



# Chaudhary Charan Singh University, Meerut

Syllabus of the Subject:

Geology

For First Three Years of Under-Graduate (UG) Programme

(As per guidelines of National Education Policy-2020

w.e.f. the session 2021-2022)

(For both University Campus and Colleges)

Board of Studies:

S.No	Name	Signature
1.	Prof. MK Gupta, Dean Faculty of Science, CCS University, Meerut, (Convenor I)	<i>M.K. Gupta</i> 31.5.2021
2.	Dr. Poonam Khare, Associate Professor, Department of Geology, J.V. Jain College, Saharanpur (Convenor II)	<i>Poonam Khare</i>
3.	Prof. R Krishnamurti, Department of Earth Science, IIT Roorkee	Scanned signature attached
4.	Prof. A.K. Biyani (Retd) Prof & Head DBS College Dehradun, Obergfell Rangarao Trust for Geosciences, 1803, Rajpura Road Dehradun	Scanned signature attached
5.	Prof. Meenal Mishra, Head Discipline of Geology, IGNOU, New Delhi	<i>Meenal Mishra</i>
6.	Dr. D.C. Nainwal, Principal SDM Govt. PG. College, Doiwala.	Scanned signature attached
7.	Naveen Shukla, State Consultant, Water Safety and Security Consultant UNICEF project Call, UP Jal Nigam, Lucknow.	Scanned signature attached

*Poonam Khare*  
Dept of Geology  
J.V. Jain College  
31/5/2021  
SRS

*Meenal*  
प्रो. मीनल मिश्रा / Prof. Meenal Mishra  
आचार्य प्रबन्धन / Professor in Geology  
विज्ञान विद्यापीठ / School of Sciences  
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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

1/26 B.Sc. Syllabus: Geology

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*Sanjay Shukla*  
3/1/2021  
**SUBJECT: Geology**

*Meenal Mishra*  
प्रो. मीनल मिश्रा / Prof. Meenal Mishra  
आचार्य प्रतिष्ठान / Professor in Geology  
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IGNOU, Mahuli Dist. Meerut

**Semester-wise Titles of the Papers in B.Sc. (Geology)**

Year	Year	Course Code	Theory/ Practical	Compulsory/ Elective	Course Title
	I	B090101T	Theory	Compulsory	Physical and Structural Geology
		B090102P	Theory	Compulsory	Practical: Structural Geology
		B090201T	Theory	Compulsory	Mineralogy and Crystallography
		B090202P	Practical	Compulsory	Practical: Mineralogy and Crystallography
	II	B090301T	Theory	Compulsory	Palaeontology
		B090402P	Practical	Compulsory	Practical: Palaeontology
		B090401T	Theory	Compulsory	Petrology
		B090402P	Theory	Compulsory	Practical: Petrology

III	B090501T	Theory	Compulsory	<i>Applied Geology and Global Tectonics</i>
	B090502T	Theory	Compulsory	<i>Stratigraphy</i>
	B090503R	Practical	Compulsory	<i>Field Work</i>
	B090601T	Theory	Compulsory	<i>Remote Sensing and Environmental Geology</i>
	B090602T	Theory	Compulsory	<i>Economic Geology and Geo</i>
	B090603P	Practical	Compulsory	<i>Practical: Economic Geolog.</i>

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### 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 the Department of Geology, J.V. Jain College, Saharanpur( affiliated with CCS University, Meerut) 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 excursions would be important components of the B.Sc. Program in Geology for laying a robust foundation to the budding geologists. Students will get exposure to actual rocks during Geological excursion. Students will learn the data collection, measurements and interpretations.

*Pranav Chaur*  
31/05/2021

*Meenal Mishra*  
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List of All Papers in All Six Semesters

Programme/Class: Certificate	Year: First	Semester: First
Subject: Geology		
Course Code: B090101T	Course Title: Physical and Structural Geology	
<p>Course outcomes:</p> <p>After completing the course, student should be able to</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> learn origin of solar system and Earth</li> <li><input type="checkbox"/> understand internal structure of Earth</li> <li><input type="checkbox"/> understand interpretation stress-strain imprinted in earth</li> <li><input type="checkbox"/> learn the Interpretation of deformed structure</li> <li><input type="checkbox"/> understand role of weathering agents</li> </ul>		
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
I	Introduction to Geology and its scope, Earth and Solar system: origin, size etc., Age of Earth, Components of Earth, Internal Structure and composition of Earth, Volcanoes and Earthquakes, Biography of renowned Indian Geologists and their contribution in Indian Geology.	7
II	Weathering and erosion: factor, types, Geological work of wind:Erosion, transportation ,deposition and their related landforms	8
III	Geological work of river and glaciers:Erosion, transportation and deposition by rivers and glaciers, and their related landforms;	8
IV	Introduction to structural geology: contours, topographic and geological maps, elementary idea of dip, strike and outcrop.Basic concepts of stress and strain; Study of outcrop; Identification of bedding; Forms of igneous bodies (concordant and discordant)	8
V	Simple deformational structures: Fold morphology, their geometric and genetic classification, Top and Bottom of Beds	7
VI	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
VII	Unconformities: their classification, recognition and geological significance, onlap and offlap; Joint and its classification, Lineation and Foliation: basic introduction.	8
VIII	Sea-floor Spreading, Continental drift,Basic Concepts of Plate Tectonics	7

*J. Prasad*  
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**Suggested Readings:**

1. The Blue Planet: An Introduction to Earth System Science – B.J. Skinner and S.C. Porter. 1995, John Wiley & Sons, Inc. 493p.
2. Introduction to Physical Geology – G.R. Thompson and J. Turk. 1998, Saunders College Publishers, Fort Worth. 371p.
3. Processes that Shape the Earth – D.M. Thompson. 2007, Infobase Publishing, NY. 116p.
4. Physical Geology – L.D. Leet, S. Judson and M.E. Kauffman, (1982). Prentice-Hall Inc. 629p.
5. Holme's Principles of Physical Geology – P.MvL.D. Duff, Fourth Edition (1993). Stanley Thornes (Publishers) Ltd.
7. Bailey, B., 1992. Mechanics in Structural Geology, Springer.
8. Davis, G. H. and Reynolds, S. J., 1996. Structural Geology of rocks and regions, John Wiley. and Sons.
9. Ghosh, S. K., 1993. Structural Geology: Fundamentals, and modern developments, Pergamon Press.

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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. Rowland, S. M., Duebendorfer, E. and Schiefelbein, I. M., 2007. Structural analysis and synthesis: a laboratory course in structural geology, Balckwell pub.
14. Van der Pluijm, B. A. and Marshak, S., 2004. Earth structure: an introduction to structural Geology.
15. Billings, M.P. (1972): Structural Geology, Prentice Hall.
16. Holmes, Arthur (1992): Principles of Physical Geology, Vol. 1, Chapman and Hall, London.
17. Leet, L.D. and Judson, S. (1969): Physical Geology, Prentice Hall.
18. Mallory, B.F and Cargo, D.N. (1979): Physical Geology, McGraw Hill.
19. Monrow, James S. (1986): Physical Geology: Exploring the Earth, Booke Cole, Australia.
20. <http://egyankosh.ac.in/handle/123456789/36575>
21. <http://egyankosh.ac.in/handle/123456789/53574>
22. <http://egyankosh.ac.in/handle/123456789/53280>

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>

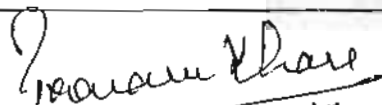
**Suggested equivalent online courses:**

**Further Suggestions:**

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IGNOU, Main Campus, Gurgaon, New Delhi-110068

*Praveen Khandelwal*  
31/05/2021

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 should be able to <ul style="list-style-type: none"> <li><input type="checkbox"/> interpret the geological maps</li> <li><input type="checkbox"/> measure the geological data from field</li> <li><input type="checkbox"/> Interpret geological structures</li> </ul>		
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
	Structural problems on dip and strike; Contour maps and completion of outcrops; Study and interpretation of topographical maps; Use of Clinometer compass, Calculation of Apparent Dip Simple Lithological boundary tracing, Determination of Thickness of bed. Identification of fold on geological maps through wooden models Identification of fault on geological maps through wooden models Identification of Unconformities on geological maps through wooden models Simple geological maps	60.
<b>Suggested Readings:</b> <ol style="list-style-type: none"> <li>1. F. H. T. Rhodes, geological maps, the commonwealth and international library.</li> <li>2. G. M. Bennison, 1992, an introduction to geological structures and maps, Edward arnold</li> <li>3. Richard j. Lisle, 1988, Geological structures, and maps, a practical guide, Amsterdam</li> <li>4. K. R. McClay, 1991, The mapping of geological structures, geological society of London handbook</li> <li>5. <a href="http://egyankosh.ac.in/handle/123456789/53580">http://egyankosh.ac.in/handle/123456789/53580</a></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>		
<b>Suggested Continuous Evaluation Methods:</b> <b>Practical Record: 20 Marks; ; 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: .....		

  
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**Meenal Mishra**  
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6/26

B.Sc. Syllabus: Geology

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Programme/Class: Certificate	Year: First	Semester: Second
Subject: Geology		
Course Code: B090201T	Course Title: Crystallography and Mineralogy	
Course outcomes: After completing the course, student should be able to		
<input type="checkbox"/> learn the mineral and its types <input type="checkbox"/> understand the crystal formation, form and occurrence <input type="checkbox"/> learn formation of mineral groups and resource		
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
I	Basic idea about crystal, crystal growth and crystallisation; Laws of crystallography; Crystal morphology; Crystallographic axes; Elements of symmetry; Crystallographic notations	7
II	Crystal forms; Habit and classification; Crystal aggregate: Twinning and common twin Laws	7
III	Symmetry and forms of Hexagonal (beryl type and calcite type), Orthorhombic (Barytes type), Monoclinic (Gypsum type), and Triclinic (Axinite type) Crystal Systems	8
IV	Symmetry and forms of Cubic (Galena type, Pyrite type and Tetrahedrite type), and Tetragonal (Zircon type) Crystal Systems	8
V	Definition of mineral; Atomic bonding; Physical properties of minerals: colour, lustre, form, hardness, fracture, cleavage, specific gravity, and characters based on heat, electricity and magnetism. Isomorphism, pseudomorphism and polymorphism. Structural classification of silicates.	8
VI	Physical properties, chemical composition, occurrences, and uses of minerals belonging to the quartz and feldspar, carbonate, zeolite and feldspathoid families, and clay minerals	7
VII	Physical properties; chemical composition, occurrences, and uses of pyroxene, olivine, mica garnet and amphibol families	6
VIII	Polarizing microscope: components and its functions. 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.	9

Pranav Khare

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	Optical properties of common rock forming minerals.	
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**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. Albarede, F, 2003. An introduction to geochemistry. Cambridge University Press.
7. <http://egyankosh.ac.in/handle/123456789/58908>
8. <http://egyankosh.ac.in/handle/123456789/58985>

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:**

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 IGNOU, Maidan Gahri, New Delhi-110068

Programme/Class: <b>Certificate</b>	Year: <b>First</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 should be able to <ul style="list-style-type: none"> <li><input type="checkbox"/> Learn to identify crystal symmetry elements</li> <li><input type="checkbox"/> Learn to identify minerals under polarizing microscope</li> <li><input type="checkbox"/> learn to identify the mineral in hand specimens</li> </ul>		
Credits: <b>2</b>	Core: <b>Compulsory</b>	
Max. Marks: <b>25+75</b>	Min. Passing Marks: <b>as per rules</b>	

Total No. of Lectures, Tutorials, Practical (in hours per week): **L T P: 0 0 2**



Unit	Topics	No. of Lectures
	<p>Graphical construction of crystallographic axes of Cubic system; Study of symmetry elements and forms of normal class of cubic tetrahedron, tetragonal, orthorhombic, hexagonal, trigonal, monoclinic and triclinic.</p> <p>Drawing of common crystals of Cube, Rhombdodecahedron, Tetrahexahedron, Trapezohedron, Pyritohedron, Tetrahedron, Zircon, Calcite</p> <p>Determination of physical properties of important rock forming minerals: (Quartz, orthoclase, Plagioclase, Microcline, Nepheline, Chlorite, Epidote, Calcite, Olivine, Garnet, Augite, Hypersthene, Hornblende, Muscovite, Biotite, Kyanite, talc, gypsum and kaolinite).</p> <p>Determination of optical properties of important rock forming minerals (Quartz, Orthoclase, Plagioclase, Microcline, Muscovite, Biotite, Garnet, Calcite).</p>	60

**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.
- 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.
6. <http://egyankosh.ac.in/handle/123456789/58895>

This course can be opted as an elective by the students of following subjects: No

**Suggested Continuous Evaluation Methods:**

**Practical Record: 20 Marks; : 10, Class participation and activity: 5, Examination:50 Marks Viva-voce: 25marks .....**

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:

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31/05/2021

*Signature of Meenal Mishra*

प्रो. मीनल मिश्रा / Prof. Meenal Mishra  
 अध्यक्ष, विभाग / Professor in Geology  
 विभाग, पदवी, 7/11/21  
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 IGNOU, Maidan Garhi, New Delhi-110068

Programme/Class: Diploma	Year: Second	
Subject: Geology		
Course Code: B090301T	Course Title: PALAEONTOLOGY	

Course outcomes:

After completing the course, student should be able to

- know the palaeo-life of earth
- know the reconstruction the earth based on fossils
- be able to determine the age of rock formation-based fossils
- be able to locate the resources based on fossils

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: 4-0-0

Unit	Topics	No. of Lectures
I	Introduction to palaeontology; processes of fossilisation; Preliminary idea of the origin of life; Basic idea of trace fossils and their uses	7
II	Morphology and geological history of Bivalvia, Brachiopoda	8
III	Morphology and geological history of Gastropoda, Cephalopoda	8
IV	Morphology and geological history of Echinoidea and Anthozoa.	8
V	Morphology and geological history of Trilobita and Graptolithina	8
IV	Introduction to Palaeobotany; Important Lower and Upper Gondwana plant fossils	7
VII	Brief idea of concept of species; Classification of organisms; Principles of marine Secology, palaeoecology;	7
VIII	Principles of sequence stratigraphy; Microplaeontology and its use	7

**Suggested Readings:**

1. Cowen, R. (2000) History of Life, Blackwell Science.
2. E. N. K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science
3. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press
4. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing
5. Patrick Wyse Jackson, (2019) Introducing Palaeontology: A Guide to Ancient Life, Dunedin Academic Press Ltd.
6. Raymond Enay (2012) Palaeontology of Invertebrates, Springer-Verlag.
7. Peter Doyle, Understanding Fossils: An Introduction to Invertebrate Palaeontology.
8. Morley Davies (2008) An Introduction to Palaeontology, Read Books.
9. Sreepat Jain (2017) Fundamentals of Invertebrate Palaeontology: Macrofossils, Springer India
10. Roland Goldring, (2014) Field Palaeontology, Routledge
11. Johansson, C. Z., Underwood, M. Richter, (2019) Evolution and development of Fishes, Cambridge University Press.
12. Pratul Kumar Saraswati, M.S. Srinivasan, (2016) Micropaleontology: Principles and Applications, Springer International Publishing Switzerland.
13. Michael Benton, David A. T. Harper, (2009) Introduction to Paleobiology and the Fossil Record

*Pratul Kumar*  
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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:

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: <b>Practical: PALAEOLOGY</b>	
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
	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 Preparation of lithostratigraphic maps of India showing distribution of important geological formations	60

*Joanau Dore*  
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प्रो. मीनल मिश्रा / Prof. Meenal Mishra  
आचार्य भूविज्ञान / Professor in Geology  
विज्ञान विद्यापीठ / School of Sciences  
इ. गां. रा. मु. वि., मैदान गढ़ी, नई दिल्ली-110068  
IGNOU, Maidan Garhi, New Delhi-110068

**Suggested Readings:**

1. Cowen, R. (2000) History of Life, Blackwell Science.
2. E. N. K. Clarkson (2013) Invertebrate palaeontology and Evolution, Blackwell Science
3. Rhona M. Black, (1989) The Elements of Palaeontology, Cambridge University Press
4. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing

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:**

**Practical Record: 10 Marks; 5, Class participation and activity: 5, Examination:40  
Marks Viva-voce: 20marks, Geological Field Excursion:20**

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:  
.....

12/26 B.Sc. Syllabus: Geology Last Save 4/24/2021 8:37 AM

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>	
Course outcomes: After completing the course, student should be able <ul style="list-style-type: none"> <li><input type="checkbox"/> learn to identify rock types and their mineralogical composition.</li> <li><input type="checkbox"/> learn texture, structure found within the rock</li> <li><input type="checkbox"/> to understand the role of temperature and pressure in formation of rocks</li> <li><input type="checkbox"/> to understand the geo-thermoeter</li> <li><input type="checkbox"/> to understand stratigraphy and sedimentation history of different sedimentary basins of India understand the process of sedimentation and rock formation</li> </ul>		
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
I	Phase Rule; Laws of thermodynamics; Phase equilibria studies in $SiO_2$ , Diopside-Anorthite, Albite-Anorthite, Leucite-Silica and Diopside-Albite Anorthite systems	8
II	Brief introduction to rocks; Magma: definition, composition and	

*Praveen Sharma*  
31/05/2021

*Meenal Mishra*  
 प्रो. मीनाल मिश्रा / Prof. Meenal Mishra  
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 विज्ञान विद्यापीठ / School of Sciences  
 इ.गं.रा.मु.वि., मैदान गढ़ी, नई दिल्ली-110068  
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	Bowen's reaction series; Magmatic differentiation and assimilation	
III	Textures of igneous rocks; IUGS classification of igneous rocks, Brief petrographic description of common igneous rocks	6
IV	Definition, agents, types and grades of metamorphism; Metamorphic rocks: texture, structure and classification; Concept of index minerals, isograds and metamorphic facies;	8
V	Regional metamorphism of pelitic, calcareous and basic rocks; anatexis; Brief description of common metamorphic rocks.	7
VI	Origin and classification of sedimentary rocks; Introduction to sedimentary rocks and their origin;	8
VII	Sediment characteristics; Diagenesis; Textures of sedimentary rocks; Sedimentary structures.	8
VIII	Classification of sedimentary rocks: clastic and non-clastic; Classification of sandstone and carbonates; Sedimentary basins in different tectonic settings	9

**Suggested Readings:**

1. Cox, K. G., Bell, J. D. and Pankhurst, R. J. 1979. Interpretations of igneous rocks. George Allen and Unwin, London.
2. Wilson, M. 1989. Igneous Petrogenesis. London Unwin Hyman.
3. Anthony R. Philpotts and Ague, J. J. 2009. Principles of Igneous and Metamorphic Petrology. Cambridge.
4. Winter, J. D. 2001. Igneous and Metamorphic Petrology. Prentice Hall.
5. Gautam Sen, 2014. Petrology: Principles and Practice: Gautam Sen (Springer).
6. Best, M. G. 2013. Igneous and Metamorphic Petrology. Wiley Blackwell.

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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>

*Gyanam Mishra*  
31/05/2021

प्रो. ग्यान मिश्रा / Prof. Gyanam Mishra  
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24, Maidan Garhi, New Delhi-110087

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

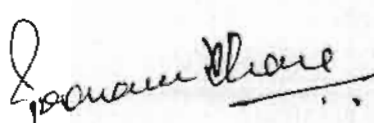
Course prerequisites: To study this course, a student must have had the subject  
**Certificate in Geology**

Suggested equivalent online courses:  
 .....

Further Suggestions:  
 .....

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Programme/Class: <b>Diploma</b>	Year: <b>Second</b>	Semester: <b>Fourth</b>
<b>Subject: Geology</b>		
Course Code: <b>B090402P</b>	Course Title: <b>Practical Petrology</b>	
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,</p> <p>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

  
 31/05/2021  
 Meenal Mishra  
 प्रो. मीनल मिश्रा / Prof. Meenal Mishra  
 आचार्य प्रविज्ञान / Professor in Geology  
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 इ.गं.रा.मु.वि., मैदान गढ़ी, नई दिल्ली-110068  
 IGNOU, Maidan Garhi, New Delhi-110068

**Suggested Readings:**

1. Cox, K. G., Bell, J. D. and Pankhurst, R. J. 1979. Interpretations of igneous rocks. George Allen and Unwin, London.
2. Wilson, M. 1989. Igneous Petrogenesis. London Unwin Hyman.
3. Anthony R. Philpotts and Ague, J. J. 2009. Principles of Igneous and Metamorphic Petrology. Cambridge.
4. Winter, J. D. 2001. Igneous and Metamorphic Petrology. Prentice Hall.
5. Prothoreo and Schwab, 2004. Sedimentary Geology, Freeman
6. Collinson, J.D. and Thompson, D.B., 1988. Sedimentary Structures, UnwinHyman, London.
7. Sam Boggs, 1995. Principles of Sedimentology and Stratigraphy, Print iceHall, New Jersey.

This course can be opted as an elective by the students of following subjects: NO

**Suggested Continuous Evaluation Methods:**

**Practical Record: 10 Marks; 10, Class participation and activity: 5, Examination: 50Marks Viva-voce: 25 marks,**

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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16/26 B.Sc. Syllabus: Geology

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Programme/Class: Degree B.Sc.	Year: Third	Semester: Sixth
Subject: Geology		
Course Code: B090501T	Course Title: Applied Geology and Global Tectonics	
Course outcomes: After completing the course, student be able to <ul style="list-style-type: none"> <li><input type="checkbox"/> understand the plate tectonic</li> <li><input type="checkbox"/> understand the processes related to rifting, volcanism, mountain building etc.</li> <li><input type="checkbox"/> understand the construction of dam, tunnel and safety of roads in hilly regions</li> </ul>		
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: 4-0-0		
Unit	Topics	

*Pranav Khari*  
8/105/2021

*Meenal Mishra*  
 प्रो. मीनल मिश्रा / Prof. Meenal Mishra  
 अध्यक्ष भूविज्ञान / Professor in Geology  
 विज्ञान विद्यापीठ / School of Sciences  
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I	Concepts of Geophysical, Geochemical and Geobotanical mineral exploration; Concept of surface and subsurface mining	8
II	Engineering properties of rocks and Soils, Soil and Soil groups of India	9
III	Introduction to geotechnical properties of rocks; Geological consideration for geo-engineered structures;	8
IV	Tunnels: geology, structure, seepage problem and role of water table	8
V	Active and Passive continental margins; Wilson Cycle, Geomagnetic reversals;	8
VI	Tectonic events in the Himalaya; Suspect Terranes, Hot-spots and Mantle plumes; Triple junctions	9
VII	Environmental considerations for mining.	5
VIII	Dam, Types and their geological and environmental considerations; Geological problem of reservoirs	5

**Suggested Readings:**

1. Kent C. Condie, Plate Tectonics and Crustal Evolution, Butterworth-Heinemann
2. Philip Kearey, Keith A. Klepeis, Frederick J. Vine, Global Tectonics, John Wiley & Sons
3. L.D. Leet, S. Judson and M.E. Kauffman, (1982), Physical Geology . Prentice-Hall Inc. 629p.
4. Krynine D.P. and Judd W.R., 1957. Principles of Engineering Geology & Geotechnics. McGraw-Hill Book
5. Kesavulu, N.C., 2009. A text book of engineering geology. Macmillan P publishing India Ltd.
6. Crozier. M.J., 1989. Landslides: causes, consequences and environment. Academic Press.
7. Readman, J.H., 1979. Techniques in Mineral exploration. Applied Science Publishres.
8. Bell, F.G., 1983. Fundamentals of Engineering Geology. Butterworth and Co

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>.**

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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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*Pravara Dhas*  
31/05/2021  
Prof. Meenal Mishra  
School of Sciences  
NOU, Maidam Garhi, New Delhi-110068



Programme/Class: Degree B.Sc.	Year: Third	Semester: Fifth
Subject: Geology		
Course Code: B090502T	Course Title: STRATIGRAPHY	
Course outcomes: After completing the course, student be able to		
<input type="checkbox"/> learn the presence of different types <input type="checkbox"/> Understand the fundamentals of stratigraphy and its branches. <input type="checkbox"/> be able to identify potential zone of earth resource		
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: 4-0-0		
Unit	Topics	No. of Lectures
I	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. Geological Time Scale	8
II	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
III	Unmetamorphosed Proterozoic successions of India with special reference to Cuddapah and Vindhyan Supergroups	8
IV	Gondwana Supergroup; Marine Palaeozoic sequences of the Himalaya and Peninsular India	7
V	Marine Triassic and Jurassic successions of India; Marine and non-marine Cretaceous successions of Trichinopoly	8
VI	Stratigraphy of the Deccan Traps and Intertrappean beds	7
VII	Cenozoic stratigraphy: Cenozoic formations of India	7
VIII	Rise of the Himalayas and development of Siwalik Group; Quaternary Period and Meghalayan Stage	8

*Prasanna Mishra*  
31/05/2021

*Meenal Mishra*  
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 विज्ञान विद्यापीठ / School of Sciences  
 ई. गा. ३१.५५, मंगल गढ़ी, नई दिल्ली-110068  
 IGNOU, Mangal Garhi, New Delhi-110068

**Suggested Readings:**

1. Doyle, P. and Bennett, M.R., 1996. Unlocking the Stratigraphic Record, John Wiley.
2. Dunbar, C.O. and Rodgers, J., 1957. Principles of Stratigraphy. John Wiley & Sons.
3. Krishnan, M.S., 1982. Geology of India and Burma, C.B.S. Publishers, Delhi
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.
5. Pascoe, E.H., 1968. A Manual of the Geology of India & Burma (Vols.IV), Govt. of India Press, Delhi.
6. Pomeroy, C., 1982. The Cenozoic Era - Tertiary and Quaternary. Ellis Harwood Ltd., Halsted Press.
7. Schoch, R.M., 1989. Stratigraphy: Principles and Methods, Van Nostrand Reinhold, New York.
8. R. Vaidyanathan & M. Ramakrishnan, 2008. Geology of India, Geological Society of India.

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>.**

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Suggested Continuous Evaluation Methods: <b>Test: 10 Marks; Presentation: 10, Class participation and activity: 5.....</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: .....

20/26 B.Sc. Syllabus: Geology

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: <b>Field Work</b>	
Course outcomes: After completing the course, student should be able to <ul style="list-style-type: none"> <li><input type="checkbox"/> understand the plate tectonic</li> <li><input type="checkbox"/> understand the processes related to rifting, volcanism, mountain building etc.</li> <li><input type="checkbox"/> understand the construction of dam, tunnel and safety of roads in hilly regions</li> </ul>		
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): <b>4-TP-2</b>		
Unit	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p style="font-size: 2em; font-family: cursive;">Ipsara Chakraborty</p> <p style="font-size: 1.5em;">31/05/2021</p> </div> <div style="text-align: center;"> <p style="font-size: 1.2em;">Topics</p> </div> <div style="text-align: right;"> <p style="font-size: 1.5em; font-family: cursive;">Meenal Mishra</p> <p style="font-size: 0.8em;">             प्रो. मीनल मिश्रा / Prof. Meenal Mishra              आचार्य भूविज्ञान / Professor in Geology              विज्ञान विद्यापीठ / School of Sciences              ६. गा. रा. मु. वि., मैदान गढ़ी, नई दिल्ली-110068              IOU, Maidan Garhi, New Delhi-110068           </p> </div> </div>	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>	<p>Geological field excursion in and around Saharanpur (60 hours)</p>
<p><b>Suggested Readings:</b></p>		
<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>		
<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>		

21/26 B.Sc. Syllabus: Geology

<p>Programme/Class: Degree B.Sc.</p>	<p>Year: <b>Third</b></p>	<p>Semester: <b>Sixth</b></p>
<p>Subject: <b>Geology</b></p>		
<p>Course Code: <b>B090601T</b></p>	<p>Course Title: <b>Remote Sensing and Environmental Geology</b></p>	
<p>Course outcomes:  After completing the course, student should be able to</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 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</li> <li><input type="checkbox"/> understand the interaction of humans with the geological environment</li> </ul>		
<p>Credits: 3</p>	<p>Core: <b>Compulsory</b></p>	
<p>Max. Marks: 25+75</p>	<p>Min. Passing Marks: as per rules</p>	
<p>Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-3-0</p>		

*Pranav Sharma*  
31/05/2021

*Meenal Mishra*  
**प्रो. मीनल मिश्रा / Prof. Meenal Mishra**  
**अवर्य प्रोफेसर / Professor in Geology**  
**विज्ञान विद्यापीठ / School of Sciences**  
**ने. डी. यु. वि., मैदान गार्ड, नई दिल्ली-110068**  
**Meenon Garhi, New Delhi-110068**

Unit	Topics	No. of Lectures
I	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
II	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
III	Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification	7
IV	Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing	7
V	Defination of Environment and Environmental geology, atmosphere, hydrosphere, lithosphere, biosphere	8
VI	Energy budget: Solar radiation; Global environments: coastal, riverine, desertic, tropical, cold, polar; Concept of global warming and climate change	8
VII	Geological hazards: Earthquakes, volcanism, landslides, avalanches, floods, droughts; Hazard mitigation	7
VIII	Resource Management: Energy resources (Conventional and non-conventional), watershed management, landuse planning, management of water resources, land reclamation	7

#### Suggested Readings:

1. T. M. Lillesand and P. W. Kiefer. 2016 Remote Sensing and Image Interpretation. Wiley
2. R. P. Gupta. 2016. Remote Sensing Geology, Springer
3. F. F. Sabins, 2007. Remote Sensing, Principal and Interpretation Waveland Pr Inc
4. P. R. Wolf and B. A. Dewitt, 2004. Elements of Photogrammetry with applications in GIS.
5. G. Joseph and C. Jeganathan, 2018. Fundamentals of Remote Sensing: Universities Press (India) Private Limited.
6. Bhatta, B., 2008. Remote Sensing and GIS. Oxford, New Delhi.
7. Verma, V.K., 1986. Geomorphology Earth surface processes and form. McGraw Hill
8. Chorley, R. J., 1984. Geomorphology. Methuen.
9. Selby, M.J., 1996. Earths Changing Surface. Oxford University Press UK.
10. Thornbury W. D., 1997. Principles of Geomorphology Wiley Eastern Ltd., New Delhi.

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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.

*Signature*  
31/05/2021

*Meenal Mishra*  
श्री. मीनाल मिश्रा / Prof. Meenal Mishra  
आचार्य पदवीधर / Professor in Geology  
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ई.गो.रा.मु.वि., मैदान गढ़ी, नई दिल्ली-110068  
ANOU, Maidan Garhi, New Delhi-110068

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:  
 .....

Further Suggestions:  
 .....

23/26 B.Sc. Syllabus: Geology

Programme/Class: Degree B.Sc.	Year: Third	Semester: Fifth
Subject: Geology		
Course Code: B090602T	Course Title: Economic Geology and GroundWater	
Course outcomes: After completing the course, student should be able to <ul style="list-style-type: none"> <li><input type="checkbox"/> identify the common ore minerals.</li> <li><input type="checkbox"/> understand the genetic controls exerted by physical and chemical processes on ore formation in various geologic settings,</li> <li><input type="checkbox"/> understand economic and policy issues related to minerals and their national importance</li> </ul>		
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: 4-0-0		
Unit	Topics	No. of Lectures
I	Classification of mineral deposits; Processes of formation of ores: magmatic, hydrothermal, oxidation and supergene enrichment; Concept of critical minerals	8
II	Occurrence, origin and distribution of the important mineral deposits of India: Copper, Iron, Manganese,	7
III	Occurrence, origin and distribution of the important mineral deposits of India: Aluminium, Chromium, Lead and Zinc.	
IV	Conventional energy resources: Coal, Petroleum,	

*Suman Das*  
 31/05/2021

*Meenal Mishra*  
 Prof. Meenal Mishra  
 School of Sciences  
 110058

V	Radioactive minerals (Uranium and Thorium) , essential and strategic minerals	8
VI	Non -conventional energy resources: Geothermal energy - hot springs; Non metallic minerals to refractory and cement industry	8
VII	Groundwater and its vertical distribution; Aquifers and the geological considerations; Water bearing properties of rocks - Porosity and Permeability; specific yield, specific retention	8
VIII	Rainwater harvesting; River and groundwater pollution	7

**Suggested Readings:**

- Ridley, John. (2013). Ore deposit geology. Cambridge University Press.
- Barnes, H.L., 1979. Geochemistry of Hydrothermal Ore Deposits, John Wiley.
- Mookherjee, A., 2000. Ore Genesis – A Holistic Approach. Allied Publisher.
- Craig, J. R., and D. J. Vaughn. "Ore microscopy and ore mineralogy." (1994).
- Pracejus, Bernhard. 2015 The ore minerals under the microscope: an optical guide. Vol. 3. Elsevier.
- Bateman, Alan Mara, and Mead L. Jensen. 1950. Economic mineral deposits. Vol. 259. New York: Wiley.

**24/26 B.Sc. Syllabus: Geology**

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>Test: 10 Marks; Presentation: 10, Class participation and activity: 5.....</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: .....

**25/26 B.Sc. Syllabus: Geology**

Programme/Class: <b>Degree B.Sc.</b>	Year: <b>Third</b>	Semester: <b>Fifth</b>
<b>Subject: Geology</b>		
Course Code: <b>B090603P</b>	Course Title: <b>Practical Economic Geology</b>	
<p>Course outcomes: After completing the course, student should be able to</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> understand the plate tectonic</li> <li><input type="checkbox"/> understand the processes related to rifting, volcanism, mountain building etc.</li> <li><input type="checkbox"/> understand the construction of dam, tunnel and safety of roads in hilly region.</li> </ul>		

*Meenal Mishra*  
31/05/2021

*Meenal Mishra*  
**श्री. मीनाक्षी मिश्रा / Prof. Meenal Mishra**  
आचार्य कृषिज्ञान / Professor in Geology  
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IGNOU, New Delhi-110068

Credits: 2		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: 0-0-2		
Unit	Topics	No. of Lectures
	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: Practical Record: 10 Marks; 5, Class participation and activity: 5, Examination:40 Marks Viva-voce: 20marks, Geological Field Excursion:20		
Course prerequisites: To study this course, a student must have had the subject <b>Diploma in Geology</b>		
Suggested equivalent online courses: .....		
Further Suggestions: .....		

26/26 B.Sc. Syllabus: Geology

*Pragnan Khare*  
 (Dr. Pragnan Khare)  
 Assoc. Prof.  
 Deptt of Geology  
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*Meenal Mishra*  
 31.5.2021  
 Dean, Faculty of Sc.