
II	Archaean Group – Anorthosites of Sittampundi, Kadavur and Oddanchatram – Alkali Rocks of Sivanmalai, Cordierite Sillimanite rocks of Trichy and Madurai, Charnockites of Pallavaram-Thiruttani Dyke swarms.	12	CO2
III	GondwanaSupergroup – 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	12	CO4

	of occurrence & distribution of precious and Semi - precious stones in Tamil Nadu. Distribution of commercial granites, Heavy mineral sands (Zircon, Rutile, Ilmenite and Garnet) and Thorium deposits of Manavalakurichi in Tamil Nadu.		
V	Mode of occurrence, uses, origin, and distribution in Tamil Nadu of the followings mineral deposit: Iron ores of Kanjamalai, Gauthimalai; 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.	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 basic of Historical Geology	PO1
CO2	Know the Important group of Stratigraphic systems	PO1, PO2
CO3	Know various economic importance of various periods	PO4, PO6
CO4	Understand the various rocks of different periods from the formation of Earth	PO4, PO5, PO6
CO5	Present is the Key to the Past – Critical Analyse	PO3, PO8

Text Books(Latest Editions)

1.	Geology of India and BurmaM.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.	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).
5.	Kumar R,Fundamentals of Historical Geology and Stratigraphy of

	India,WiIey.New Delhi (1988).
References Books (Latest editions, and the style as given below must be strictly adhered to)	
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.	Wadia,D.N, Geology of India, McMillan India Delhi(1953)
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)

Subject Code	Subject Name	Category	L	T	P	S	Credit	Hours	Marks

									CIA	External	Total
23UGECT12	ECONOMIC GEOLOGY AND MINERAL ECONOMICS	Core	Y	-	-	-	4	6	25	75	100
Course Objectives											
CO1	Understand basics of Economic minerals										
CO2	Know the various process of mineral formation										
CO3	Know the various mode of mineral deposits										
CO4	Know the physical and chemical characters of minerals										
CO5	To understand various uses of minerals										

UNIT	Details	No. of Hours	Course Objectives
I	Definition of ore, tenor, grade and metallic and non-metallic minerals.Geologic thermometry –– Classification of ore deposits, (Lindgren and Bateman).Process of mineral formations – magmatic concentration – sublimation, contact metasomatism- Hydrothermal process – sedimentation – evaporation.	12	CO1
II	Processes of mineral formation: Residual and mechanical concentration – Oxidation and supergene sulphide enrichment – metamorphism. Coal deposits: Use, origin, Mode of Occurrence, distribution in India.Petroleum deposits: Origin and distribution in India.- Mineralogy, origin, mode of occurrence, uses and distribution in India of the following: - Gold Deposits, Iron deposits, and copper deposits.	12	CO2
III	Mineralogy, origin, mode of occurrence, uses and distribution in India of the following: - manganese deposits, lead and zinc deposits, bauxite deposits and chromite deposits. Granite Industry I: Building stones – properties – cost, color, durability, crushing strength, transverse strength, absorption, density, frost and fire resistance, structural features, texture.Important building stones, physical and chemical properties and uses of granite, marble, limestone, sandstone, slate.Classificationof commercial granites in pre-cambrian terrain of south India.	12	CO3
IV	Physical properties, chemical composition, mode of	12	CO4

	occurrence and distribution in India of minerals required for the following industries: – Abrasives, fertilizers and refractory.Descriptive mineralogy, Mode of occurrence, uses, distribution in India of the following ores and industrial minerals: realgar, orpiment, cinnabar, fluorite, ilmenite, rutile, graphite, magnesite, asbestos and chrysotile.		
V	Granite Industry II: Granite blocks - 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, marketability, Resource estimation	12	CO5
	Total	60	

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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 Minerals	PO1
CO2	Understand the importance of Minerals in Geological studies	PO1, PO2
CO3	Know different group of minerals systems	PO4, PO6
CO4	Understand the descriptive mineralogy of different groups	PO4, PO5, PO6
CO5	Understand the importance of Minerals and mineralogical studies	PO3, PO8

Text Books
(Latest Editions)

1.	Economic Mineral deposits, Bateman, A.N. (1981), Asian publishers House, New Delhi
2.	Economic Geology – Economic Mineral Deposits, Umeshwar Prasad, (2010), CBS Pub. &Dist, New Delhi
3.	KrishnasamyS,India'sMineralResources, Oxford &IBH. Delhi(1988)

4.	SharmaN.L&R.K.Sinha. MineralEconomics, Oxford &IBH.Delhi(1985)
5.	Prasad U, EconomicMineralDeposits, CBS.Delhi(2003)
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	India's Mineral Resoruces, Krishnaswamy.S revised by Shina, R.K, (1986), III Edi., Oxford & IBH Pub., Co., Ltd., New Delhi
2.	Introduction to Indian Economic minerals, Sharma, N.L and Ram, K.S.V.,(1970), Dhanbad publications, Dhanbad.
3.	Industrial Minerals ,Sinha,R.K,(1986), Oxford 7 IBH Pub. Co., New Delhi.
4.	Craig,R.C& D.V. Vaughan. Ore Microscopy and Ore Petrography. Wiley. New York.(1985)
5.	Aiyengar, N.K.N, Minerals of Madras, Dept.of Industries &Commerce. Guindy, Madras, (1964).
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/

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)

Subject Code	Subject Name	Category	L	T	P	S	Credit	Hours	Marks

									CIA	External	Total
23UGECT13	APPLIED GEOLOGY	Core	Y	-	-	-	4	6	25	75	100
Course Objectives											
CO1	Understand basics of Hydrological Cycle										
CO2	Know the various hydrological parameters										
CO3	Know the various water bearing formations										
CO4	Know the application of Geological methods in groundwater investigations										
CO5	To explore groundwater regime through various geophysical methods										

UNIT	Details	No. of Hours	Course Objectives
I	Engineering Geology: Dams, Reservoirs and Tunnels – Brief description of the types of dam, Reservoir, spillways, Tunnels, bridges and highways. Engineering properties of Rocks: Porosity – permeability – elasticity characteristics of rocks.	12	CO1
II	Environmental Geology: Environmental science – Introduction; Environmental impacts due to mining and mineral process. A short account of renewable and non-renewable resources.Effects of urbanization on surface and subsurface water- causes for ground water pollution.	12	CO2
III	Hydrologic cycle – origin of water – meteoric, juvenile, magmatic and seawaters;Hydrological parameters - Precipitation, evaporation, transpiration and infiltration.vertical distribution of ground water,Springs and its types; Porosity and permeability.specific yield, specific retention. Aquifer, aquitard, aquifuge and aquiclude– Classifications of aquifers.Ground water movements – Darcy's law.Specific yield and specific retention.Water Level fluctuation and its causes.Ground water quality – Physical and chemical properties of water, quality criteria for different uses.	12	CO3
IV	Concepts of drainage basin and ground water provinces of India.A short account of ground water basins in Tamil Nadu.-Ground water exploration- Dowsing- – Brief out line of various methods of groundwater exploration.	12	CO4

V	Geological Method – Identification of formations and structure favorable for movement and storage of groundwater water. Geophysical Methods- Surface and Subsurface methods.Electrical resistivity method – Wenner Method – Schlumberger Method.Field Data interpretation – Curve matching and inverse slope method.	12	CO5
	Total	60	

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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 basics of Hydrological Cycle	PO1
CO2	Know the various hydrological parameters	PO1, PO2
CO3	Know the various water bearing formations	PO4, PO6
CO4	Know the application of Geological methods in groundwater investigations	PO4, PO5, PO6
CO5	To explore groundwater regime through various geophysical methods	PO3, PO8

Text Books
(Latest Editions)

1.	Outlines of Geophysical Prospecting - A manual for geologists by RamachandraRao, M.B.,Prasaranga, University of Mysore, Mysore, 1975.
2.	Groundwater Hydrology, Todd.D.K. (1980) John Wiley Sons, Inc
3.	Coppola D.P, Introduction to International Disaster Management, Butterworth Heinemann(2007)
4.	Pine,J.C, Natural Hazards Analysis: Reducing the Impact of Disasters, CRC Press, Taylor and Francis Group(2009)
5.	Smith K, Environmental Hazards: Assessing Risk and Reducing Disaster Rout ledge Press(2001)

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

1.	Groundwater Drilling, Handa.O.P (1984) Oxford & I.B.H. Publishing Co.

2.	Groundwater, Raghunath.H.M. (1987) 2nd Edition, Wiley Eastern Ltd.
3.	Groundwater Assessment Development and Management, Karanth.K.R. (1987) Tata McGraw Hill Publishing Company, Ltd.
4.	Miller T.G. Environmental Science. Wadsworth Publishing.US(2004).
5.	Coates,D.R. Environmental Geology. McGraw Hill.NewYork(1984)
Web Resources	
1.	https://www.britannica.com/science/geology/sedimentary-petrology
2.	https://limk.springer.com/chapter/10
3.	https://www.geo.mtu.edu/UPSeis/hazards.html
4.	https://www.omafra.gov.on.ca/english/engineer/facts/
5.	https://geology.com/rocks/rock-salt.shtml

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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECP03	MINERALOGY ANDPETROLOGY PRACTICAL	Core	Y	-	-	-	3	5	40	60	100

Course Objectives	
CO1	Understand the basic Petrology
CO2	Know the macro and micro-structures
CO3	Know various agents of sedimentary and metamorphic petrology
CO4	Understand the Petrographical characters of rocks
CO5	Analyse Origin of various rock types

UNIT	Details	No. of Hours	Course Objectives
I	Megascopic identification and description of the following: quartz, chalcedony, opal, agate, flint, jasper, amethyst, rose quartz, orthoclase, microcline, albite, oligoclase, labradorite, adularia, sanidine, nepheline, sodalite, lapislazuli, hornblende, Actinolite, tremolite, enstatite, bronzite, hypersthene, augite, olivine, serpentine, muscovite, biotite, phlogopite, lepidolite, vermiculite, chlorite, epidote, garnet, apophyllite, stilbite, heulandite, talc, steatite, beryl, kaolin, cordierite, apatite, andalusite, staurolite, sillimanite, kyanite, tourmaline, topaz, calcite, dolomite and fluorspar.	12	CO1
II	Microscopic identification and description of the following: quartz, orthoclase, albite, oligoclase, andesine, labradorite, anorthite, nepheline, leucite, sodalite, hypersthene, augite, diopside, aegerine, hornblende, tremolite, actinolite, glaucophane, riebeckite, muscovite, biotite, phlogopite, olivine, serpentine, chlorite, epidote, garnet, apatite, zircon, sphene, magnetite, tourmaline, calcite, dolomite, andalusite, staurolite, sillimanite and cordierite.	12	CO2
III	Megascopic identification and description of the following rocks: granite, graphic granite, pegmatite, aplite, orbicular granite, schorl rock, tourmaline rock, granite porphyry, Syenite, dolerite, gabbro, anorthosite,	12	CO3

	olivine, gabbro, dunite, pyroxenite, norite, dolerite porphyry, basalt, trachyte, rhyolite, vitrophyre, obsidian, pumice, scoria, pitchstone, volcanic tuff and volcanic breccia.		
IV	Megascopic identification and description of the following: conglomerate, breccia, laterite, sandstone, arkose, greywacke, grit, shales, limestones, chert, flint, peat, bituminous coal, anthracite, lignite, chalk, gneisses, schist, phyllite, slates, quartzite, marble, ophicalcite, itabirite, jaspillite, quartz-magnetite rock, amphibolite, eclogite, leptynite, khondalite, kodurite, gondite, charnockite, calc granulite and basic granulite.	12	CO4
V	Microscopic identification and description of the following: mica granite, hornblende granite, tourmaline granite, schorl rock, aplite, graphic granite, quartz syenite, mica syenite, hornblende syenite, nephelinesyenite, quartz diorite, hornblende diorite, olivine gabbro, hypersthene gabbro, troctolite, dunite, peridotite granite porphyry; syenite porphyry, diorite porphyry, quartz porphyry, dolerite, minette, anorthosite, rhyolite, trachyte, andesite, basalt, leucite, phonolite, nosean, and volcanic breccia.	12	CO5
	Total	60	

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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 basic Petrology	PO1
CO2	Know the macro and micro-structures	PO1, PO2
CO3	Know various agents of sedimentary and metamorphic petrology	PO4, PO6
CO4	Understand the Petrographical characters of rocks	PO4, PO5, PO6
CO5	Analyse Origin of various rock types	PO3, PO8

Text Books(Latest Editions)	
1.	Economic Mineral deposits, Bateman, A.N. (1981), Asian publishers House, New

	Delhi
2.	Economic Geology – Economic Mineral Deposits, Umeshwar Prasad, (2010), CBS Pub. &Dist, New Delhi
3.	KrishnasamyS,India'sMineralResources, Oxford &IBH. Delhi(1988)
4.	SharmaN.L&R.K.Sinha. MineralEconomics, Oxford &IBH.Delhi(1985)
5.	Prasad U, EconomicMineralDeposits, CBS.Delhi(2003)
References Books (Latest editions, and the style as given below must be strictly adhered to)	
1.	India's Mineral Resoruces, Krishnaswamy.S revised by Shina, R.K, (1986), III Edi., Oxford & IBH Pub., Co., Ltd., New Delhi
2.	Introduction to Indian Economic minerals, Sharma, N.L and Ram, K.S.V.,(1970), Dhanbad publications, Dhanbad.
3.	Industrial Minerals ,Sinha,R.K,(1986), Oxford 7 IBH Pub. Co., New Delhi.
4.	Craig,R.C& D.V. Vaughan. Ore Microscopy and Ore Petrography. Wiley. New York.(1985)
5.	Aiyengar, N.K.N, Minerals of Madras, Dept.of Industries &Commerce. Guindy, Madras, (1964).
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/

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGECP04	ECONOMIC GEOLOGY AND ORE ANALYSIS PRACTICAL	CORE	Y	-	-	-	3	5	40	60	100

Course Objectives	
CO1	Understand the basics of Minerals
CO2	Understand the importance of Minerals in Geological studies
CO3	Know different group of minerals systems
CO4	Understand the descriptive mineralogy of different groups
CO5	Understand the importance of Minerals and mineralogical studies

UNIT	Details	No. of Hours	Course Objectives
I	Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following ores: galena, anglesite, cerrusite, sphalerite, zincite, willemite, bornite, azurite, chalcopyrite, cuprite, malachite.	12	CO1
II	Megascopic identification, description of visible characteristics, mode of occurrence and uses of the following ores: haematite, magnetite, siderite, goethite, pyrolusite, psilomelane, rhodochrosite, rhodonite, chromite, cinnabar, bauxite, realgar, orpiment, stibnite, molybdenite, pyrite, coal and its varieties.	12	CO2
III	Megascopic identification and description of: monazite, samarskite, columbite, tantalite, beryl, zircon, Megascopic identification and description of the following minerals used for industrial purposes – magnesite, calcite, dolomite, gypsum, strontianite, celestite, fluorite,apatite.	12	CO3
IV	Megascopic identification and description of the following minerals used for industrial purposes: barite, witherite, limonite, asbestos, quartz, feldspar, kaolin, garnet, rutile and ilmenite.	12	CO4
V	Identification of the following mineral powders by blowpipe methods: galena, chalcopyrite, haematite, magnetite, celestite, strontianite, witherite, gypsum, bauxite, apatite, pyrite, siderite, orpiment, realgar,	12	CO5

	calcite, psilomelane, rhodochrosite, smithsonite and ilmenite.		
	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 Minerals	
CO2	Understand the importance of Minerals in Geological studies	
CO3	Know different group of minerals systems	
CO4	Understand the descriptive mineralogy of different groups	
CO5	Understand the importance of Minerals and mineralogical studies	

Text Books
(Latest Editions)

1.	Economic Mineral deposits, Bateman, A.N. (1981), Asian publishers House, New Delhi
2.	Economic Geology – Economic Mineral Deposits, Umeshwar Prasad, (2010), CBS Pub. &Dist, New Delhi
3.	KrishnasamyS,India'sMineralResources, Oxford &IBH. Delhi(1988)
4.	SharmaN.L&R.K.Sinha. MineralEconomics, Oxford &IBH.Delhi(1985)
5.	Prasad U, EconomicMineralDeposits, CBS.Delhi(2003)

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

1.	India's Mineral Resoruces, Krishnaswamy.S revised by Shina, R.K, (1986), III Edi., Oxford & IBH Pub., Co., Ltd., New Delhi
2.	Introduction to Indian Economic minerals, Sharma, N.L and Ram, K.S.V.,(1970), Dhanbad publications, Dhanbad.
3.	Industrial Minerals ,Sinha,R.K,(1986), Oxford 7 IBH Pub. Co., New Delhi.
4.	Craig,R.C& D.V. Vaughan. Ore Microscopy and Ore Petrography. Wiley. New York.(1985)
5.	Aiyengar, N.K.N, Minerals of Madras, Dept.of Industries &Commerce. Guindy,

	Madras, (1964).
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/

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)

NON-MAJOR ELECTIVE COURSE

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGENE01	**GEMOLOGY AND GEMSTONE EVALUATION**	NME	Y				2	2	25	75	100

Course Objectives	
CO1	Understand the basics of Gems
CO2	Understand the importance of Gems in Geological studies
CO3	Know different group of Gemssystems
CO4	Understand the descriptive Gemmologyof different groups
CO5	Understand the importance of quality of Gems

UNIT	Details	No. of Hours	Course Objectives
I	Definition and Scope of Gemology – Minerals as Gemstones – Classification of Gemstones – Characteristic and Desirable Features of Gemstones. Basic Physical and Optical properties of Gemstones– Optical Classification of Gemstones.	12	CO1
II	Gem Testing: Introduction to Gem Mineral Equipment and Instruments: polarizer – Refractometer – Pycnometer – Use of Heavy liquids. Non destructive methods in gem Identification. Gem Simulants and Proxies. Artificial Gemstones and Substitutes.	12	CO2
III	Gemstone Cutting: Cutting Instruments: Diamond Saw – Blade. Preliminary Observations – Rough Cutting of Gemstones – Sizing and Shaping of Raw stones – Styles of Cutting: Rounding, Cabochon, Flat, Square, Rectangle, Crown, Brilliant, and Laser Sculpting	12	CO3
IV	Weight Standard Schemes used in Gemology – 4Cs Scheme for Diamonds. Polishing of Gemstones – Polishing Angles and limits. Polishing Equipments. Feasibility and Economics of Gem Industries in India with special reference to Tamil Nadu. Grading, Valuation and Pricing of Gems.	12	CO4
V	Gemstone Prospecting: Host rocks – Gemstone Mineralization – Deposits. Exploration Techniques and Exploitation. Gemstone Occurrences in India and with special references to Tamil Nadu.	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 Gems		
CO2	Understand the importance of Gems with identify the test studies		
CO3	Know different group of Gems quality of minerals systems		
CO4	Understand the descriptive Gems and value and price		
CO5	Understand the importance of Gemstones in India		
Text Books (Latest Editions)			
1.	Economic Mineral deposits, Bateman, A.N. (1981), Asian publishers House, New Delhi		
2.	Karanth K.V. (2000), Gem and gem industry in India, Memoir 45,Geological Societyof India, Bangalore		
3.	Anderson, B.W(1990).Gem testing (10th edition),Butterworth Scientific, London. Babu, T.M.(1998) Diamonds in India. Geological Society of India, Bangalore		
4.	Hall,C.(1994).Gemstone, Dorling Kindesley, London		
5.	Prasad U, EconomicMineralDeposits, CBS.Delhi(2003)		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	India's Mineral Resoruces, Krishnaswamy.S revised by Shina, R.K, (1986), III Edi., Oxford & IBH Pub., Co., Ltd., New Delhi		
2.	Deer,W.A., Houre,R.Aabdzussman.S.(1992).An introduction to rock forming minerals,ELBS,London		
3.	Industrial Minerals ,Sinha,R.K,(1986), Oxford 7 IBH Pub. Co., New Delhi.		
4.	Kerr, P.F.(1997). Optical mineralogy, 4th Ed. McGraw Hill Book & Co NewYork		

n 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)

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
23UGENE02	OCEANOGRAPHY	NME	Y				2	2	25	75	100

Course Objectives			
CO1	Understand the basics of Ocean		
CO2	Understand the importance of Major Ocean affecting factor		
CO3	Know different group of factor using tides		
CO4	Understand the descriptive types of ocean		
CO5	Understand the importance of Resource of ocean		
UNIT	Details	No. of Hours	Course Objectives
I	Oceanography: Scope, Content, Significance, Distribution of Land and Sea - Hypsometric Curve, Surface Configuration of the Ocean Floor: Continental Shelf, Continental Slope, Deep Sea Plain, Oceanic Deeps and Submarine Canyons	12	CO1
II	Relief Features of the Major Oceans: Atlantic, Pacific and Indian Ocean –Horizontal and Vertical Distribution of Seawater Temperature. Salinity: Factors Affecting Salinity and Distribution	12	CO2
III	Ocean Water Circulation: Factors Influencing Ocean Circulation - General Circulation of Ocean Currents,	12	CO3

	Currents of the Atlantic, Pacific and Indian Ocean, Waves and Tides: Definition and Types, Tsunamis: Origin and Effects		
IV	Marine Deposits: Classification and Distribution - Coral Reefs types - Conditions for the Growth	12	CO4
V	Marine Resources: Types - Distribution and Uses - Tidal Energy - Role of National Institute of Oceanography in 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	Understand the basics of Ocean	
CO2	To Understand the importance of energy source in ocean studies	
CO3	Know different tides form oceans	
CO4	Understand the descriptive descriptivetypes of ocean	
CO5	Understand the importance of oceans in India	

Text Books
(Latest Editions)

1.	Anikouchine, W. A. and Sternberg, R. W., (1973): The World Oceans - An Introduction to Oceanography, Englewood Cliffs.
2.	Garrison, T., (1998): Oceanography, Wadsworth Co.USA
3.	Gerald, S. (1980): General Oceanography: An Introduction, John Wiley & Sons, NewYork
4.	King, C. A. M., (1972): Beaches and Coasts, E. Arnold, London: King, C. A. M.,(1975): Oceanography for Geographers, E. Arnold,London
5.	Ramasamy, G., (1970): Oceanography (Tamil Edition), Tamil Nadu Text Book Society,Chennai

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

1.	Sharma, R. C. and Vatel, M., (1970): Oceanography for Geographers, CheytanyaPublishingHouse, Allahabad

n 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)