



## Department of Higher Education U.P. Government, Lucknow

### National Education Policy-2020 Common Minimum Syllabus for all U.P. State Universities Year wise Structure of B.Sc. (Geology)

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
1	I	B090101T	Physical and Structural Geology	Theory	4
1	I	B090102P	Practical: Structural Geology	Practical	2
1	II	B090201T	Mineralogy and Crystallography	Theory	4
1	II	B090202P	Practical: Mineralogy and Crystallography	Practical	2
2	III	B090301T	Palaeontology	Theory	4
2	III	B090302P	Practical: Palaeontology	Practical	2
2	IV	B090401T	Petrology	Theory	4
2	IV	B090402P	Practical: Petrology	Practical	2
3	V	B090501T	Applied Geology and Global Tectonics	Theory	4
3	V	B090502T	Stratigraphy	Theory	4
3	V	B090503R	Field Work	Field Work	2
3	VI	B090601T	Remote Sensing and Environmental Geology	Theory	4
3	VI	B090602T	Economic Geology and Ground water	Theory	4
3	VI	B090603P	Practical: Economic Geology	Practical	2

Name	Designation	Affiliation
<b>Steering Committee</b>		
Mrs. Monika S. Garg, (I.A.S.) Chairperson Steering Committee	Additional Chief Secretary	Dept. of Higher Education U.P., Lucknow
Prof. Poonam Tandan	Professor, Dept. of Physics	Lucknow University, U.P.
Prof. Hare Krishna	Professor, Dept. of Statistics	CCS University Meerut, U.P.
Dr. Dinesh C. Sharma	Associate Professor, Dept. of Zoology	K.M. Govt. Girls P.G. College Badalpur, G.B. Nagar, U.P.
<b>Supervisory Committee-Science Faculty</b>		
Dr. Vijay Kumar Singh	Associate Professor, Dept. of Zoology	Agra College, Agra
Dr. Santosh Singh	Dean, Dept. of Agriculture	Mahatma Gandhi Kashi Vidhyapeeth, Varanasi
Dr. Baby Tabussam	Associate Professor, Dept. of Zoology	Govt. Raza P.G. College Rampur, U.P.
Dr. Sanjay Jain	Associate Professor, Dept. of Statistics	St. John's College, Agra

#### Syllabus Developed by:

S.No.	Name	Designation	Department	College/University
1.	Prof. K K Agarwal	Professor	Geology	University of Lucknow
2.	Dr. Rajesh Singh	Assistant Professor	Geology	University of Lucknow
3.	Dr. Sanjay Shukla	Associate Professor	Geology	BSNV PG College, Lucknow

Programme	Year	Semester	Theory/ Practical	Compulsory/ Elective	Course Title	Credits	Teaching Hours
Certificate	I	First	Theory	Compulsory	<i>Physical and Structural Geology</i>	04	60
			Theory	Compulsory	<i>Practical: Structural Geology</i>	02	60
		Second	Theory	Compulsory	<i>Mineralogy and Crystallography</i>	04	60
			Practical	Compulsory	<i>Practical: Mineralogy and Crystallography</i>	02	60
Diploma	II	Third	Theory	Compulsory	<i>Palaeontology</i>	04	45
			Practical	Compulsory	<i>Practical: Palaeontology</i>	02	90
		Fourth	Theory	Compulsory	<i>Petrology</i>	04	60
			Theory	Compulsory	<i>Practical: Petrology</i>	02	60
B.Sc. Degree	III	Fifth	Theory	Compulsory	<i>Applied Geology and Global Tectonics</i>	04	60
			Theory	Compulsory	<i>Stratigraphy</i>	04	60
			Practical	Compulsory	<i>Field Work</i>	02	60
		Sixth	Theory	Compulsory	<i>Remote Sensing and Environmental Geology</i>	04	60
			Theory	Compulsory	<i>Economic Geology and Ground water</i>	04	60
			Practical	Compulsory	<i>Practical: Economic Geology</i>	02	60

## Format for developing syllabus for a Subject

- Subject prerequisites: To study this subject, a student must have had the subject(s) ... **Physics/ Mathematics/ Chemistry/ Biological Sciences** .... in class/12<sup>th</sup>.
- Programme outcomes (POs)  
The Bachelor of Science program in Department of Geology, University of Lucknow is designed with the objective of educating students for success as a geo-scientist having employability in government sector, public sector, private sector, research institutes, or further qualifying JAM or other national examinations so as to pursue further study.
- Programme specific outcomes (PSOs):  
  
Geological excursion would be important components of the B.Sc. Program in Geology for laying a robust foundation to the budding geologists. Students will get exposure of actual rocks during Geological excursion. Students will learn the data collection, measurements and interpretations.
- List of all papers in all six semesters.

Programme/Class: <b>Certificate</b>	Year: <b>First</b>	Semester: <b>First</b>
Subject: <b>Geology</b>		
Course Code: <b>B090101T</b>	Course Title: <b>Physical and Structural Geology</b>	
<p>Course outcomes:  After completing the course, student  Will learn origin of solar system and Earth  Will understand internal structure of Earth  Will understand interpretation stress-strain imprinted in earth  Will learn the Interpretation of deformed structure  Will understand role of weathering agents</p>		
Credits: 4		Core: Compulsory
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0		
Unit	Topics	No. of Lectures
<b>I</b>	Introduction to Geology and its scope, Earth and Solar system: origin, size etc., Age of Earth, Earth's atmosphere, Internal Structure and composition of Earth,	7
<b>II</b>	Sea-floor spreading; Basic concepts of Plate -Tectonics, Continental Drift	7
<b>III</b>	Weathering and erosion: factor, types, Erosion, transportation and deposition by wind and their related landforms	8
<b>IV</b>	Erosion, transportation and deposition by rivers and glaciers, and their related landforms;	8
<b>V</b>	Introduction to structural geology; Basic concepts of stress and strain; Study of outcrop; Identification of bedding; Measurement of dip, strike and thickness of beds; Forms of igneous bodies (concordant and discordant)	8
<b>VI</b>	Simple deformational structures: Fold morphology, their geometric and genetic classification, Top and Bottom of Beds	7
<b>VII</b>	Geometric and genetic classification of Faults (Normal, reverse and strike-slip faults); Recognition of faults in the field; Effects of faults on folded beds,	7
<b>VII</b>	Unconformities: their classification, recognition and geological significance, onlap and offlap; Joint and its classification, Lineation and Foliation: basic introduction.	8
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>1. The Blue Planet: An Introduction to Earth System Science – B.J. Skinner and S.C. Porter. 1995, John Wiley &amp; Sons, Inc. 493p.</li> <li>2. Introduction to Physical Geology – G.R. Thompson and J. Turk. 1998, Saunders College Publishers, Fort Worth. 371p.</li> <li>3. Processes that Shape the Earth – D.M. Thompson. 2007, Infobase Publishing, NY. 116p.</li> <li>4. Physical Geology – L.D. Leet, S. Judson and M.E. Kauffman, (1982). Prentice-Hall Inc. 629p.</li> <li>5. Holme's Principles of Physical Geology – P.MvL.D. Duff, Fourth Edition (1993). Stanley Thornes (Publishers) Ltd.</li> <li>6. Suggested Readings:</li> <li>7. Bailey, B., 1992. Mechanics in Structural Geology, Springer.</li> <li>8. Davis, G. H. and Reynolds, S. J., 1996. Structural Geology of rocks and regions, John Wiley. and Sons.</li> <li>9. Ghosh, S. K., 1993. Structural Geology: Fundamentals, and modern developments, Pergamon Press.</li> </ol>		

10. Leyson, P. R. and Lisle, R. J., 1996. Stereographic projection techniques in structural geology, Cambridge University Press.

11. Passier, C. and Trouw, R. A. J., 2005. Microtectonics. Springer, Berlin.

12. Pollard, D. D. and Fletcher, R. C., 2005. Fundamentals of structural geology, Cambridge University Press.

13. Ramsay, J. G. and Huber, M. I., 1983. Techniques of Modern Structural Geology: vol. I & II. Academic Press.

14. Ramsay, J. G., 1967. Folding and Fracturing of Rocks, McGraw-Hill Book Company, New York.

15. Rowland, S. M., Duebendorfer, E. and Schiefelbein, I. M., 2007. Structural analysis and synthesis: a laboratory course in structural geology, Balckwell pub.

16. Suppe, J., 1985 The Principles of Structural Geology, Prentice-Hall, Inc., New Jersey,.

17. Twiss, R. J. and Moores, E.M., 2007. Structural Geology. Freeman.

18. Van der Pluijm, B. A. and Marshak, S., 2004. Earth structure: an introduction to structural Geology.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12<sup>th</sup>.**

Suggested Continuous Evaluation Methods:

**Test: 10 Marks; Presentation: 10, Class participation and activity: 5** .....

Course prerequisites: To study this course, a student must have had the subject ... **Physics/ Mathematics/ Chemistry/ Biological Sciences** ..... in class/12<sup>th</sup>

Suggested equivalent online courses:

Further Suggestions:

Programme/Class: <b>Certificate</b>	Year: <b>First</b>	Semester: <b>First</b>
Subject: <b>Geology</b>		
Course Code: <b>B090102P</b>	Course Title: <b>Practical: Structural Geology</b>	
Course outcomes: After completing the course, student will be able to interpret the geological maps will able to measure the geological data from field		
Credits: 2	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2		
Unit	Topics	No. of Lectures
	Problems on dip, strike; Contour maps and completion of outcrops; study and Interpretation of topographical maps; Use of Clinometer compass Calculation of apparent dip Simple Lithology boundary tracing, Determination of Thickness of bed. Identification of fault and calculation of Throw Identification of Unconformities Identification of fold Some Complex geological maps	60
<b>Suggested Readings:</b> 1. F. H. T. Rhodes, geological maps, the commonwealth and international library. 2. G. M. Bennison, 1992, an introduction to geological structures and maps, Edward arnold 3. Richard j. Lisle, 1988, Geological structures, and maps, a practical guide, Amsterdam 4. K. R. McClay, 1991, The mapping of geological structures, geological society of London handbook		
This course can be opted as an elective by the students of following subjects: <b>Open for all who have science stream in 12<sup>th</sup>.</b>		
Suggested Continuous Evaluation Methods: <b>Practical Record: 20 Marks; ; 10, Class participation and activity: 5, Examination:50 Marks Viva-voce: 25marks</b>		
Course prerequisites: To study this course, a student must have had the subject ... <b>Physics/ Mathematics/ Chemistry/ Biological Sciences</b> ..... in class/12 <sup>th</sup>		
Suggested equivalent online courses: .....		
Further Suggestions: .....		

Programme/Class: <b>Certificate</b>	Year: <b>First</b>	Semester: <b>Second</b>
Subject: <b>Geology</b>		
Course Code: <b>B090201T</b>	Course Title: <b>Crystallography and Mineralogy</b>	
Course outcomes: After completing the course, student Will learn the mineral and its types Will understand the crystal formation, form and occurrence Will learn formation of mineral groups and resources		
Credits: 4	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0		
Unit	Topics	No. of Lectures
<b>I</b>	Basic idea about crystal, crystal growth and crystallisation; Laws of crystallography; Crystal morphology; Crystallographic axes; Elements of symmetry; Crystallographic notations;	7
<b>II</b>	Crystal forms; Habit and classification; Preliminary idea about various types of projection, Crystal aggregate: Twinning and common twin Jaws;	7
<b>III</b>	Symmetry and forms of Hexagonal (beryl type and calcite type), Orthorhombic (Barytes type), Monoclinic (Gypsum type), and Triclinic (Axinite type) Crystal Systems	8
<b>IV</b>	Symmetry and forms of Cubic (Galena type, Pyrite type and Tetrahedrite type), and Tetragonal (Zircon type) Crystal Systems	8
<b>V</b>	Definition of mineral; Atomic bonding; Physical properties of minerals: colour, lustre, form, isomorphism, pseudomorphism, polymorphism, hardness, fracture, cleavage, specific gravity, and characters based on heat, electricity and magnetism;	8
<b>VI</b>	Physical properties, chemical composition, occurrences, and uses of minerals belonging to the Silica and Feldspar families, and clay minerals	7
<b>VII</b>	Physical properties; chemical composition, occurrences, and uses of Pyroxene, Olivine, Mica and Garnet families; Amphibole,	6
<b>VIII</b>	Nicol prism; Optically isotropic and anisotropic minerals; Polarisation of light; Optical properties of minerals under polarised light and crossed polars: refractive index, pleochroism, relief, twinkling, birefringence, interference colours, extinction and twinning; Classification of minerals into uniaxial and biaxial minerals	9

**Suggested Readings:**

1. Putnis A. 1992. Introduction to Mineral Sciences, Cambridge publication.
2. Cornelis Klein and Barbara Dutrow, 2007, The manual of Mineral Science, Wiley Publication
3. Mason, B., 1986. Principles of Geochemistry. 3rd Edition, Wiley New York.
4. Rollinson H. 2007 Using geochemical data-evaluation. Presentation and interpretation. 2nd Edition. Publisher Longman Scientific & Technical.
5. Walther John, V., 2009 Essentials of Geochemistry, student edition. Jones and Bartlett Publishers.
6. Publishers.
7. Albarede, F, 2003. An introduction to geochemistry. Cambridge University Press.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12<sup>th</sup>.**

**Suggested Continuous Evaluation Methods:**

**Test: 10 Marks; Presentation: 10, Class participation and activity: 5** .....

Course prerequisites: To study this course, a student must have had the subject ... **Physics/ Mathematics/ Chemistry/ Biological Sciences** ..... in class/12<sup>th</sup>

**Suggested equivalent online courses:**

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**Further Suggestions:**

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Programme/Class: <b>Certificate</b>	Year: <b>First</b>	Semester: <b>Second</b>
Subject: <b>Geology</b>		
Course Code: <b>B090202P</b>	Course Title: <b>Practical Mineralogy and Crystallography</b>	
Course outcomes: After completing the course, student will see and feel the natural mineral will learn to identify the mineral in hand specimens		
Credits: 2	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		
<b>Unit</b>	<b>Topics</b>	<b>No. of Lectures</b>
	Verification of Euler's formula; Graphical construction of crystallographic axes of Cubic system; Clinographic projections of typical crystals of Cube, Rhombdodecahedron, Tetrahexahedron, Trapezohedron, Pyritohedron, Tetrahedron, Zircon, Calcite  Determination of physical properties of rock forming minerals: quartz family, Feldspar family, pyroxene family, Amphibole Family, Garnet Family; Mica Family, Identification of important rock forming minerals in hand specimens  Use of polarizing, Optical properties of minerals	60
<b>Suggested Readings:</b>		
1. Putnis A. 1992. Introduction to Mineral Sciences, Cambridge publication. 2. Cornelis Klein and Barbara Dutrow, 2007, The manual of Mineral Science, Wiley Publication 3. Phillips, F.C., 1963. An introduction to crystallography. Wiley, New York 4. Nesse, D.W., 1986. Optical Mineralogy. McGraw Hill. 5. Kerr, B.F., 1995. Optical Mineralogy 5th Ed. Mc Graw Hill, New York.		
This course can be opted as an elective by the students of following subjects: <b>No</b>		
Suggested Continuous Evaluation Methods:		
<b>Practical Record: 20 Marks; : 10, Class participation and activity: 5, Examination:50 Marks</b>		
<b>Viva-voce: 25marks</b> .....		
Course prerequisites: To study this course, a student must have had the subject ... <b>Physics/ Mathematics/ Chemistry/ Biological Sciences</b> ..... in class/12 <sup>th</sup> .....		
Suggested equivalent online courses: .....		
Further Suggestions: .....		

Programme/Class: <b>Diploma</b>	Year: <b>Second</b>	Semester: <b>Third</b>
Subject: <b>Geology</b>		
Course Code: <b>B090301T</b>	Course Title: <b>PALAEONTOLOGY</b>	
<p>Course outcomes:  After completing the course, student  will know the palaeo-life of earth  will know the reconstruction the earth based on fossils  will be able to determine the age of rock formation-based fossils  will be able to locate the resources based on fossils</p>		
Credits: 4		Core: <b>Compulsory</b>
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	No. of Lectures
<b>I</b>	Introduction to palaeontology; processes of fossilisation; Preliminary idea of the origin of life; Basic idea of trace fossils and their uses	7
<b>II</b>	Morphology and geological history of Bivalvia, Brachiopoda	8
<b>III</b>	Morphology and geological history of Gastropoda, Cephalopoda	8
<b>IV</b>	Morphology and geological history of Echinoidea and Anthozoa.	8
<b>V</b>	Morphology and geological history of Trilobita and Graptolithina	8
<b>IV</b>	Introduction to Palaeobotany; Important Lower and Upper Gondwana plant fossils	7
<b>VII</b>	Brief idea of concept of species; Classification of organisms; Principles of marine Secology, palaeoecology;	7
<b>VIII</b>	Principles of sequence stratigraphy; Microplaeontology and its use	7
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>1. Cowen, R. (2000) History of Life, Blackwell Science.</li> <li>2. E. N. K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science</li> <li>3. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press</li> <li>4. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing</li> <li>5. Patrick Wyse Jackson, (2019) Introducing Palaeontology: A Guide to Ancient Life, Dunedin Academic Press Ltd.</li> <li>6. Raymond Enay (2012) Palaeontology of Invertebrates, Springer-Verlag.</li> <li>7. Peter Doyle, Understanding Fossils: An Introduction to Invertebrate Palaeontology.</li> <li>8. Morley Davies (2008) An Introduction to Palaeontology, Read Books.</li> <li>9. Sreepat Jain (2017) Fundamentals of Invertebrate Palaeontology: Macrofossils, Springer India</li> <li>10. Roland Goldring, (2014) Field Palaeontology, Routledge</li> <li>11. Johansson, C. Z., Underwood, M. Richter, (2019) Evolution and development of Fishes, Cambridge University Press.</li> <li>12. Pratul Kumar Saraswati, M.S. Srinivasan, (2016) Micropaleontology: Principles and Applications, Springer International Publishing Switzerland.</li> <li>13. Michael Benton, David A. T. Harper, (2009) Introduction to Paleobiology and the Fossil Record,</li> </ol>		

Wiley-Blackwell.

14. Colbert, E.H. and Minkoff, Eli C. (2001) Evolution of vertebrates, Wiley Liss

15. Wadia, D., 1973. Geology of India. Mc Graw Hill Book co.

16. Krishnan, M.S., 1982. Geology of India and Burma, 6th Edition. CBS Publ.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12<sup>th</sup>.**

Suggested Continuous Evaluation Methods:

**Test: 10 Marks; Presentation: 10, Class participation and activity: 5** .....

Course prerequisites: To study this course, a student must have had the subject **Certificate in Geology**

Suggested equivalent online courses:

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Further Suggestions:

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Programme/Class: <b>Diploma</b>	Year: <b>Second</b>	Semester: <b>Third</b>
Subject: <b>Geology</b>		
Course Code: <b>B090302P</b>	Course Title: Practical: PALAEONTOLOGY	
Course outcomes: After completing the course, student		
Credits: 2	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		
Unit	Topics	No. of Lectures
	<p>Study of the morphology of representative fossil invertebrates of Mollusca (Bivalvia, Gastropoda and Cephalopoda), Brachiopoda, Echinodermata (Echinoidea) and Cnidaria (Anthozoa); Study of important Gondwana plant fossils</p> <p>Preparation of lithostratigraphic maps of India showing distribution of important geological formations</p> <p>Study of advanced geological maps, and preparation of cross-sections; dip-strike problems by stereographic projection.</p>	60
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>1. Cowen, R. (2000) History of Life, Blackwell Science.</li> <li>2. E. N. K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science</li> <li>3. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press</li> <li>4. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing</li> </ol>		
This course can be opted as an elective by the students of following subjects: <b>Open for all who have science stream in 12<sup>th</sup>.</b>		
Suggested Continuous Evaluation Methods: <b>Practical Record: 10 Marks; 5, Class participation and activity: 5, Examination:40 Marks</b> <b>Viva-voce: 20marks, Geological Field Excursion:20</b>		
Course prerequisites: To study this course, a student must have had the subject <b>Certificate in Geology</b>		
Suggested equivalent online courses: .....		
Further Suggestions: .....		

Programme/Class: <b>Diploma</b>	Year: <b>Second</b>	Semester: <b>Fourth</b>
Subject: <b>Geology</b>		
Course Code: <b>B090401T</b>	Course Title: <b>PETROLOGY</b>	
<p>Course outcomes:</p> <p>After completing the course, student</p> <ul style="list-style-type: none"> <li>will learn to identify rock types and their mineralogical composition.</li> <li>will learn texture, structure found within the rock</li> <li>will understand the role of temperature and pressure in formation of rocks</li> <li>will understand the geo-thermoeter</li> </ul> <p>Understand stratigraphy and sedimentation history of different sedimentary basins of India</p> <p>will understand the process of sedimentation and rock formation</p>		
Credits: 3		Core: <b>Compulsory</b>
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0		
Unit	Topics	No. of Lectures
<b>I</b>	Phase Rule; Laws of thermodynamics; Phase equilibria studies in $SiO_2$ , Diopside-Anorthite, Albite-Anorthite, Leucite-Silica and Diopside-Albite-Anorthite systems	8
<b>II</b>	Brief introduction to rocks; Magma: definition, composition and origin; Bowen's reaction series; Magmatic differentiation and assimilation	6
<b>III</b>	Textures of igneous rocks; IUGS classification of igneous rocks, Brief petrographic description of common igneous rocks	6
<b>IV</b>	Definition, agents, types and grades of metamorphism; Metamorphic rocks: texture, structure and classification; Concept of index minerals, isograds and metamorphic facies;	8
<b>V</b>	Regional metamorphism of pelitic, calcareous and basic rocks; anatexis; Brief description of common metamorphic rocks.	7
<b>VI</b>	Origin and classification of sedimentary rocks; Introduction to sedimentary rocks and their origin; Flow dynamics; Froude number; Reynolds number; Flow regime; Types of flow	8
<b>VII</b>	Sediment characteristics; Diagenesis; Textures of sedimentary rocks; Sedimentary structures.	8
<b>VIII</b>	Classification of sedimentary rocks: clastic and non-clastic; Classification of sandstone and carbonates; Sedimentary basins in different tectonic settings	9
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>1. Cox, K. G., Bell, J. D. and Pankhurst, R. J. 1979. Interpretations of igneous rocks. George Allen and Unwin, London.</li> <li>2. Wilson, M. 1989. Igneous Petrogenesis. London Unwin Hyman.</li> <li>3. Anthony R. Philpotts and Ague, J. J. 2009. Principles of Igneous and Metamorphic Petrology. Cambridge.</li> <li>4. Winter, J. D. 2001. Igneous and Metamorphic Petrology. Prentice Hall.</li> <li>5. Gautam Sen, 2014. Petrology: Principles and Practice: Gautam Sen (Springer).</li> <li>6. Best, M. G. 2013. Igneous and Metamorphic Petrology. Wiley Blackwell.</li> </ol>		

7. Don L. Anderson 2012 Theory of the Earth Blackwell Scientific Publications  
8. Alexander R McBirney, 2006 Igneous Petrology, III edition: Alexander R McBirney  
9. White, W. M. Isotope Geochemistry. Wiley Blackwell  
10. Faure, G. and Mensing, T. M. 2009 Isotope principles and Applications.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12<sup>th</sup>.**

Suggested Continuous Evaluation Methods:  
**Test: 10 Marks; Presentation: 10, Class participation and activity: 5** .....

Course prerequisites: To study this course, a student must have had the subject **Certificate in Geology**

Suggested equivalent online courses:  
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Further Suggestions:  
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Programme/Class: <b>Diploma</b>	Year: <b>Second</b>	Semester: <b>Fourth</b>
Subject: <b>Geology</b>		
Course Code: <b>B090402P</b>	Course Title: Practical Petrology	
Course outcomes: After completing the course, student		
Credits: 2	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-3		
Unit	Topics	No. of Lectures
	<p>Study of rock types in hand specimens and thin sections: Granite, Syenite, Diorite, Dolerite, Gabbro, Dunite, Rhyolite, Basalt, Quartzite, Marble, Schist and Charnockite, Study of rock types in hand specimens only: Pegmatite, Sandstone, Limestone, Conglomerate, Shale, Phyllite, Slate and Gneiss</p> <p>Study of sedimentary rock types in hand specimens and thin sections: Quartz-arenite, Arkose, Glauconitic-sandstone, Oolitic limestone, Pellet limestone, Fossiliferous limestone.</p> <p>Study of sedimentary rock types in hand specimens only: Conglomerate, Breccia, Stromatolitic limestone, Siltstone and Shale.</p> <p>Study of sedimentary structures in hand specimens such as ripple marks, cross-bedding, graded- bedding, mud cracks, salt pseudomorphs, rain prints etc.</p>	60
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>1. Cox, K. G., Bell, J. D. and Pankhurst, R. J. 1979. Interpretations of igneous rocks. George Allen and Unwin, London.</li> <li>2. Wilson, M. 1989. Igneous Petrogenesis. London Unwin Hyman.</li> <li>3. Anthony R. Philpotts and Ague, J. J. 2009. Principles of Igneous and Metamorphic Petrology. Cambridge.</li> <li>4. Winter, J. D. 2001. Igneous and Metamorphic Petrology. Prentice Hall.</li> <li>5. Prothoreo and Schwab, 2004. Sedimentary Geology, Freeman</li> <li>6. Collinson, J.D. and Thompson, D.B., 1988. Sedimentary Structures, UnwinHyman, London.</li> <li>7. Sam Boggs, 1995. Principles of Sedimentology and Stratigraphy, Print iceHall, New Jersey.</li> </ol>		
This course can be opted as an elective by the students of following subjects: <b>NO</b>		
<p>Suggested Continuous Evaluation Methods:  <b>Practical Record: 10 Marks; 10, Class participation and activity: 5, Examination: 50Marks</b>  <b>Viva-voce: 25 marks,</b></p>		
Course prerequisites: To study this course, a student must have had the subject <b>Certificate in Geology</b>		
Suggested equivalent online courses: .....		

Further Suggestions:

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Programme/Class: <b>Degree B.Sc.</b>	Year: <b>Third</b>	Semester: <b>Sixth</b>
Subject: <b>Geology</b>		
Course Code: <b>B090501T</b>	Course Title: Applied Geology and Global Tectonics	
Course outcomes: After completing the course, student will understand the plate tectonic will understand the processes related to rifting, volcanism, mountain building etc. will understand the construction of dam, tunnel and safety of roads in hilly regions		
Credits: 4	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	No. of Lectures
<b>I</b>	Concepts of Geophysical, Geochemical and Geobotanical mineral exploration; Concept of surface and subsurface mining	8
<b>II</b>	Engineering properties of rocks and Soils, Soil and Soil groups of India	9
<b>III</b>	Introduction to geotechnical properties of rocks; Geological consideration for geo-engineered structures;	8
<b>IV</b>	Tunnels: geology, structure, seepage problem and role of water table	8
<b>V</b>	Active and Passive continental margins; Wilson Cycle, Geomagnetic reversals;	8
<b>VI</b>	Tectonic events in the Himalaya; Suspect Terranes, Hot-spots and Mantle plumes; Triple junctions	9
<b>VII</b>	Environmental considerations for mining.	5
<b>VIII</b>	Dam, Types and their geological and environmental considerations; Geological problem of reservoirs	5
<b>Suggested Readings:</b>		
<ol style="list-style-type: none"> <li>1. Kent C. Condie, Plate Tectonics and Crustal Evolution, Butterworth-Heinemann</li> <li>2. Philip Kearey, Keith A. Klepeis, Frederick J. Vine, Global Tectonics, John Wiley &amp; Sons</li> <li>3. L.D. Leet, S. Judson and M.E. Kauffman, (1982), Physical Geology . Prentice-Hall Inc. 629p.</li> <li>4. Krynine D.P. and Judd W.R., 1957. Principles of Engineering Geology &amp; Geotechnics. McGraw-Hill Book</li> <li>5. Kesavulu, N.C., 2009. A text book of engineering geology. Macmillan P publishing India Ltd.</li> <li>6. Crozier. M.J., 1989. Landslides: causes, consequences and environment. Academic Press.</li> <li>7. Readman, J.H., 1979. Techniques in Mineral exploration. Applied Science Publishres.</li> <li>8. Bell, F.G., 1983. Fundamentals of Engineering Geology. Butterworth and Co</li> </ol>		
This course can be opted as an elective by the students of following subjects: <b>Open for all who have science stream in 12<sup>th</sup>.</b>		

<p>Suggested Continuous Evaluation Methods:  <b>Test: 10 Marks; Presentation: 10, Class participation and activity: 5</b> .....</p>
<p>Course prerequisites: To study this course, a student must have had the subject  <b>Diploma in Geology</b></p>
<p>Suggested equivalent online courses:  .....</p>
<p>Further Suggestions:  .....</p>

At the End of the whole syllabus any remarks/ suggestions:

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Programme/Class: <b>Degree B.Sc.</b>	Year: <b>Third</b>	Semester: <b>Fifth</b>
Subject: <b>Geology</b>		
Course Code: <b>B090502T</b>	Course Title: <b>STRATIGRAPHY</b>	
<p>Course outcomes:          After completing the course, student          Will learn the presence of different types          Understand fundamentals of stratigraphy and its branches.          Will be able to identify potential zone of earth resource</p>		
Credits: 4		Core: <b>Compulsory</b>
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	No. of Lectures
<b>I</b>	Principles of Stratigraphy; History and Development of Stratigraphy; Concept of Lithofacies and Biofacies; Lithostratigraphic, Chronostratigraphic and Biostratigraphy units; Stratigraphic correlation; Concepts of Magnetostratigraphic, Chemostratigraphy, Event stratigraphy	8
<b>II</b>	Physical and structural subdivisions of the Indian subcontinent and their characters; Brief idea about Archaean successions of Peninsular India with special reference to the Dharwar Supergroup	7
<b>III</b>	Unmetamorphosed Proterozoic successions of India with special reference to Cuddapah and Vindhyan Supergroups	8
<b>IV</b>	Gondwana Supergroup; Marine Palaeozoic sequences of the Himalaya and Peninsular India	7
<b>V</b>	Marine Triassic and Jurassic successions of India; Marine and non-marine Cretaceous successions of Trichinopoly	8
<b>VI</b>	Stratigraphy of the Deccan Traps and Intertrappean beds	7
<b>VII</b>	Cenozoic stratigraphy: Cenozoic formations of India	7
<b>VIII</b>	Rise of the Himalayas and development of Siwalik Group; Quaternary Period and Meghalayan Stage	8
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>1. Doyle, P. and Bennett, M.R., 1996. Unlocking the Stratigraphic Record, John Willey.</li> <li>2. Dunbar, C.O. and Rodgers, J., 1957. Principles of Stratigraphy. John Wiley &amp; Sons.</li> <li>3. Krishnan, M.S., 1982. Geology of India and Burma, C.B.S. Publishers, Delhi</li> <li>4. Naqvi, S.M. 2005. Geology and Evolution of the Indian Plate: From Hadean to Holocene 4 Ga to 4 Ka. Capital Pub., New Delhi.</li> <li>5. Pascoe, E.H., 1968. A Manual of the Geology of India &amp; Burma (Vols.IN), Govt. of India Press, Delhi.</li> <li>6. Pomerol, C., 1982. The Cenozoic Era - Tertiary and Quaternary. Ellis Harwood Ltd., Halsted Press.</li> <li>7. Schoch, R.M., 1989. Stratigraphy: Principles and Methods, Van Nostrand Reinhold, New York.</li> <li>8. R. Vaidyanathan &amp; M.Ramakrishnan, 2008. Geology of India, Geological Society of India.</li> </ol>		
<p>This course can be opted as an elective by the students of following subjects: <b>Open for all who have science stream in 12<sup>th</sup>.</b></p>		

Suggested Continuous Evaluation Methods:

**Test: 10 Marks; Presentation: 10, Class participation and activity: 5** .....

Course prerequisites: To study this course, a student must have had the subject

**Diploma in Geology**

Suggested equivalent online courses:

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Further Suggestions:

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Programme/Class: <b>Degree B.Sc.</b>	Year: <b>Third</b>	Semester: <b>Sixth</b>
Subject: <b>Geology</b>		
Course Code: <b>B090503R</b>	Course Title: Field Work	
<p>Course outcomes:          After completing the course, student          will understand the plate tectonic          will understand the processes related to rifting, volcanism, mountain building etc.          will understand the construction of dam, tunnel and safety of roads in hilly regions</p>		
Credits: 2	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		
Unit	Topics	No. of Lectures
	<p><b>Geological Field Excursion at least of 7Days</b></p> <p>Every student shall be required to attend the field training and submit to the Head of the Department a record of field observations and specimens collected, properly labelled and arranged; and a Viva–Voce examination based on the field work.</p> <p>The marks assigned to the fieldwork shall be on the basis of the field records and collections, and performance in the field.</p>	7 Days
<b>Suggested Readings:</b>		
This course can be opted as an elective by the students of following subjects: <b>Open for all who have science stream in 12<sup>th</sup>.</b>		
<p>Suggested Continuous Evaluation Methods:  <b>Test: Performance in Field 30 Marks; Sample Collection 10 Marks; Field Report 40 Marks; Viva: 20Marks</b> .....</p>		
<p>Course prerequisites: To study this course, a student must have had the subject  <b>Diploma in Geology</b></p>		
<p>Suggested equivalent online courses:          .....</p>		
<p>Further Suggestions:          .....</p>		

Programme/Class: <b>Degree B.Sc.</b>	Year: <b>Third</b>	Semester: <b>Sixth</b>
Subject: <b>Geology</b>		
Course Code: <b>B090601T</b>	Course Title: <b>Remote Sensing and Environmental Geology</b>	
<p>Course outcomes:  After completing the course, student  will state of art technology, being effectively used to monitor and assess the earth's resources  will be able to develop skills of interpreting the visual and digital satellite data  will understand the interaction of humans with the geological environment</p>		
Credits: 3		Core: <b>Compulsory</b>
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0		
Unit	Topics	No. of Lectures
<b>I</b>	Elementary idea about photogeology: electro-magnetic spectrum, types & geometry of aerial photographs; factors affecting aerial photography; types of camera, film and filters; factors affecting scale	8
<b>II</b>	Fundamentals of remote sensing; remote sensing systems; remote sensing sensors; signatures of rocks, minerals and soils. Application of remote sensing in geoscience and geomorphological studies.	8
<b>III</b>	Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification	7
<b>IV</b>	Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing	7
<b>V</b>	Earth and its spheres: atmosphere, hydrosphere, lithosphere, biosphere and Man; Earth Material	8
<b>VI</b>	Energy budget: Solar radiation; Global environments: coastal, riverine, desertic, tropical, cold, polar; Concept of global warming and climate change	8
<b>VII</b>	Geological hazards: Earthquakes, volcanism, landslides, avalanches, floods, droughts; Hazard mitigation	7
<b>VIII</b>	Resource Management: Energy resources (Conventional and non-conventional), watershed management, landuse planning, management of water resources, land reclamation	7
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>1. T. M. Lillesand and P. W. Kiefer. 2016 Remote Sensing and Image Interpretation. Wiley</li> <li>2. R. P. Gupta. 2016. Remote Sensing Geology, Springer</li> <li>3. F. F. Sabins, 2007. Remote Sensing, Principal and Interpretation Waveland Pr Inc</li> <li>4. P. R. Wolf and B. A. Dewitt, 2004. Elements of Photogrammetry with applications in GIS.</li> <li>5. G. Joseph and C. Jeganathan, 2018. Fundamentals of Remote Sensing: Universities Press (India) Private Limited.</li> <li>6. Bhatta, B., 2008. Remote Sensing and GIS. Oxford, New Delhi.</li> <li>7. Verma, V.K., 1986. Geomorphology Earth surface processes and form. McGraw Hill.</li> <li>8. Chorley, R. J., 1984. Geomorphology. Methuen.</li> <li>9. Selby, M.J., 1996. Earths Changing Surface. Oxford University Press UK.</li> <li>10. Thornbury W. D., 1997. Principles of Geomorphology Wiley Eastern Ltd., New Delhi.</li> </ol>		

11.Valdiya, K. S., 1987. Environmental Geology - Indian Context. Tata McGraw Hill New Delhi.  
 12.Keller, E. A., 2000. Environmental Geology. Shales E. Merril Publishing Co., Columbus, Ohio.  
 13.Montgomery, C., 1984. Environmental Geology. John Wiley and Sons, London.  
 14.Bird, Eric, 2000. Coastal Geomorphology: An Introduction. John Wiley & Sons, Ltd. Singapore.  
 15.Liu, B.C., 1981. Earthquake Risk and Damage, Westview.

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12<sup>th</sup>.**

Suggested Continuous Evaluation Methods:

**Test: 10 Marks; Presentation: 10, Class participation and activity: 5** .....

Course prerequisites: To study this course, a student must have had the subject **Diploma in Geology**

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Suggested equivalent online courses:

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Further Suggestions:

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Programme/Class: <b>Degree B.Sc.</b>	Year: <b>Third</b>	Semester: <b>Fifth</b>
Subject: <b>Geology</b>		
Course Code: <b>B090602T</b>	Course Title: <b>Economic Geology and Ground Water</b>	
<p>Course outcomes:  After completing the course, student  will identify the common ore minerals.  will understand the genetic controls exerted by physical and chemical processes on ore formation in various geologic settings,  will understand economic and policy issues related to minerals and their national importance</p>		
Credits: 4		Core: <b>Compulsory</b>
Max. Marks: 25+75		Min. Passing Marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
Unit	Topics	No. of Lectures
<b>I</b>	Classification of mineral deposits; Processes of formation of ores: magmatic, hydrothermal, oxidation and supergene enrichment; Concept of critical,	8
<b>II</b>	Occurrence, origin and distribution of the important mineral deposits of India: Copper, Iron, Manganese,	7
<b>III</b>	Occurrence, origin and distribution of the important mineral deposits of India: Aluminium , Chromium, Lead and Zinc.	6
<b>IV</b>	Conventional energy resources: Coal, Petroleum,	8
<b>V</b>	Radioactive minerals (Uranium and Thorium) , essential and strategic minerals	8
<b>VI</b>	Non -conventional energy resources: Geothermal energy - hot springs; Non-metallic minerals to refractory and cement industry	8
<b>VII</b>	Groundwater and its vertical distribution; Aquifers and the geological considerations; Water bearing properties of rocks - Porosity and Permeability; specific yield, specific retention	8
<b>VIII</b>	Rainwater harvesting; River and groundwater pollution	7
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>Ridley, John. (2013). Ore deposit geology. Cambridge University Press.</li> <li>Barnes, H.L., 1979. Geochemistry of Hydrothermal Ore Deposits, John Wiley.</li> <li>Mookherjee, A, 2000. Ore Genesis – A Holistic Approach. Allied Publisher.</li> <li>Craig, J. R., and D. J. Vaughn. “Ore microscopy and ore mineralogy.” (1994).</li> <li>Pracejus, Bernhard. 2015The ore minerals under the microscope: an optical guide. Vol. 3. Elsevier.</li> <li>Bateman, Alan Mara, and Mead L. Jensen. 1950. Economic mineral deposits. Vol. 259. New York: Wiley.</li> </ol>		

This course can be opted as an elective by the students of following subjects: **Open for all who have science stream in 12<sup>th</sup>.**

Suggested Continuous Evaluation Methods:

**Test: 10 Marks; Presentation: 10, Class participation and activity: 5**.....

Course prerequisites: To study this course, a student must have had the subject

**Diploma in Geology**

Suggested equivalent online courses:

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Further Suggestions:

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Programme/Class: <b>Degree B.Sc.</b>	Year: <b>Third</b>	Semester: <b>Fifth</b>
Subject: <b>Geology</b>		
Course Code: <b>B090603P</b>	Course Title: <b>Practical Economic Geology</b>	
<p>Course outcomes:          After completing the course, student          will understand the plate tectonic          will understand the processes related to rifting, volcanism, mountain building etc.          will understand the construction of dam, tunnel and safety of roads in hilly regions</p>		
Credits: 2	Core: <b>Compulsory</b>	
Max. Marks: 25+75	Min. Passing Marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-2		
<b>Unit</b>	<b>Topics</b>	<b>No. of Lectures</b>
	Study of important economic minerals in hand specimens.  Stereographic projection technique to solve dip and strike problem & other problems, Surveying Methods	60
This course can be opted as an elective by the students of following subjects: <b>Open for all who have science stream in 12<sup>th</sup>.</b>		
Suggested Continuous Evaluation Methods: <b>Practical Record: 10 Marks; 5, Class participation and activity: 5, Examination:40 Marks</b> <b>Viva-voce: 20marks, Geological Field Excursion:20</b>		
Course prerequisites: To study this course, a student must have had the subject <b>Diploma in Geology</b>		
Suggested equivalent online courses: .....		
Further Suggestions: .....		