

**B.Sc.,  
GEOLOGY**

**MODEL SYLLABUS**

**AUGUST- 2022**

**TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION,  
CHENNAI – 600 005**

<b>Programme:</b>	<b>B.Sc., Geology</b>
<b>Programme Code:</b>	
<b>Duration:</b>	<b>3 years [UG]</b>
<b>Programme Outcomes:</b>	<p><b>PO1: Disciplinary knowledge:</b> Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study</p> <p><b>PO2: Communication Skills:</b> Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.</p> <p><b>PO3: Critical thinking:</b> Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.</p> <p><b>PO4: Problem solving: Capacity</b> to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.</p> <p><b>PO5: Analytical reasoning:</b> Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.</p> <p><b>PO6: Research-related skills:</b> A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation</p> <p><b>PO7: Cooperation/Team work:</b> Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team</p> <p><b>PO8: Scientific reasoning:</b> Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.</p> <p><b>PO9: Reflective thinking:</b> Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.</p>

	<p><b>PO10 Information/digital literacy:</b> Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.</p> <p><b>PO 11 Self-directed learning:</b> Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.</p> <p><b>PO 12 Multicultural competence:</b> Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.</p> <p><b>PO 13: Moral and ethical awareness/reasoning:</b> Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.</p> <p><b>PO 14: Leadership readiness/qualities:</b> Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.</p> <p><b>PO 15: Lifelong learning:</b> Ability to acquire knowledge and skills, including „learning how to learn“, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.</p>
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<p><b>Programme</b> <b>Specific Outcomes:</b></p>	<p><b>PSO1 – Placement:</b> To prepare the students who will demonstrate respectful engagement with others’ ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.</p> <p><b><u>PSO 2 - Entrepreneur:</u></b> <u>To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations</u></p> <p><b><u>PSO3 – Research and Development:</u></b> <u>Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.</u></p> <p><b><u>PSO4 – Contribution to Business World:</u></b> <u>To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</u></p> <p><b><u>PSO 5 – Contribution to the Society:</u></b> <u>To contribute to the development of the society by collaborating with stakeholders for mutual benefit</u></p>
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**Credit Distribution for all UG courses with LAB Hours  
B.Sc., GEOLOGY**

**First Year  
Semester-I**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language	3	6
	English	3	4
Part-3	Core: General Geology and Crystallography	4	5
	Geo-statistics - I	4	5
Part-2	Allied Mathematics	3	3
Part-4	Skill Enhancement Course SEC-1 (NME)	2	2
	Foundation Course	2	2
	Ability Enhancement Compulsory Course(AECC) Soft Skill-1	2	2
		<b>23</b>	<b>30</b>

**Semester-II**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language	3	6
	English	3	4
Part-3	Core: Crystallography Practical	4	5
	Geo-statistics - II	4	5
Part-2	Allied Chemistry	3	4
Part-4	Skill Enhancement Course -SEC-2 (NME)	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
	Ability Enhancement Compulsory Course(AECC) Soft Skill-2	2	2
		<b>24</b>	<b>30</b>

**Second Year  
Semester-III**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language	3	6
	English	3	4
Part-3	Core: Palaeontology	4	5
	Core: Geomorphology and Geotectonics	4	5
Part-2	Allied Physics - I	3	3
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	2	2
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	Ability Enhancement Compulsory Course(AECC) Soft Skill-2	2	2
	E.V.S	-	1
		<b>23</b>	<b>30</b>

**Semester-IV**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
Part-1	Language	3	6
	English	3	4
Part-3	Core: Structural Geology	5	6
	Core: Structural Geology, Remote Sensing and Survey Practical	4	4
Part-2	Allied Physics - II	3	2
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	Ability Enhancement Compulsory Course(AECC) Soft Skill-2	2	2

	E.V.S	2	2
		<b>25</b>	<b>30</b>

**Third Year  
Semester-V**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
<b>Part-3</b>	Stratigraphy	5	6
	Mineralogy	5	7
	Igneous Petrology	5	6
	Sedimentary and Metamorphology	5	7
<b>Part-4</b>	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	2
		<b>24</b>	<b>30</b>

**Semester-VI**

<b>Part</b>	<b>List of Courses</b>	<b>Credit</b>	<b>No. of Hours</b>
<b>Part-3</b>	Regional Geology	4	6
	Economic Geology and Mineral Economics	4	6
	Applied Geology	4	6
	<b>MINERALOGY AND PETROLOGY PRACTICAL</b>	3	5
	<b>ECONOMIC GEOLOGY AND ORE ANALYSIS PRACTICAL</b>	3	5
<b>Part-4</b>	Extension Activity	1	-
	Professional Competency Skill	2	2
		<b>21</b>	<b>30</b>
	<b>TOTAL CREDITS</b>		140

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	<b>GENERAL GEOLOGY AND CRYSTALLOGRAPHY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	The main objective of this course is to enumerate the origin of Earth.										
LO2	To describe the concepts of Dating and internal structure of the Earth										
LO3	To explain various components of crystals and crystallography										
LO4	To study various class and forms of a crystal system.										
LO5	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	LO1		
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	LO2		
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 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							12	LO3		
IV	Study of common forms and combinations of the following systems and classes: Isometric System: Hexoctahedral, Diploidal, Hextetrahedral – Tetragonal System: Ditetragonal							12	LO4		



	bipyramidal, Tetragonal bipyramidal, Tetragonal Pyramidal, Tetragonal Sphenoidal – Hexagonal System: Dihexagonal Bipyramidal, Hexagonal Bipyramidal Trigonal System – Ditrigonal Scalenohedral - Ditrigonal pyramidal, Trirhombohedral, Trigonal trapezohedral.		
V	Study of common forms and combinations of the following systems and classes: Orthorhombic System: Rhombic Bipyramidal, Rhombic pyramidal, Rhombic Disphenoidal – 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	LO5
<b>Total</b>		<b>60</b>	
<p><b>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.</b></p>			
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO 1</b>	Understand the origin of Galaxy, Our Solar System and Crystal Science	PO1	
<b>CO 2</b>	Knowledge on Dating of Earth Age	PO1, PO2	
<b>CO 3</b>	Correlate various Hypothesis on Origin of Earth	PO4, PO6	
<b>CO 4</b>	Analyze the importance of Crystallography Studies	PO4, PO5, PO6	
<b>CO 5</b>	Various Type minerals and their respective crystal system	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
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, Kolkata(1990)		
5.	Reed, J.S. &T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005)		

<b>References Books</b> (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)
<b>Web Resources</b>	
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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>Geo-Statistics - I</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	The main objective of this course is to importance of statistics in science.										
LO2	To describe the concepts of basic statistics										
LO3	To explain various components of advanced statistical methods										
LO4	To study various graphical methods and its applications										
LO5	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	LO1		
II	Measures of Central Tendency-Arithmetic Mean Median, Mode, Combined arithmetic mean-merits and demerits.							12	LO2		
III	Measures of Dispersion- Absolute and Relative measures Range, Quartile deviation, Mean deviation, Standard deviation							12	LO3		
IV	Curve fitting by the Method of Least square-Fitting straight line of the form $Y=ax+b$ and parabola $Y= a x^2 + b x +c$ (Simple problems)							12	LO4		
V	Correlation-Karl person's coefficient of correlation, Rank correlation- Spearman's Rank correlation coefficient. Reregression-regression equation and their properties.							12	LO5		
<b>Total</b>							<b>60</b>				

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### Course Outcomes

Course Outcomes	On completion of this course, students will;	
<b>CO 1</b>	To describe the definition, scope, classification, tabulation, drawing diagrams and plotting graphs of Statistics through Geological information.	PO1
<b>CO 2</b>	To measure and interpret the various measures of averages using Geological data.	PO1, PO2
<b>CO 3</b>	To measure and interpret the various measures of dispersions using Geological data.	PO4, PO6
<b>CO 4</b>	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
<b>CO 5</b>	To fit the curve using geological data.	PO3, PO8

### Text Books (Latest Editions)

1.	Statistics – R.S.N. Pillai and V. Bhagavathi, Publications S. Chand.
2.	Statistical Methods, Gupta, S.P. (2007): Sultan Chand & Sons Pvt Ltd, New Delhi, 35 <sup>th</sup> Revised Edition.
3.	Statistics for Geoscientists - Marsal, D. Pergamon press, New York.
4.	Cline, Graysen (2019). Nonparametric Statistical Methods Using R. EDTECH. ISBN 978-1-83947-325-8. OCLC 1132348139. Archived from the original on 2022-05-15. Retrieved 2021-09-16.
5.	Anderson, D.R.; Sweeney, D.J.; Williams, T.A. (1994) Introduction to Statistics: Concepts and Applications, pp. 5–9. West Group. ISBN 978-0-314-03309-3

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

1.	Statistics for Geoscientists - Marsal, D. Pergamon press, New York.
2.	Statistics – R.S.N. Pillai and V. Bhagavathi, Publications S. Chand.
3.	Statistical Methods, Gupta, S.P. (2007): Sultan Chand & Sons Pvt Ltd, New Delhi, 35 <sup>th</sup> 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.	<a href="https://en.wikipedia.org/wiki/Statistics">https://en.wikipedia.org/wiki/Statistics</a>
2.	<a href="http://onlinestatbook.com/2/introduction/descriptive.html">http://onlinestatbook.com/2/introduction/descriptive.html</a>
3.	<a href="https://socialresearchmethods.net/kb/statdesc.php">https://socialresearchmethods.net/kb/statdesc.php</a>
4.	<a href="https://en.wikipedia.org/wiki/Descriptive_statistics">https://en.wikipedia.org/wiki/Descriptive_statistics</a>
5.	<a href="#">Philosophy of Statistics</a> from the <a href="#">Stanford Encyclopedia of Philosophy</a>

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
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>Understanding the Earth</b>	NM E	Y	-	-	-	2	2	25	75	100
<b>Course Objectives</b>											
LO1	The main objective of this course is to understand various properties of Earth.										
LO2	To describe the concepts of internal structure of the Earth										
LO3	To explain various components related to external processes of Earth										
LO4	To study concepts of various currents and atmospheric circulation.										
LO5	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	LO1		
II	Internal structure: core, mantle, crust; External Structure: hydrosphere, atmosphere and biosphere. Earth's magnetic field.							12	LO2		
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	LO3		
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	LO4		
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	LO5		
<b>Total</b>							<b>60</b>				

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<b>Course Outcomes</b>		
<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO 1</b>	Understand the properties of Earth	PO1
<b>CO 2</b>	Knowledge on Dating of Earth Age	PO1, PO2
<b>CO 3</b>	Correlate various Hypothesis on Origin of Earth	PO4, PO6
<b>CO 4</b>	Analyze the importance of Crystallography Studies	PO4, PO5, PO6
<b>CO 5</b>	Various Type minerals and their respective crystal system	PO3, PO8
<b>Text Books (Latest Editions)</b>		
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, Kolkata(1990)	
5.	Reed, J.S. & T.H. Wicander, Essentials of Geology, McGraw Hill., New York(2005)	
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>		
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)	
<b>Web Resources</b>		
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.	Solarsystem.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
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>CRYSTALLOGRAPHY AND PALOENTOLOGY PRACTICAL</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	The main objective of this course is to enumerate the origin of Earth.										
LO2	To describe the concepts of Dating and internal structure of the Earth										
LO3	To explain various components of crystals and crystallography										
LO4	To study various class and forms of a crystal system.										
LO5	To determine various crystallographic properties of crystals with suitable examples.										
UNIT	Details							No. of Hours	Course Objectives		
I	<p>Isometric System: Normal Class – Galena, Fluorite, Magnetite, Garnet, and Leucite, Copper- Pyritohedral class – Pyrite, Tetrahedral Class – Tetrahedrite.</p> <p>Tetragonal System: Normal Class – Zircon, Vesuvianite, Cassiterite, and Rutile. Tripyramidal – Scheelite, Meionite Sphenoidal Class – Chalcopyrite.</p> <p>Hexagonal System: Normal Class – Beryl, Tripyramidal – Apatite, Hemimorphic – Zincite, Rhombohedral Normal – Calcite, Trapezohedral Class – Quartz.</p>							12	LO1		
II	<p>Orthorhombic System: Normal – Barite, Sulphur, Stibnite, Topaz, Staurolite, and Aragonite. Hemimorphic – Calymene, Sphenoidal Class – Epsomite.</p> <p>Monoclinic System: Normal – Gypsum, Pyroxenes and Amphiboles.</p> <p>Triclinic System: Normal – Axinite, Albite, and Rhodonite.</p> <p>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.</p>							12	LO2		
III	Identification and description of the following fossils: Lamellibranchs: Arca, Meretrix, Pecten, Cardita, Lima,							12	LO3		

	Allectronia, Inoceramus, Gryphaea, Exogyra, Radiolites, Ostrea, Unio, Trigonina. Gastropods: Turritella, Turbo, Cerithium, Trochus, Physa, Murex, Voluta, Helix, Euomphalus, Cyprea.		
IV	Cephalopods: Nautilus, Orthoceras, Ceratite, Goniatite, Belemnites, Baculites, and Perisphinctes. Echinodermata: Cidaris, Holaster, Hemiaster, Stigmatophygus, Apiocrinus. Trilobites: Paradoxides, Olenus, Olenellus, Phacops, Calymene.	12	LO4
V	Corals: Calceola, Zaphrentis, Lithostrotion, Omphyma, Thecosmelia. Brachiopoda: Terebratula, Spirifer, Productus, Monograptus, Tetragraptus, Diplograptus.	12	LO5
<b>Total</b>		<b>60</b>	

**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;	
<b>CO 1</b>	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
<b>CO 2</b>	To describe the concepts of Mineralogy is essential to comprehend the concepts of Petrology.	PO1, PO2
<b>CO 3</b>	To explain the importance of instrumentation techniques for better analysis	PO4, PO6
<b>CO 4</b>	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
<b>CO 5</b>	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.	Can explain
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).	

<b>References Books</b> (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)
<b>Web Resources</b>	
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
	<b>Geo-Statistics - II</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	The main objective of this course is to importance of statistics in science.										
LO2	To describe the concepts of basic statistics										
LO3	To explain various components of advanced statistical methods										
LO4	To study various graphical methods and its applications										
LO5	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	LO1		
II	Measures of Central Tendency-Arithmetic Mean Median, Mode, Combined arithmetic mean-merits and demerits.							12	LO2		
III	Measures of Dispersion- Absolute and Relative measures Range, Quartile deviation, Mean deviation, Standard deviation							12	LO3		
IV	Curve fitting by the Method of Least square-Fitting straight line of the form $Y=ax+b$ and parabola $Y= a x^2 + b x +c$ (Simple problems)							12	LO4		
V	Correlation-Karl person's coefficient of correlation, Rank correlation- Spearman's Rank correlation coefficient. Reregression-regression equation and their properties.							12	LO5		
<b>Total</b>							<b>60</b>				

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### Course Outcomes

Course Outcomes	On completion of this course, students will;	
<b>CO 1</b>	To describe the definition, scope, classification, tabulation, drawing diagrams and plotting graphs of Statistics through Geological information.	PO1
<b>CO 2</b>	To measure and interpret the various measures of averages using Geological data.	PO1, PO2
<b>CO 3</b>	To measure and interpret the various measures of dispersions using Geological data.	PO4, PO6
<b>CO 4</b>	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
<b>CO 5</b>	To fit the curve using geological data.	PO3, PO8

### Text Books (Latest Editions)

1.	Statistics – R.S.N. Pillai and V. Bhagavathi, Publications s. Chand.
2.	Statistical Methods, Gupta, S.P. (2007): sultan Chand & sons Pvt Ltd, New Delhi, 5 <sup>th</sup> 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, 5 <sup>th</sup> 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.	<a href="https://en.wikipedia.org/wiki/Statistics">https://en.wikipedia.org/wiki/Statistics</a>
2.	<a href="http://onlinestatbook.com/2/introduction/descriptive.html">http://onlinestatbook.com/2/introduction/descriptive.html</a>
3.	<a href="https://socialresearchmethods.net/kb/statdesc.php">https://socialresearchmethods.net/kb/statdesc.php</a>
4.	<a href="https://en.wikipedia.org/wiki/Descriptive_statistics">https://en.wikipedia.org/wiki/Descriptive_statistics</a>
5.	<a href="#">Philosophy of Statistics</a> from the <a href="#">Stanford Encyclopedia of Philosophy</a>

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
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>Basics of Earth Science</b>	NM E	Y	-	-	-	2	2	25	75	100
<b>Course Objectives</b>											
LO1	The main objective of this course is to understand various properties of Earth.										
LO2	To describe the concepts of internal structure of the Earth										
LO3	To explain various components related to external processes of Earth										
LO4	To study concepts of various currents and atmospheric circulation.										
LO5	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	LO1		
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	LO2		
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	LO3		
IV	<b>Study of Fossils-</b> 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	LO4		
V	<b>Applications of Geology:</b> 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	LO5		
<b>Total</b>								<b>60</b>			

**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**

<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO 1</b>	Gather basic information on Earth Sciences	PO1
<b>CO 2</b>	Understand the importance of various components of Earth	PO1, PO2
<b>CO 3</b>	Process of Geomorphological features	PO4, PO6
<b>CO 4</b>	Understand, predict and analyze the fossil and dating	PO4, PO5, PO6
<b>CO 5</b>	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, Kolkata(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 & 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.	<a href="http://www.nationalgeographic.org">www.nationalgeographic.org</a>
5.	<a href="http://Solarsystem.nasa.gov">Solarsystem.nasa.gov</a>

**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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>PALAEONTOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basics of Fossils										
LO2	Understand the importance of fossils in Geological studies										
LO3	Know different phylum and their species with morphological changes										
LO4	Understand and correlate fossil with various rock formations										
LO5	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	LO1		
II	The morphology and geological distribution of Mollusca-classes, Pelecypoda, gastropoda, Cephalopoda – orders - Nautiloidea, Ammonoidea, Dibranchia – Belemnites.							12	LO2		
III	Phylum – Brachiopoda, Phylum – Coelenterata.Class Anthozoa – Subclass Zoantharia Orders Rugosa, Tabulata and Scaleractina. Phylum – Hemichordata – Class Graptozoa, order Dendroidea, Order Graptolitoidea.							12	LO3		
IV	Phylum – Arthropoda Class – Trilobita Phylum – Echinodermata Class - Echinoidea Class – Crinoidea. Class: Blastoidea. Introduction to Paleobotany, Gondwana Flora.							12	LO4		
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	LO5		
<b>Total</b>							<b>60</b>				

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### Course Outcomes

<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO 1</b>	Understand the basics of Fossils	PO1
<b>CO 2</b>	Understand the importance of fossils in Geological studies	PO1, PO2
<b>CO 3</b>	Know different phylum and their species with morphological changes	PO4, PO6
<b>CO 4</b>	Understand and correlate fossil with various rock formations	PO4, PO5, PO6
<b>CO 5</b>	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, 4 <sup>th</sup> Edt. 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
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>GEOMORPHOLOGY AND GEOTECTONICS</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Know the basics of Geotectonics and landforms										
LO2	Understand the importance of various geomorphological agencies										
LO3	Process of Geomorphological features and creation of landforms										
LO4	Understand and predict Earth's Internal and external processes										
LO5	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	LO1		
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	LO2		
III	Mountains – their kinds, development and important mountain building movements. Processes of weathering – types and products- Mass Movements.							12	LO3		
IV	Earthquakes – types – seismographs – intensity and Magnitude scales (Richter & Mercalli) –Tsunami-Global Distribution; Volcanoes – structure, types – products – Global Distribution .							12	LO4		
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	LO5		
<b>Total</b>							<b>60</b>				

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#### Course Outcomes

<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO 1</b>	Know the basics of Geotectonics and landforms	PO1
<b>CO 2</b>	Understand the importance of various geomorphological agencies	PO1, PO2
<b>CO 3</b>	Process of Geomorphological features and creation of landforms	PO4, PO6
<b>CO 4</b>	Understand and predict Earth's Internal and external processes	PO4, PO5, PO6
<b>CO 5</b>	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.	Sathya Narayanaswami,B.S. Structural Geology. Dhanpat Rai & Sons. New Delhi.(1994)
3.	Gokhale,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.	HiIs 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, Blackie. London (1983).
4.	Radhakrishnan V, General Geology, V.V.P. Publications, Tuticorin(1996),
5.	Bloom A., Principles of Geomorphology (1985).

#### Web Resources

1.	<a href="http://www.labotka.net">http://www.labotka.net</a>
2.	<a href="http://www.patnasciencecollege.org">http://www.patnasciencecollege.org</a>
3.	<a href="https://geomorphology.org.uk">https://geomorphology.org.uk</a>
4.	<a href="https://gradeup.co">https://gradeup.co</a>
5.	<a href="https://www.nps.gov&gt;subjects&gt;gla">https://www.nps.gov&gt;subjects&gt;gla</a>

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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>Structural Geology and Photo Geology</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basics components of Structural Geology										
LO2	Know the formations of geological formations										
LO3	Basics of Aerial Photographs										
LO4	Understand the Application of Satellite science										
LO5	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	LO1		
II	Fold: Definition and parts of fold; classification of folds. Joints: Description and classification. Description and origin of foliations and lineations.							12	LO2		
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	LO3		
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	LO4		
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; productgeneration in GIS; tools for map analysis;							12	LO5		



	integration of GIS and remote sensing		
	<b>Total</b>	<b>60</b>	
<p><b>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.</b></p>			
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO 1</b>	Understand the basics components of Structural Geology	PO1	
<b>CO 2</b>	Know the formations of geological formations	PO1, PO2	
<b>CO 3</b>	Basics of Aerial Photographs	PO4, PO6	
<b>CO 4</b>	Understand the Application of Satellite science	PO4, PO5, PO6	
<b>CO 5</b>	Analyse various physiographical features through GIS	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
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)		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
1.	Basic Problems of Geotectonics Belousov.V.V. (1962)., McGraw Hill, New York		
2.	Structural Geology De Sitter. L.U. (1956)., McGraw Hill, New York		
3.	Elements of Structural Geology Hill. E.S. (1972)., John Wiley, New York		
4.	Aerial Photographic Interpretation Lueder.D.R. (1959)., McGraw Hill, New York.		
5.	Lillisand T.M & R.W.Kiefer, Remote Sensing and Image Interpretation, WileDelhi(2000)		
<b>Web Resources</b>			
1.	<a href="https://stratigraphy.org/">https://stratigraphy.org/</a>		
2.	<a href="https://www.sepm.org/">https://www.sepm.org/</a>		
3.	<a href="https://www.geosocindia.org/">https://www.geosocindia.org/</a>		
4.	<a href="https://www.moes.gov.in/">https://www.moes.gov.in/</a>		
5.	<a href="https://isegindia.org/">https://isegindia.org/</a>		

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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>Structural Geology, Remote Sensing and Survey Practical</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basics components of Structural Geology										
LO2	Know the formations of geological formations										
LO3	Basics of Aerial Photographs										
LO4	Understand the Application of Satellite science										
LO5	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, 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.							12	LO1		
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	LO2		
III	Solving of dip and strike problems by trigonometrical method – Determination of true thickness of beds by calculations							12	LO3		
IV	Interpretation of geomorphology, lithology and geological structures on aerial photographs. Visit to nearby geological organizations							12	LO4		
V	Definition – Primary divisions – classification – Chain survey – description of instruments employed – chain traverse – Compass survey – description of prismatic compass – whole circle bearings – reduced bearings –							12	LO5		

	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		
	<b>Total</b>	<b>60</b>	
<p><b>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.</b></p>			
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO 1</b>	Understand the basics components of Structural Geology	PO1	
<b>CO 2</b>	Know the formations of geological formations	PO1, PO2	
<b>CO 3</b>	Basics of Aerial Photographs	PO4, PO6	
<b>CO 4</b>	Understand the Application of Satellite science	PO4, PO5, PO6	
<b>CO 5</b>	Analyse various physiographical features through GIS	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
1.	Gokhale, N.W. , Theory of Structural Geology, CBS, Delhi(1995)		
2.	Sathya Narayanaswami, B.S. Structural Geology. Dhanpat Rai & Sons. New Delhi.(1994)		
3.	Lillisand T.M & R.W.Kiefer, Remote Sensing and Image Interpretation, Wiley Delhi(2000)		
4.	Reddy A, Principles of Remote Sensing and GIS, CBS. Delhi(2010)		
5.	Subramanian, Surveying and Levelling, Oxford University Press(2nd edition)		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
1.	Park, P.G., Foundations of Structural Geology, Blackie. London (1983).		
2.	Mahapatra G.B. Textbook of Physical Geology, 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. Kanetkar and S.V. Kulkarni, Surveying and Levelling Vol. I and Vol. II, Pune Vidyarthi Griha Prakashan 2006		
<b>Web Resources</b>			
1.	<a href="http://www.labotka.net">http://www.labotka.net</a>		
2.	<a href="http://www.patnasciencecollege.org">http://www.patnasciencecollege.org</a>		
3.	<a href="http://www.wamis.org">www.wamis.org</a>		

4.	<a href="http://www.sciencedirect.com&gt;earth-and-planetaryh-sciences">www.sciencedirect.com&gt;earth-and-planetaryh-sciences</a>
5.	<a href="https://www.geo.cornell.edu">https://www.geo.cornell.edu</a>

**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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	2	1	1	2	1	1	2	2

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

**SEMESTER - V**

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	<b>STRATIGRAPHY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basic of Historical Geology										
LO2	Know the Important group of Stratigraphic systems										
LO3	Know various economic importance of various periods										
LO4	Understand the various rocks of different periods from the formation of Earth										
LO5	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: ARCHAEOAN: Dharwar Supergroup – Champian Gneiss – Peninsular Gneiss – Closepet Granite- Sakoli Series – Saucer Series – Bundelkhand Gneiss – Banded gneissic complex – Aravalli Supergroup – Raiolo Series - Singhbhum Iron ore Series – Singhbhum copper belt shear zone – Newer Dolerite – Mineral riches of Archaeana.							12	LO1		
II	PROTEROZOIC: Cuddapah Supergroup – Kaladgi series – Delhi Supergroup – Erinpura Granite – Malani Igneous suite – Hazara slates – Attock slates – Dogra Slates – Mineral riches of Cuddapah - Vindyan Supergroup – Kurnool Supergroup – Bhima Series – Mineral riches of Vindhyan.							12	LO2		
III	PALAEOZOIC: Cambrian of Salt range – Age of Saline series – Haimanta System – Muth Quartzites – Kanawar System – Fenestella Shales – Kuling System – Everest Limestone – Panjal Volcanic Series. Gondwana Supergroup – Climate and Sedimentation – Classification – Lithology – Fossil contents – Distribution of Coal Deposits.							12	LO3		

IV	MESOZOIC: Triassic of Spiti – Succession and fossil contents Jurassic of Kutch – Succession and fossil content – Cretaceous of Tiruchirapalli and Bagh beds. CENOZOIC: Deccan traps – Age – Distribution – Petrology – Lametabeds – Infratrappean and Intertrappean beds	12	LO4
V	Tertiary of Assam and Tamilnadu Siwalik Supergroup – Varkala and Quilon beds of Kerala – Tertiary of Cambay a Karewa formation – Rise of Himalayas- Pleistocene Glaciation – Indo-Gangetic alluvium – Laterite.	12	LO5
<b>Total</b>		<b>60</b>	

**The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire 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;	
<b>CO 1</b>	Understand the basic of Historical Geology	PO1
<b>CO 2</b>	Know the Important group of Stratigraphic systems	PO1, PO2
<b>CO 3</b>	Know various economic importance of various periods	PO4, PO6
<b>CO 4</b>	Understand the various rocks of different periods from the formation of Earth	PO4, PO5, PO6
<b>CO 5</b>	Present is the Key to the Past – Critical Analyse	PO3, PO8

#### Text Books (Latest Editions)

1.	Geology of India and Burma M.S. Krishnan, (2010), 6 <sup>th</sup> 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.	Mehdiratta R.C.Geology of India, Pakistan, 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, Wiley. New Delhi (1988).
<b>Web Resources</b>	
1.	<a href="https://stratigraphy.org/">https://stratigraphy.org/</a>
2.	<a href="https://www.sepm.org/">https://www.sepm.org/</a>
3.	<a href="https://www.geosocindia.org/">https://www.geosocindia.org/</a>
4.	<a href="https://www.moes.gov.in/">https://www.moes.gov.in/</a>
5.	<a href="https://isegindia.org/">https://isegindia.org/</a>

**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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>MINERALOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basics of Minerals										
LO2	Understand the importance of Minerals in Geological studies										
LO3	Know different group of minerals systems										
LO4	Understand the descriptive mineralogy of different groups										
LO5	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	LO1		
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	LO2		
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	LO3		
IV	Descriptive mineralogy of the following essential rock forming minerals:- Quartz and its varieties – Families of Feldspar and Feldspathoids - Olivine							12	LO4		

	and Garnet groups-Epidote, Beryl & Tourmaline		
V	Descriptive mineralogy of the following rock forming mineral groups: - Amphibole and Pyroxene. Mica and Chlorite groups - Serpentine - Kaolin- Talc and Steatite - . Zircon - Sphene - Topaz - Andalusite - Sillimanite - Kyanite - Staurolite - Rutile - Calcite - Dolomite - Apatite - Fluorite.	12	LO5
	<b>Total</b>	<b>60</b>	
<p><b>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.</b></p>			
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO 1</b>	Understand the basics of Minerals	PO1	
<b>CO 2</b>	Understand the importance of Minerals in Geological studies	PO1, PO2	
<b>CO 3</b>	Know different group of minerals systems	PO4, PO6	
<b>CO 4</b>	Understand the descriptive mineralogy of different groups	PO4, PO5, PO6	
<b>CO 5</b>	Understand the importance of Minerals and mineralogical studies	PO3, PO8	
<b>Text Books (Latest Editions)</b>			
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.	HalDar,S.K.&J.Tisjlar, Introduction to Mineralogy and Petrology, Elsevier,(2014)		
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>			
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), 2 <sup>nd</sup> 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).

<b>Web Resources</b>	
1.	<a href="https://en.m.wikipedia.org/wiki/mineral">https://en.m.wikipedia.org/wiki/mineral</a>
2.	<a href="https://britannica.com/science/chlorite-mineral">https://britannica.com/science/chlorite-mineral</a>
3.	<a href="https://mineralseducationcoalition.org/minerals-database/zeolite">https://mineralseducationcoalition.org/minerals-database/zeolite</a>
4.	<a href="https://www.britannica.com/science/epidote">https://www.britannica.com/science/epidote</a>
5.	<a href="https://www.abracom.es">https://www.abracom.es</a>

**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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>IGNEOUS PETROLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basic Petrology										
LO2	Know the textures and micro-structures										
LO3	Know composition of magma and various system of rock formation										
LO4	Understand the Petrographical characters of rocks										
LO5	Analyse Origin of various rock types										
UNIT	Details							No. of Hours	Course Objectives		
I	<b>UNIT I</b> 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	LO1		
II	Textures and Microstructures – Classification of Igneous rocks (Tyrell and Streikeisen).							12	LO2		
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	LO3		
IV	Petrographic characters of Granites, Diorites, Syenites, Gabbros, Dolerite, Basalt, Pegmatites, Aplites and Lamprophyres.							12	LO4		
V	Origin of igneous rocks - Differentiation – Assimilation, - Petrography of special rock types, Anorthosite and Carbonatites.							12	LO5		
	<b>Total</b>							<b>60</b>			

**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;	
CO 1	Understand the basic Petrology	PO1
CO 2	Know the textures and micro-structures	PO1, PO2
CO 3	Know composition of magma and various system of rock formation	PO4, PO6
CO 4	Understand the Petrographical characters of rocks	PO4, PO5, PO6
CO 5	Analyse Origin of various rock types	PO3, PO8
<b>Text Books (Latest Editions)</b>		
1.	Best, M.G, Igneous and Metamorphic Petrology, Wiley, New Delhi (2003)	
2.	McBirney A.R, Igneous Petrology, CBS New Delhi (1993)	
3.	Best M.G, Igneous Petrology, Wiley, New Delhi (2005)	
4.	Hatch, F.H. et al, Petrology of the Igneous Rocks, CBS Delhi.	
5.	Hyndman D.W, Petrology of the Igneous and Metamorphic Rocks McGraw Hill, New York (1985)	
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>		
1.	Tyre II, G.W, Principles of Petrology, B.I. Publications New Delhi (1958)	
2.	Haung, W.T, Petrology, McGraw Hill, 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)	
<b>Web Resources</b>		
1.	<a href="https://minerva.union.edu/hollochk/c-petrology/resources.html">https://minerva.union.edu/hollochk/c-petrology/resources.html</a>	
2.	<a href="https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html">https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html</a>	
3.	<a href="https://geology.com/rocks/igneous-rocks.shtml">https://geology.com/rocks/igneous-rocks.shtml</a>	
4.	<a href="https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/">https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/</a>	
5.	<a href="https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html">https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html</a>	

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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>SEDIMENTARY AND METAMORPHIC PETROLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basic Petrology										
LO2	Know the macro and micro-structures										
LO3	Know various agents of sedimentary and metamorphic petrology										
LO4	Understand the Petrographical characters of rocks										
LO5	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	LO1		
II	Descriptive Petrography of clastic - Arenaceous, Argillaceous and Rudaceous - Chemical and Organic deposits.							12	LO2		
III	Definition – Agents and kinds of metamorphism – structure and textures – Depth zones – A brief study of Facies and grades.							12	LO3		
IV	Cataclastic metamorphism and its products, thermal and dynamothermal metamorphism on Quartzofelspathic, argillaceous, calcareous and basic igneous rocks.							12	LO4		
V	Plutonic metamorphism on Quartzofelspathic, argillaceous, calcareous and basic igneous rocks – Charnockites – Metasomatism – A brief account of migmatites – Anatexis and palingenesis and retrogressive metamorphism.							12	LO5		
<b>Total</b>							<b>60</b>				
<p><b>The course outcome is based on the course objectives. Each course objective will have a course outcome. This will elucidate what the student will acquire 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.</b></p>											



<b>Course Outcomes</b>		
<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO 1</b>	Understand the basic Petrology	PO1
<b>CO 2</b>	Know the macro and micro-structures	PO1, PO2
<b>CO 3</b>	Know various agents of sedimentary and metamorphic petrology	PO4, PO6
<b>CO 4</b>	Understand the Petrographical characters of rocks	PO4, PO5, PO6
<b>CO 5</b>	Analyse Origin of various rock types	PO3, PO8
<b>Text Books (Latest Editions)</b>		
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.	Williams,H. et al, Petrography, CBS.New Delhi(1982)	
5.	Haung,W.T, Petrology,McGraw Hill. New York(1962)	
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>		
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.	Folk,R.L, Petrology of the Sedimentary Rocks. Hemphill.Texas.USA(1974)	
<b>Web Resources</b>		
1.	<a href="https://www.britannica.com/science/geology/sedimentary-petrology">https://www.britannica.com/science/geology/sedimentary-petrology</a>	
2.	<a href="https://link.springer.com/chapter/10">https://link.springer.com/chapter/10</a>	
3.	<a href="https://www.geo.mtu.edu/UPSeis/hazards.html">https://www.geo.mtu.edu/UPSeis/hazards.html</a>	
4.	<a href="https://www.omafra.gov.on.ca/english/engineer/facts/">https://www.omafra.gov.on.ca/english/engineer/facts/</a>	
5.	<a href="https://geology.com/rocks/rock-salt.shtml">https://geology.com/rocks/rock-salt.shtml</a>	

**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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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	NM E	Y	-	-	-	2	2	25	75	100	
<b>Course Objectives</b>												
LO1	The students will enhance their writing skills.											
LO2	They will acquire knowledge about writing their assignments.											
LO3	They will delve into uncharted territory with regard to Scientific/Technical writing of research papers/reports.											
LO4	The students will understand what is Bibliography, how to cite references and how to quote them in the text.											
LO5	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	LO1			
<b>Total</b>												
<p><b>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.</b></p>												
<b>Course Outcomes</b>												
Course Outcomes	On completion of this course, students will;											
CO 1	The students will enhance their writing skills.							PO1				
CO 2	They will acquire knowledge about writing their assignments.							PO1, PO2				
CO 3	They will delve into uncharted territory with regard to Scientific/Technical writing of research papers/reports.							PO4, PO6				
CO 4	The students will understand what is Bibliography, how to cite references and how to quote them in the text.							PO4, PO5, PO6				
CO 5	They will be trained in how to avoid redundancies, which constitute a major problem while writing a Scientific Paper/Technical Report.							PO3, PO8				

<b>Text Books (Latest Editions)</b>	
1.	Best, M.G, Igneous and Metamorphic Petrology, Wiley, New Delhi (2003)
2.	McBirney A.R, Igneous Petrology, CBS, New Delhi (1993)
3.	Best M.G, Igneous Petrology, Wiley, New Delhi (2005)
4.	Hatch, F.H. et al, Petrology of the Igneous Rocks, CBS, Delhi.
5.	Hyndman D.W, Petrology of the Igneous and Metamorphic Rocks McGraw-Hill, New York (1985)
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>	
1.	Tyre II, G.W, Principles of Petrology, B.I. Publications, New Delhi (1958)
2.	Haug, W.T, Petrology, McGraw-Hill, 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)
<b>Web Resources</b>	
1.	<a href="https://minerva.union.edu/hollochk/c-petrology/resources.html">https://minerva.union.edu/hollochk/c-petrology/resources.html</a>
2.	<a href="https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html">https://topex.ucsd.edu/es10/lecture/lecture10/lecture10.html</a>
3.	<a href="https://geology.com/rocks/igneous-rocks.shtml">https://geology.com/rocks/igneous-rocks.shtml</a>
4.	<a href="https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/">https://course.lumenlearning.com/wmopen-geology/chapter/outcome-metamorphic-rocks/</a>
5.	<a href="https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html">https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/10875.html</a>

**In order to avoid pulling 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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>REGIONAL GEOLOGY</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand various Geological formations at Regional Scale										
LO2	Know the Important Stratigraphic landforms										
LO3	Know various economic importance of regional geology										
LO4	Know the mode of occurrence and uses of minerals										
LO5	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 Tamilnadu and their structural aspects. The Cauvery and Tambraparani Rivers – Soil types of Tamil Nadu..							12	LO1		
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	LO2		
III	Gondwana Supergroup – Sriperumbudur beds and Therany clay beds - Cretaceous of Trichy District – Cenomanian Marine transgression –Tertiary group of Cauvery basins. Distribution of petroleum and natural gas in Tamil Nadu.							12	LO3		
IV	Cuddalore Sandstone, Neyveli Lignite Deposits - Mode of occurrence & distribution of precious and Semi - precious stones in Tamil Nadu. Distribution of commercial granites, Heavy mineral sands (Zircon, Rutile, Ilmenite and Garnet ) and Thorium deposits of Manavalakurichi in Tamil Nadu.							12	LO4		
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	LO5		
<b>Total</b>							<b>60</b>				

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

<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO 1</b>	Understand the basic of Historical Geology	PO1
<b>CO 2</b>	Know the Important group of Stratigraphic systems	PO1, PO2
<b>CO 3</b>	Know various economic importance of various periods	PO4, PO6
<b>CO 4</b>	Understand the various rocks of different periods from the formation of Earth	PO4, PO5, PO6
<b>CO 5</b>	Present is the Key to the Past – Critical Analyse	PO3, PO8

#### Text Books (Latest Editions)

1.	Geology of India and Burma M.S. Krishnan, (2010), 6 <sup>th</sup> 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,Wiley.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.	<a href="https://stratigraphy.org/">https://stratigraphy.org/</a>
2.	<a href="https://www.sepm.org/">https://www.sepm.org/</a>
3.	<a href="https://www.geosocindia.org/">https://www.geosocindia.org/</a>
4.	<a href="https://www.moes.gov.in/">https://www.moes.gov.in/</a>
5.	<a href="https://isegindia.org/">https://isegindia.org/</a>

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
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>ECONOMIC GEOLOGY AND MINERAL ECONOMICS</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand basics of Economic minerals										
LO2	Know the various process of mineral formation										
LO3	Know the various mode of mineral deposits										
LO4	Know the physical and chemical characters of minerals										
LO5	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	LO1		
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	LO2		
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. Classification of commercial granites in pre-cambrian terrain of south							12	LO3		



	India.		
IV	Physical properties, chemical composition, mode of 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.	12	LO4
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	LO5
<b>Total</b>		<b>60</b>	

**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

<b>Course Outcomes</b>	On completion of this course, students will;	
<b>CO 1</b>	Understand the basics of Minerals	PO1
<b>CO 2</b>	Understand the importance of Minerals in Geological studies	PO1, PO2
<b>CO 3</b>	Know different group of minerals systems	PO4, PO6
<b>CO 4</b>	Understand the descriptive mineralogy of different groups	PO4, PO5, PO6
<b>CO 5</b>	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's MineralResources, Oxford &IBH. Delhi(1988)
4.	SharmaN.L&R.K.Sinha. MineralEconomics, Oxford &IBH.Delhi(1985)
5.	Prasad U, EconomicMineralDeposits, CBS.Delhi(2003)
<b>References Books</b> <b>(Latest editions, and the style as given below must be strictly adhered to)</b>	
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).
<b>Web Resources</b>	
1.	<a href="https://www.britannica.com/topic/economic-geology">https://www.britannica.com/topic/economic-geology</a>
2.	<a href="https://en.m.wikipedia.org/wiki/supergene-(geology)">https://en.m.wikipedia.org/wiki/supergene-(geology)</a>
3.	<a href="https://energymining.sa.gov.au/minerals/mineral-commodities">https://energymining.sa.gov.au/minerals/mineral-commodities</a>
4.	<a href="https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology">https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology</a>
5.	<a href="https://link.spring.com/">https://link.spring.com/</a>

**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
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>Applied Geology</b>	Core	Y	-	-	-	4	4	25	75	100
<b>Course Objectives</b>											
LO1	Understand basics of Hydrological Cycle										
LO2	Know the various hydrological parameters										
LO3	Know the various water bearing formations										
LO4	Know the application of Geological methods in groundwater investigations										
LO5	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	LO1		
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	LO2		
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	LO3		

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 outline of various methods of groundwater exploration.	12	LO4
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	LO5
<b>Total</b>		<b>60</b>	

**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;	
<b>CO 1</b>	Understand basics of Hydrological Cycle	PO1
<b>CO 2</b>	Know the various hydrological parameters	PO1, PO2
<b>CO 3</b>	Know the various water bearing formations	PO4, PO6
<b>CO 4</b>	Know the application of Geological methods in groundwater investigations	PO4, PO5, PO6
<b>CO 5</b>	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)

<b>References Books</b> (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) 2 <sup>nd</sup> 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)
<b>Web Resources</b>	
1.	<a href="https://www.britannica.com/science/geology/sedimentary-petrology">https://www.britannica.com/science/geology/sedimentary-petrology</a>
2.	<a href="https://link.springer.com/chapter/10">https://link.springer.com/chapter/10</a>
3.	<a href="https://www.geo.mtu.edu/UPSeis/hazards.html">https://www.geo.mtu.edu/UPSeis/hazards.html</a>
4.	<a href="https://www.omafra.gov.on.ca/english/engineer/facts/">https://www.omafra.gov.on.ca/english/engineer/facts/</a>
5.	<a href="https://geology.com/rocks/rock-salt.shtml">https://geology.com/rocks/rock-salt.shtml</a>

**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
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>MINERALOGY AND ETROLOGY PRACTICAL</b>	Core	Y	-	-	-	3	5	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basic Petrology										
LO2	Know the macro and micro-structures										
LO3	Know various agents of sedimentary and metamorphic petrology										
LO4	Understand the Petrographical characters of rocks										
LO5	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	LO1		
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	LO2		
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	LO3		

	olivine, gabbro, dunite, pyroxenite, norite, dolerite porphyry, basalt, trachyte, rhyolite, vitrophyre, obsidian, pumice, scoria, pitchstone, volcanic tuff and volcanic breccia.		
IV	Megascope 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	LO4
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, nepheline syenite, 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	LO5
<b>Total</b>		<b>60</b>	
<p><b>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.</b></p>			
<b>Course Outcomes</b>			
<b>Course Outcomes</b>	On completion of this course, students will;		
<b>CO 1</b>	Understand the basic Petrology	PO1	
<b>CO 2</b>	Know the macro and micro-structures	PO1, PO2	
<b>CO 3</b>	Know various agents of sedimentary and metamorphic petrology	PO4, PO6	
<b>CO 4</b>	Understand the Petrographical characters of rocks	PO4, PO5, PO6	
<b>CO 5</b>	Analyse Origin of various rock types	PO3, PO8	

<b>Text Books (Latest Editions)</b>	
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.	Krishnasamy S., India's Mineral Resources, Oxford & IBH. Delhi (1988)
4.	Sharma N.L. & R.K. Sinha. Mineral Economics, Oxford & IBH. Delhi (1985)
5.	Prasad U, Economic Mineral Deposits, CBS. Delhi (2003)
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>	
1.	India's Mineral Resources, 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 & 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).
<b>Web Resources</b>	
1.	<a href="https://www.britannica.com/topic/economic-geology">https://www.britannica.com/topic/economic-geology</a>
2.	<a href="https://en.m.wikipedia.org/wiki/supergene-(geology)">https://en.m.wikipedia.org/wiki/supergene-(geology)</a>
3.	<a href="https://energymining.sa.gov.au/minerals/mineral-commodities">https://energymining.sa.gov.au/minerals/mineral-commodities</a>
4.	<a href="https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology">https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology</a>
5.	<a href="https://link.spring.com/">https://link.spring.com/</a>

**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:**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>
<b>CO 1</b>	3	3	2	3	3	3	2	2
<b>CO 2</b>	2	3	3	3	3	3	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1
<b>CO 4</b>	3	3	3	3	3	2	1	1
<b>CO 5</b>	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
	<b>ECONOMIC GEOLOGY AND ORE ANALYSIS PRACTICAL</b>		Y	-	-	-	3	5	25	75	100
<b>Course Objectives</b>											
LO1	Understand the basics of Minerals										
LO2	Understand the importance of Minerals in Geological studies										
LO3	Know different group of minerals systems										
LO4	Understand the descriptive mineralogy of different groups										
LO5	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	LO1		
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	LO2		
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	LO3		
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	LO4		
V	Identification of the following mineral powders by blowpipe methods: galena, chalcopyrite, haematite, magnetite, celestite, strontianite, witherite, gypsum, bauxite, apatite, pyrite, siderite, orpiment, realgar, calcite, psilomelane, rhodochrosite, smithsonite and ilmenite.							12	LO5		
<b>Total</b>							<b>60</b>				

**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.**

<b>Course Outcomes</b>	
<b>Course Outcomes</b>	On completion of this course, students will;
<b>CO 1</b>	Understand the basics of Minerals
<b>CO 2</b>	Understand the importance of Minerals in Geological studies
<b>CO 3</b>	Know different group of minerals systems
<b>CO 4</b>	Understand the descriptive mineralogy of different groups
<b>CO 5</b>	Understand the importance of Minerals and mineralogical studies
<b>Text Books (Latest Editions)</b>	
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.	Krishnasamy S, India's Mineral Resources, Oxford & IBH. Delhi (1988)
4.	Sharma N.L. & R.K. Sinha. Mineral Economics, Oxford & IBH. Delhi (1985)
5.	Prasad U, Economic Mineral Deposits, CBS. Delhi (2003)
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>	
1.	India's Mineral Resources, 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 & 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).
<b>Web Resources</b>	
1.	<a href="https://www.britannica.com/topic/economic-geology">https://www.britannica.com/topic/economic-geology</a>
2.	<a href="https://en.m.wikipedia.org/wiki/supergene-(geology)">https://en.m.wikipedia.org/wiki/supergene-(geology)</a>
3.	<a href="https://energymining.sa.gov.au/minerals/mineral-commodities">https://energymining.sa.gov.au/minerals/mineral-commodities</a>
4.	<a href="https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology">https://www.slideshare.net/mobile/monokaonaBoruah/magmatic-deposits-economic-geology</a>
5.	<a href="https://link.spring.com/">https://link.spring.com/</a>

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
	EXTENSION ACTIVITY	NM E	Y	-	-	-	1		25	75	100
<b>Course Objectives</b>											
LO1											
LO2											
LO3											
LO4											
LO5											
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	LO1		
<b>Total</b>											
<p><b>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.</b></p>											
<b>Course Outcomes</b>											
Course Outcomes	On completion of this course, students will;										
LO1											
LO2											
LO3											
LO4											
LO5											
<b>Text Books (Latest Editions)</b>											
1.											
2.											
<b>References Books (Latest editions, and the style as given below must be strictly adhered to)</b>											
1.											



<b>CO 4</b>								
<b>CO 5</b>								

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