

**MAHAKAUSHAL UNIVERSITY,  
JABALPUR M.P.**

**Approved by Higher Education  
and the Governor of M.P.**



**Faculty of Science  
Scheme & Syllabus  
For  
Subject- Geology  
M.Sc. Programme  
~~(1 Year PG Diploma/1 Year PG/2Year PG~~  
Programme  
I to IV Semester  
2025-26**

**Theory Paper: Scheme B-1 for Two Year PG Program**

**Part A- Introduction**

Program:2 Year PG	Class: M.Sc. I Semester	Year: 2025	Session: 2025-26
Subject: <b>Geology</b>			
1	Course Code	MGEO0101-T	
2	Course Title	Geomorphology, Geodynamics and Remote Sensing	
3	Course Type	Core Course	
4	Course Level	400	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	<p>Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Geomorphology, Geodynamics and Remote Sensing.</b></p> <p>Students will also develop theoretical reasoning and knowledge for practical use.</p> <p>Ancient Indian knowledge about Indian Rivers, and other natural agents, various Landforms.</p>	
7	Credit Value	6	
8	Total Marks	Max. Marks: 100 ( 40+60)	Minimum Passing Marks: 40

**Part B : Content of the Course**

**Total No. Of Lectures- Tutorial-Practicum ( in hours per week): 6**

**L-T-P: 90**

Unit	Topics	No. Of Lectures
I	<p><i>Ancient Indian knowledge about Nakshatra system and Solar system.</i>                      Earth and the solar system, Meteorites and other extra-terrestrial materials.                      Planetary evolution of the earth and its internal structure.  <i>Ancient Indian knowledge about Indian Rivers, and various major Landforms of India.</i> Vedic Saraswati River.                      Modern Basic principles of geomorphology; Weathering and soil formations; Mass wasting. Influence of climate on processes. Concept of erosion cycles; Geomorphic cycles and their interpretation; Morphology and its relation to structure and lithology.                      Activities:                      Poster presentation, Seminar-PPT</p>	18
II	<p>Fluvial Geomorphology, Rivers valley development – base level and its varieties, graded streams. Classifications of valleys. Drainage patterns and their significance. Drainage basin analysis. Arid zones and Wind action landforms, coastal regions geomorphology, 'Karst' landscapes and glaciated ranges and landforms. Geomorphic mapping.                      Orogeny and epeirogeny. Geosynclines and its types.                      Activities:                      Poster presentation, Seminar-PPT</p>	18

III	<p>Isostasy: Development of the concept, isostatic anomalies, isostatic models. Orogeny and epeirogeny. Geosynclines and its types. Continental drift: geological and geophysical evidences, mechanics, present status. Evidences of continental drift and polar wandering. Gravity and magnetic anomalies at Mid-ocean ridges, deep sea trenches, continental shield areas and mountain chains.</p> <p>Activities: Poster presentation, Seminar-PPT</p>	18
IV	<p>Concepts of Plate Tectonics and sea floor spreading. Types of plate boundaries and their features. Geodynamics of the Indian plate. Arc-Trench system, volcanic mountain chain. Triple junctions and their stability. Causes of plate motion. Seismic belts of the Earth. Seismicity and plate movements. Earthquake zones of India.</p> <p>Activities: Poster presentation, Seminar-PPT</p>	18
V	<p>Concepts and principles of aerial photography and photogrammetry; Orbiting satellites and sensor systems; Indian satellite remote sensing: data products and their interpretation. Digital image processing. Application of remote sensing in landform and land use mapping, structural mapping, hydrogeological studies and mineral exploration. Global and Indian Space Missions. Geographic Information System (GIS): principles and applications. Global Positioning System (GPS) - its applications.</p> <p>Activities: Poster presentation, Seminar-PPT</p>	18
<p>Keywords/ Tags: Geodynamics, Geosynclines, Mid-ocean ridges, GIS, GPS.</p>		

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings:

Merh S. S., Radhadrishna B. P.: M-42. Vedic Sarasvati – Evolutionary History of a Lost River of Northwestern India, Geol soc. India

Savinder Singh, 1998: Geomorphology. Prayag Pustak Bhawan

Pandey S N 2001: Principles and Applications of Photo Geology. New Age

Tripathi and Bajpai ed. 2000: Remote Sensing in Geosciences

Condle K C: Plate Tectonics and Crustal Evolution.

Davies, Geoffrey F. 1999: Dynamic Earth. 1e Cambridge Univ Press Gerald

Gutenberg Beno: Internal Constitution of the Earth. Dover

Hodgson, J H: Earthquake and Earth's Structures. Prentice Hall

Holmes, Doris L and Arthur: Holmes' Principles of Physical Geology. Wiley

Martin H P Bott, 1982: The Interior of the Earth. Edward Arnold

Schubert Donald L. Turcotte, 2002: Geodynamics. 2e, Cambridge Univ Press

Strahler, A N, 1971: Earth Sciences. Harper and Row

Wyllie, Peter J: The Dynamic Earth. Wiley

Wyllie, Peter J: The Way the Earth Works. Wiley

David Lang: The Earth System. Brown Publishers

Halis, J R: Applied Geomorphology.

Holmes, Doris L and Arthur Holmes, 1978: Principles of Physical Geology. Wiley

Oscar Diedrich von Engel, 1953: Geomorphology, Systematic and Regional. McMillan

Small, R J, 1970: Study of Landforms. Cambridge

Thornbury, W D 1968: Principles of Geomorphology. Wiley

Curran P J, 1985: Principles of Remote Sensing. ELBS/Longman

Drury S A, 1987: Image Interpretation in Geology. Allen and Unwin

Jensen, J A, 2006 : Remote Sensing of the Environment. Prentice Hall

Lueder D R, 2003: Aerial Photographic Interpretation: Principles and Applications. Textbook publisher

Miller V C, 1961: Photo Geology. McGraw

Pratt, William K, 2001: Digital Image Processing PIKS Scientific Inside. J Wiley

Wolf, P R, 1974: Elements of Photogrammetry. McGraw

<https://www.youtube.com/watch?v=AmWSSFP7dLU>

[The Chronology and Geography of Mahabharata: A ...](#)

YouTube · Sangam Talks

<https://www.youtube.com/watch?v=IDhNkbrdgsI&t=411s>

Wonders of Ancient Indian Science & Technology | Dr Raj Vedam | #SangamTalks

[https://www.researchgate.net/publication/237142076 Geographical Knowledge Of Ancient India](https://www.researchgate.net/publication/237142076_Geographical_Knowledge_Of_Ancient_India)

<https://www.youtube.com/watch?v=BQ0w-WytFpk>

geography of Ramayana

## Pattern of Marks Distribution THEORY PAPER for NEP PG courses

### Assessment and Evaluation

Recommended Continuous Assessment Methods:- <b>Maximum Marks: 100</b> Continuous Comprehensive Evaluation (CCE): 40 Marks University Examination: 60 Marks		
<b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):	<b>Class Test</b> <b>Assignment/Presentation</b>	20 Marks 20 Marks <b>Total Marks = 40</b>
<b>External Assessment:</b> University Examination: Time: 3 Hours	<b>Section (A)</b> - Five very short answer question (20 words each) <b>Section (B)</b> - Five short answer question (200 words each) <b>Section (C)</b> - Two long answer question (500 words each)	<b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b>

Part A- Introduction			
Program: 2-Year PG	Class: M.Sc. I Semester	Year: 2025	Session: 2025-26
Subject: Geology			
1	Course Code	MGEO0101-P	
2	Course Title	Geodynamics, Geomorphology and Remote Sensing	
3	Course Type	Practical Course	
	Course Level	400	
4	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
5	Course Learning Outcome (CLO)	The Practicum Part will enhance the theoretical reasoning by directly exposing the students to representative samples/ models/ problems. This will help students improve the understanding of the subject <b>Geomorphology, Geodynamics and Remote Sensing</b> in totality. Understanding of ancient India knowledge of River Systems and mountains	
6	Credit Value	4	
7	Total Marks	Max. Marks: 100 ( 40+60)	Minimum Passing Marks: 40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practical ( in hours per week): 2 hrs per credit per week = 8 hrs of Lab per week L-T-P: 120 Hrs			
Topics			No. Of Lectures
Morphometric analysis of third order basins. Morphometric analysis of drainage basins. Morphometric analysis of Terrains. Elements in photo-interpretation, Study and nature of aerial photographs resolution, mosaics, symbols, gully, pattern and drainage analysis, image parallax; determination of scale, height, dip, slope, vertical exaggeration and image distortion; detailed study of imageries. Digitization of area maps in GIS environments and generation of data based on digital data in open access GIS software. Group discussion on Indian approach towards Rivers, Seas and Mountains.			120 Hrs
Keywords/ Tags: Morphometric analysis, drainage basins, GIS software			

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings:

Merh S. S., Radhadrishna B. P.: M-42. Vedic Sarasvati – Evolutionary History of a Lost River of Northwestern India, Geol soc. India

Savinder Singh, 1998: Geomorphology. Prayag Pustak Bhawan

Pandey S N 2001: Principles and Applications of Photo Geology. New Age

Tripathi and Bajpai ed. 2000: Remote Sensing in Geosciences

Condie K C: Plate Tectonics and Crustal Evolution.

Davies, Geoffrey F. 1999: Dynamic Earth. 1e Cambridge Univ Press Gerald

Gutenberg Beno: Internal Constitution of the Earth. Dover

Hodgson, J H: Earthquake and Earth's Structures. Prentice Hall

Holmes, Doris L and Arthur: Holmes' Principles of Physical Geology. Wiley

Martin H P Bott, 1982: The Interior of the Earth. Edward Arnold

Schubert Donald L. Turcotte, 2002: Geodynamics. 2e, Cambridge Univ Press

Strahler, A N, 1971: Earth Sciences. Harper and Row

Wyllie, Peter J: The Dynamic Earth. Wiley

Wyllie, Peter J: The Way the Earth Works. Wiley

David Lang: The Earth System. Brown Publishers

Halis, J R: Applied Geomorphology.

Holmes, Doris L and Arthur Holmes, 1978: Principles of Physical Geology. Wiley

Oscar Diedrich von Engeln , 1953: Geomorphology, Systematic and Regional. McMillan

Small, R J, 1970: Study of Landforms. Cambridge

Thornbury, W D 1968: Principles of Geomorphology. Wiley

Currant P J, 1985: Principles of Remote Sensing. ELBS/Longman

Drury S A, 1987: Image Interpretation in Geology. Allen and Unwin

Jensen, J A, 2006 : Remote Sensing of the Environment. Prentice Hall

Lueder D R, 2003: Aerial Photographic Interpretation: Principles and Applications. Textbook publisher

Miller V C, 1961: Photo Geology. McGraw

Pratt, William K, 2001: Digital Image Processing PIKS Scientific Inside. J Wiley

Wolf, P R, 1974: Elements of Photogrammetry. McGraw

<https://www.youtube.com/watch?v=AmWSSFP7dLU>

[The Chronology and Geography of Mahabharata: A ...](#)

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Wonders of Ancient Indian Science & Technology | Dr Raj Vedam | #SangamTalks

[https://www.researchgate.net/publication/237142076 Geographical Knowledge Of Ancient India](https://www.researchgate.net/publication/237142076_Geographical_Knowledge_Of_Ancient_India)

<https://www.youtube.com/watch?v=BQ0w-WytFpk>

geography of Ramayana

## Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

### Assessment and Evaluation

Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

**Theory Paper: Scheme B-1 for Two Year PG Program**

**Part A- Introduction**

<b>Program: 2-Year PG</b>	<b>Class: M.Sc. I Semester</b>	<b>Year: 2025</b>	<b>Session: 2025-26</b>
<b>Subject: Geology</b>			
1	<b>Course Code</b>	MGEO0102-T	
2	<b>Course Title</b>	<b>Structural Geology and Mineralogy</b>	
3	<b>Course Type</b>	Core Course	
4	<b>Course Level</b>	400	
5	<b>Pre-Requisite (if any)</b>	After completing 3 Year Bachelor Degree with Geology Subject	
6	<b>Course Learning Outcome (CLO)</b>	<p>Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Structural Geology and Mineralogy</b>.</p> <p>Students will also develop theoretical reasoning and knowledge for practical use.</p> <p>Understanding of Ancient Indian Knowledge base on strength and properties of rocks and various minerals.</p>	
7	<b>Credit Value</b>	6	
8	<b>Total Marks</b>	Max. Marks: 100 (40+60)	Minimum Passing Marks: 40

**Part B : Content of the Course**

**Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 6**

**L-T-P: 90**

<b>Unit</b>	<b>Topics</b>	<b>No. Of Lectures</b>
I	<p>Ancient Indian Knowledge base on various rocks and minerals.</p> <p>Concept of Stress, Stress in a body and at a point. Stress tensor. Stress in two and three dimensions, stress ellipsoid, Mohr circles, Mean and deviatoric stress. Stress invariants. Strain and its types, strain measurements, Finite and infinitesimal strain, Progressive deformation. Strain ellipsoid, strain invariants, concept of displacement and deformation gradients and strain tensor components.</p> <p>Activities: Group discussion, Seminar-PPT</p>	18
II	<p>Stress-strain relationships of Hooke anbehavior. Elastic constants. Brittle deformation. Fractures and joints, Mechanics of their origin. Geometry of faults and Faults classification. Recognition of faults. Mechanics of faulting. Fault complexes.</p> <p>Activities: Group discussion, Seminar-PPT</p>	18
III	<p>Stress-strain relationships of Newtonian behavior in plastic and viscous materials, and effect of conditions on behavior of materials. Folds classification; Geometry of fold surfaces: Recognition of folds. Effects of folds on outcrops. Mechanics of folding. Introduction to Shear zones.</p> <p>Activities:</p>	18

	Group discussion, Seminar-PPT	
<b>IV</b>	<p>Lineation, their types. Relation of lineation's to other structures. Foliation, rock cleavages and schistosity. Their relationship with other major structures. Unconformities- Types and recognition. Introduction to petro-fabrics. Time-relationship between crystallization and deformation.</p> <p>Activities: Group discussion, Seminar-PPT</p>	18
<b>V</b>	<p>Principles of optics, Double refraction, Optical classification of minerals, Birefringence, Determination of Refractive Index, Uniaxial and Biaxial Indicatrix, Determination of pleochroic scheme, interference colors, interference figures, and Optic Sign of minerals.</p> <p>Physical, chemical, optical and crystallographic characteristics of the following groups (Families) –Silica, Feldspar, Pyroxene, Amphibole and Mica.</p> <p>Activities: Quiz, Posters, Seminar-PPT</p>	18
Keywords/ Tags: Stress, Mohr circles, strain, Lineation, Uniaxial and Biaxial		

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings:

- Jain A.K. : An Introduction to Structural Geology Geol soc. India
- Bhattacharya A.R.: Structural Geology, Springer
- Ghosh S K 1995: Structural Geology Fundamentals of Modern Developments.
- Badgley P C, 1959: Structural Geology for the Exploration Geology. Harper and Bro
- Bayly B 1992: Mechanics in Structural Geology. Springer-Verlag
- Billings, M P : Structural Geology. 3e.
- Davis G H 1984: Structural Geology of Rocks and Region. John Wiley
- Fossen, H, 2016: Structural Geology. Cambridge
- Hobbs, Means and Williams, 1973: An Outline of Structural Geology. Wiley
- Means, W.D. (1976) Stress and Strain. Springer-Verlag
- Moore E and Twiss RJ 1995: Tectonics. Freeman Pergamon Press
- Park, R G, 1988: Foundations of Structural Geology. 2e Blackie Academy
- Price NJ and Cosgrove JW 1990: Analysis of Geological Structure. Cambridge Univ. P
- Dana, E.S. and Ford, W.E. 2002: A textbook of Mineralogy (Reprint).
- Deer, WA; Howie, RA and Zussman, J 1996: Rock forming minerals. Longman
- Gribble, CD.1993: Rutley's Elements of Mineralogy.
- Kerr, P.F. 1977: Optical Mineralogy, McGraw Hill.
- Klein, C and Hurlbut, CS. 1993: Manual of mineralogy. John Willey.
- Krauskopf, K.B. 1967: Introduction to Geochemistry, McGraw Hill.
- Mason, B. and Moore, C.B. 1991: Introduction to Geochemistry, Wiley Eastern.
- Moorhouse, W.W. (1951): Optical Mineralogy, Harper and Row
- Perkins, D.; Mineralogy, Prentice Hall India, 3rd ed. 2012.
- Phillips, WR and Griffin DT; 1986: Optical mineralogy. CBS
- Rathore, B.S.; Basics of Crystallography, Mineralogy and Geochemistry. Notion Press India, 2020.
- Sharma, R.S. and Sharma, Anurag; Crystallography and Mineralogy - Concepts and Methods. Geol. Soc. Ind., Bengaluru, 2013.
- Perkins, D. 1998: Mineralogy, Prentice Hall.
- Winchell, E.N. (1951): Elements of Optical Mineralogy, Wiley Eastern.

#### Metals and Minerals in ancient India

<http://eprints.nias.res.in/374/1/B8-2013%20Minerals%20and%20Metals%20Heritage%20of%20India.pdf>

<https://www.exoticindiaart.com/book/details/minerals-and-mining-in-ancient-india-from-earliest-times-to-beginning-of-christian-era-uax073/rock-cut-temples/sites>

[https://en.wikipedia.org/wiki/Indian\\_rock-cut\\_architecture](https://en.wikipedia.org/wiki/Indian_rock-cut_architecture)

## Pattern of Marks Distribution THEORY PAPER for NEP PG courses

### Assessment and Evaluation

Recommended Continuous Assessment Methods-: <b>Maximum Marks: 100</b> Continuous Comprehensive Evaluation (CCE): 40 Marks University Examination: 60 Marks		
<b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):	<b>Class Test</b> <b>Assignment/Presentation</b>	20 Marks 20 Marks <b>Total Marks = 40</b>
<b>External Assessment:</b> University Examination: Time: 3 Hours	<b>Section (A)-</b> Five very short answer question (20 words each) <b>Section (B)-</b> Five short answer question (200 words each) <b>Section (C)-</b> Two long answer question (500 words each)	<b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b>

Practicum Paper: Scheme B-1 for Two Year PG Program			
Part A- Introduction			
Program: 2-Year PG	Class: M.Sc. I Semester	Year: 2025	Session: 2025-26
Subject: Geology			
1	Course Code	MGEO0102-P	
2	Course Title	Structural Geology and Mineralogy	
3	Course Type	Practical Course	
4	Pre-Requisite (if any)	400	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	The Practicum Part will enhance the theoretical reasoning by directly exposing the students to representative samples/ models/ problems. This will help students improve the understanding of the subject <b>Structural Geology and Mineralogy</b> in totality.  Indian Knowledge base on rocks and minerals	
7	Credit Value	4	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks: 40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 hrs per credit per week = 8 hrs of Lab per week L-T-P: 120 Hrs			
Topics			No. Of Lectures
1. 1. Study of geological maps. 2. Stereo-net Analysis of structural data. 3. Strain ellipsoid from deformed fossils. 4. Determination of longitudinal strain and shear strain on stretched belemnites and sheared brachiopod fossils 5. Determining normal and shear stresses on a plane with Mohr's diagram for given values principal stresses. 6. Determination of the style of folding according to Ramsay's classification 7. Interpretation of deformed natural samples 8. Interpretation of Wooden structural models of folds and faults 9. Megascopic study of important rock forming minerals 10. Microscopic Study of important rock forming minerals along with determination of Optic Sign, Pleochroic scheme, Birefringence, dispersion ellipsoid, extinction, indicatrix, interference figure, Optic orientation 2. Group discussions on the Indian understanding of various minerals, their trades etc.			120 Hrs
Keywords/ Tags: geological map, Strain ellipsoid, Mohr's diagram, Ramsay's classification, Birefringence,			

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings:

- Jain A.K. : An Introduction to Structural Geology Geol soc. India
- Bhattacharya A.R.: Structural Geology, Springer
- Ghosh S K 1995: Structural Geology Fundamentals of Modern Developments.
- Badgley P C, 1959: Structural Geology for the Exploration Geology. Harper and Bro
- Bayly B 1992: Mechanics in Structural Geology. Springer-Verlag
- Billings, M P : Structural Geology. 3e.
- Davis G H 1984: Structural Geology of Rocks and Region. John Wiley
- Fossen, H, 2016: Structural Geology. Cambridge
- Hobbs, Means and Williams, 1973: An Outline of Structural Geology. Wiley
- Means, W.D. (1976) Stress and Strain. Springer-Verlag
- Moore E and Twiss RJ 1995: Tectonics. Freeman Pergamon Press
- Park, R G, 1988: Foundations of Structural Geology. 2e Blackie Academy
- Price NJ and Cosgrove JW 1990: Analysis of Geological Structure. Cambridge Univ. P
- Dana, E.S. and Ford, W.E. 2002: A textbook of Mineralogy (Reprint).
- Deer, WA; Howie, RA and Zussman, J 1996: Rock forming minerals. Longman
- Gribble, CD.1993: Rutley's Elements of Mineralogy.
- Kerr, P.F. 1977: Optical Mineralogy, McGraw Hill.
- Klein, C and Hurlbut, CS. 1993: Manual of mineralogy. John Willey.
- Krauskopf, K.B. 1967: Introduction to Geochemistry, McGraw Hill.
- Mason, B. and Moore, C.B. 1991: Introduction to Geochemistry, Wiley Eastern.
- Moorhouse, W.W. (1951): Optical Mineralogy, Harper and Row
- Perkins, D.; Mineralogy, Prentice Hall India, 3rd ed. 2012.
- Phillips, WR and Griffin DT; 1986: Optical mineralogy. CBS
- Rathore, B.S.; Basics of Crystallography, Mineralogy and Geochemistry. Notion Press India, 2020.
- Sharma, R.S. and Sharma, Anurag; Crystallography and Mineralogy - Concepts and Methods. Geol. Soc. Ind., Bengaluru, 2013.
- Perkins, D. 1998: Mineralogy, Prentice Hall.
- Winchell, E.N. (1951): Elements of Optical Mineralogy, Wiley Eastern.

#### Metals and Minerals in ancient India

<http://eprints.nias.res.in/374/1/B8-2013%20Minerals%20and%20Metals%20Heritage%20of%20India.pdf>

<https://www.exoticindiaart.com/book/details/minerals-and-mining-in-ancient-india-from-earliest-times-to-beginning-of-christian-era-uax073/rock-cut-temples/sites>

[https://en.wikipedia.org/wiki/Indian\\_rock-cut\\_architecture](https://en.wikipedia.org/wiki/Indian_rock-cut_architecture)

## Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

### Assessment and Evaluation

Suggested Continuous Evaluation Methods:			
<b>Internal Assessment</b>	<b>Marks</b>	<b>External Assessment</b>	<b>Marks</b>
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

Theory Paper: Scheme B-1 for Two Year PG Program			
Part A- Introduction			
Program: 2-Year PG	Class: M.Sc. II Semester	Year: 2025	Session: 2025-26
Subject: Geology			
1	Course Code	MGEO0201-T	
2	Course Title	Hydrogeology and Engineering Geology	
3	Course Type	Core Course	
4	Course Level	400	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	<p>Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Hydrogeology and Engineering Geology</b>. Students will also develop theoretical reasoning and knowledge for practical use.</p> <p>Understanding of ancient Indian knowledge base on Hydrology and Engineering Geology</p>	
7	Credit Value	6	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 6			
L-T-P: 90			
Unit	Topics		No. Of Lectures
I	<p><i>Introduction to ancient Indian Knowledge of groundwater availability indicators. Ancient water harvesting methods and recharge structures. Introduction to ancient Indian constructions of dams and large reservoir and Canal networking.</i></p> <p>Surface and subsurface distribution of water. Introductory idea to type and age of water. Hydrological cycle, precipitation and its types.</p> <p>Groundwater: Origin, importance, occurrences and subsurface reservoirs. Hydro-stratigraphic units. Water table contour maps. Geological factors governing the occurrence of groundwater. Porosity, permeability, specific yield, specific retention, hydraulic conductivity, and storage coefficient. Aquifers and their classification.</p> <p>Activities: Poster, Seminar-PPT</p>		18
II	<p>Groundwater flow: confined, unconfined, steady, unsteady, and radial flows. Forces causing flow. Darcy's Law. Water level fluctuations: causative factors and their measurements. Well hydraulics. Physical characteristics of groundwater quality: turbidity, colour, taste, odour, temperature and specific conductivity.</p> <p>Chemical characters of groundwater quality: TDS and suspended solids, pH value, hardness, heavy metals and dissolved gases.</p> <p>Biological characteristics. Water contaminants and pollutants</p> <p>Activities: Poster, Seminar-PPT</p>		18

III	<p>Salt water intrusion in coastal aquifers, remedial measures. Radio isotopes in hydrogeological studies. Water harvesting. Wetland management. Consumptive and conjunctive use of surface and groundwater. Concept of watershed management. Natural and artificial recharge of ground water.</p> <p>Activities: Poster, Seminar-PPT</p>	18
IV	<p>Importance of geology in civil engineering projects. Mechanical properties of rocks and soils and determination. Seismicity in India and earthquake-resistant structures. Geological investigations for river valley projects — Dams and reservoirs. Dam and its Parts. Types of dam. Geological investigations for Canals.</p> <p>Activities: Poster, Seminar-PPT</p>	18
V	<p>Tunnel: terminology and types, Geological considerations for tunneling grounds. Geological considerations for construction of highways. Bridges — types and foundation problems. Problems of groundwater in engineering projects.</p> <p>Activities: Poster, Seminar-PPT</p>	18
<p>Keywords/ Tags: Hydrological cycle, Groundwater, Darcy's Law, Wetland, earthquake</p>		

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings:

- Vaidyanadhan R: SP-03: Rejuvenation of Surface Water Resources of India: Potential, Problems and Prospects Geol soc. India
- Radhadrishna B. P : Hydrogeological Studies (Anthology) Geol soc. India
- Sawkar RH: Groundwater Development and Rainwater Harvesting in Greater Bengaluru Geol soc. India
- R H Sawkar, Subhajyoti Das: P-05: Integrated and Sustainable Water Management: Science and Technology Geol soc. India
- Namdeo J Pawar, Raymond A Duraiswami, Subhajyoti Das: National Conference on Groundwater Resource Development and Management in Hard Rock Geol soc. India
- Karanth, K R 1987: Ground Water Assessments, Development and Managements. McGraw
- Raghunath, N M, 1982: Ground Water. Wiley Eastern
- Subramaniam, V, 2000: Water. Kingston London Tata McGraw Hill
- Gautam Mahajan: Groundwater Survey and Investigation. APH Publishing
- Davis, S N and De Wiest R J M, 1966: Hydrogeology. John Wiley
- Fetter, C W, 1990: Applied Hydrogeology. Merrill
- Freeze, R A & Cherry J A, 1979: Ground Water. Prentice Hall
- Gilman, Kevin: Hydrology and Wetland Conservation. Wiley
- Todd, D K 1980: Ground Water Hydrology. John Wiley
- Tolman, C F 1957: Ground Water. Tata McGraw Hill
- Blyth F C H: Geology for Engineers. Arnold Ltd.
- Gangopadhyay Subinoy: Engineering Geology, 2014 Oxford
- Kesavulu N C: Text Book of Engineering Geology. McMillan
- Khurmi R S: Fundamental of Engineering Geology. Dhanpat Rai & Sons
- Krynine and Judd W R: Principles of Engineering Geology and Geotechnics. McGraw
- Parbin Singh: Engineering and General Geology. Katson P House
- Ramnathan R M: Engineering Geology. Anuradha Agency T N
- Ancient Indian: Hydrology & Engineering Geology  
<https://www.youtube.com/watch?v=nrOfeVWILh4>
- water management in ancient India  
<https://www.youtube.com/watch?v=ZNdyUWuJwtc>
- <https://www.youtube.com/watch?v=1Tu9Tp1tgM8>
- Hydrology and water resources management in ancient India <https://hess.copernicus.org/articles/24/4691/2020/>  
[https://www.researchgate.net/publication/349919987\\_Ancient\\_Knowledge\\_of\\_water\\_and\\_Water\\_Traditions\\_in\\_India](https://www.researchgate.net/publication/349919987_Ancient_Knowledge_of_water_and_Water_Traditions_in_India)
- S.K.Lal, *Rivers in Hindu Mythology and Ritual*, Delhi: Bharatiya Kala Prakashan, 2007.

## Assessment and Evaluation

<p>Recommended Continuous Assessment Methods-: (It may vary for respective course subject but <b>TOTAL marks distribution will remain same</b>)</p> <p><b>Maximum Marks: 100</b></p> <p>Continuous Comprehensive Evaluation (CCE): 40 Marks</p> <p>University Examination: 60 Marks</p>		
<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test</b> <b>Assignment/Presentation</b></p>	<p>20 Marks</p> <p>20 Marks</p> <p><b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)</b>- Five very short answer question (20 words each) <b>Section (B)</b>- Five short answer question (200 words each) <b>Section (C)</b>- Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i></p> <p><b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i></p> <p><b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i></p> <p><b>Total Marks = 60</b></p>

Practicum Paper: Scheme B-1 for Two Year PG Program			
Part A- Introduction			
Program: 2-Year PG	Class: M.Sc. II Semester	Year: 2025	Session: 2025-26
Subject: Geology			
1	Course Code	MGEO0201-P	
2	Course Title	Hydrogeology and Engineering Geology	
3	Course Type	Practical Course	
4	Course Level	400	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	<p>The Practicum Part will enhance the theoretical reasoning by directly exposing the students to representative samples/ models/ problems. This will help students improve the understanding of the subject <b>Hydrogeology and Engineering Geology</b> in totality.</p> <p>Understanding of ancient Indian practices of water resource development, small and large structures for water conservation, Dams and canal networks.</p>	
7	Credit Value	4	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 hrs per credit per week = 8 hrs of Lab per week			
L-T-P: 120 Hrs			
Topics			No. Of Lectures
<ol style="list-style-type: none"> <li>1. Study of hydrogeological properties of rocks.</li> <li>2. Preparation of Water Table Contour Maps and their interpretation.</li> <li>3. Chemical Analysis of water in practical and study.</li> <li>4. Pumping test, time-draw down test and evolution of aquifer parameters.</li> <li>5. Study of electrical resistivity sampling data.</li> <li>6. Exercise on ground water exploration.</li> <li>7. Determination of hydrological characteristics by using Thiems, Theis, Jacob and Cooper techniques.</li> <li>8. Study of engineering properties of rocks.</li> <li>9. Study of maps and models of important engineering structures on dam sites tunnels etc.</li> <li>2. Group discussion on ancient Indian dams, canals, and water planning</li> <li>3. Poster presentation of old water harvesting and recharge structure in India with special reference to Rajasthan.</li> <li>4. Essay writing of ancient Indian water resource development and management</li> </ol>			120 Hrs
Keywords/ Tags: Water Table Contour Maps , aquifer parameters, ground water exploration, Jacob and Cooper techniques			

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings:

- Vaidyanadhan R: SP-03: Rejuvenation of Surface Water Resources of India: Potential, Problems and Prospects Geol soc. India
- Sadhadrishna B. P : Hydrogeological Studies (Anthology) Geol soc. India
- Sawkar RH: Groundwater Development and Rainwater Harvesting in Greater Bengaluru Geol soc. India
- R N Sawkar, Subhajyoti Das: P-05: Integrated and Sustainable Water Management: Science and Technology Geol soc. India
- Narndas J Pawar, Raymond A Duraiswami, Subhajyoti Das: National Conference on Groundwater Resource Development and Management in Hard Rock Geol soc. India
- Karant, K R 1987: Ground Water Assessments, Development and Managements. McGraw
- Raghunath, N M, 1982: Ground Water. Wiley Eastern
- Subramaniam, V, 2000: Water. Kingston London Tata McGraw Hill
- Gautam Mahajan: Groundwater Survey and Investigation. APH Publishing
- Davis, S N and De Wiest R J M, 1966: Hydrogeology. John Wiley
- Fetter, C W, 1990: Applied Hydrogeology. Merrill
- Freeze, R A & Cherry J A, 1979: Ground Water. Prentice Hall
- Gilman, Kevin: Hydrology and Wetland Conservation. Wiley
- Todd, D K 1980: Ground Water Hydrology. John Wiley
- Tolman, C F 1957: Ground Water. Tata McGraw Hill
- Blyth F C H: Geology for Engineers. Arnold Ltd.
- Gangopadhyay Subinoy: Engineering Geology, 2014 Oxford
- Kesavulu N C: Text Book of Engineering Geology. McMillan
- Khurmi R S: Fundamental of Engineering Geology. Dhanpat Rai & Sons
- Krynine and Judd W R: Principles of Engineering Geology and Geotechnics. McGraw
- Parbin Singh: Engineering and General Geology. Katson P House
- Ramnathan R M: Engineering Geology. Anuradha Agency T N
- Ancient Indian: Hydrology & Engineering Geology
- <https://www.youtube.com/watch?v=nrOfeVWILh4>  
water management in ancient India
- <https://www.youtube.com/watch?v=ZNdyUWuJwtc>  
rock-cut temples/sites/architecture
- [https://en.wikipedia.org/wiki/Indian\\_rock-cut\\_architecture](https://en.wikipedia.org/wiki/Indian_rock-cut_architecture)
1. Hydrology and water resources management in ancient India  
<https://hess.copernicus.org/articles/24/4691/2020/>
  2. <https://www.researchgate.net/publication/349919987> Ancient Knowledge of water and Water Traditions in India
  3. S.K.Lal, *Rivers in Hindu Mythology and Ritual*, Delhi: Bharatiya Kala Prakashan, 2007.

## Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

### Assessment and Evaluation

Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

Part A- Introduction			
Program: 2-Year PG		Class: M.Sc. II Semester	Year: 2025
Session: 2025-26			
Subject: Geology			
1	Course Code	MGEO0202-T	
2	Course Title	Economic and Fuel Geology	
3	Course Type	Core Course	
4	Course Level	500	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	<p>Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Economic and Fuel Geology</b> .</p> <p>Students will also develop theoretical reasoning and knowledge for practical use.</p> <p>Understanding of Indian Knowledge base of economic deposits and fuels sources.</p>	
7	Credit Value	6	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 6			
L-T-P: 90			
Unit	Topics		No. Of Lectures
I	<p><i>Ancient Indian Ore deposits. Ancient India's status in Gold, Silver, Pb, Zn, Copper, Iron and other metal and nonmetal deposits and distant trades.</i></p> <p>Ore genesis: processes of mineral deposit formation. Magmatic concentration, Contact metasomatism, Hydrothermal, Sedimentary, Placer, Residual, and Oxidation &amp; Supergene enrichment and Volcano-genetic deposits.</p> <p>Activities: Group discussion, Posters</p>		18
II	<p>Mineralization associated with — (i) Ultramafic, Mafic and Acidic Rocks, (ii) greenstone belts, (iii) Komatiites, Anorthosites and Kimberlites and (iv) Submarine Volcanism; Porphyry, Skarn and Hydrothermal Mineralization.</p> <p>Activities: Group discussion, Posters</p>		18
III	<p>Stratiform and Strataboundores. Occurrence and distribution in India of Metalliferous deposits— Iron, Manganese, Aluminium, Chromium, Copper, Lead, Zinc, Gold, Silver, Indian deposits of non-metals— mica, asbestos, barytes, gypsum, graphite, apatite and beryl. Gemstones, refractory minerals used in fertilizer and cement industries.</p> <p>Activities: Group discussion, Posters</p>		18
IV	<p>Definition, origin of coal. Stratigraphy of coal measures. Industrial application of coal petrology. Preparation of Coal for industrial Purpose (Washing), Carbonization (Coke Manufacturing), Gasification and Hydrogenation, Briquetting of Coal. Indian coal deposits. Classification of Coal. Coal Bed Methane.</p> <p>Activities:</p>		18

	Group discussion, Posters	
V	<p>Origin, migration and entrapment of natural hydrocarbons. Characters of source and reservoir rocks. Structural, stratigraphic and mixed traps. Techniques of exploration. Geographical and geological distributions of onshore and offshore petroliferous basins of India. Mineralogy and geochemistry of radioactive minerals. Instrumental techniques of detection and measurement of radioactivity. Productive Horizons in India, distribution of radioactive minerals in India.</p> <p>Activities: Group discussion, Posters</p>	18
Keywords/ Tags: Ore genesis, Washing, Gasification, Coal Bed Methane, radioactive minerals		

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings :

- Dhana Raju R: Handbook of Mineral Exploration and Ore Petrology: Techniques & Applications Geol soc. India  
Acharyya SK, Mukhopadhyay G: Coal and Lignite Basins of India Geol soc. India  
Dr HSM Prakash, Dr M Venkataswamy: KOLAR GOLD MINES A Short History of Gold Mining and its Socio-Economic Impact Geol soc. India  
P Krishnamurthy: Rare Earth Element Occurrences and Deposits of India and Strategies for New Discoveries Geol soc. India  
Dhana Raju R: Handbook of Geochemistry: Techniques and Applications in Mineral Exploration Geol soc. India  
Singh MP 1998: Coal and Organic Petrology. Hindustan Publications ND  
Bateman, 1981: Economic Mineral Deposits. Wiley  
Dahlkamp F J 1993: Uranium Ore Deposits. Springer Verlag  
Durance E M, 1986: Radioactivity in Geology: Principles and Applications. Ellis  
Gaudin, A M, 1971: Principles of Mineral Dressing. Tata McGraw Hill  
Holson G D and Tiratsoo E N, 1985: Introduction of petroleum Geology. Gulf Pub  
Indian Minerals Year Book IBM (updates on www.ibm.nic.in)  
Krishnaswamy, S, 1972: India's Mineral Resources. Oxford and IBH  
Lewis, R S, and Clark, G.B., 1964, Elements of Mining, 3e Wiley, New York  
McKinstry, Hough Exton, 1948, Mining Geology. Prentice Hall  
Mookherjee, Asoke 2000: Ore Genesis - a holistic approach. Allied P  
Nettleton L L, 1940: Geophysical Prospecting for Oil. McGraw Hill  
North F K 1985: Petroleum Geology. Allen and Unwin  
R N P, 1996: Courses in Mining Geology. Oxford/ IBH  
Selley R C, 1998: Elements of Petroleum Geology. Academic Press  
Tissot B P and Welt DH 1984: Petroleum Formation and Occurrence. Springer  
Dahlkamp FJ 1993: Uranium Ore Deposits. Springer Verlag  
Durance EM, 1986: Radioactivity in Geology: Principles and Applications. Ellis H  
Holson GD and Tiratsoo E N, 1985: Introduction of petroleum Geology. Gulf Pub  
Nettleton L L 1940: Geophysical Prospecting for Oil  
North FK 1985: Petroleum Geology. Allen and Unwin  
Selley RC, 1998: Elements of Petroleum Geology. Academic Press  
Tissot BP and Welt DH 1984: Petroleum Formation and Occurrence. Springer Verlag  
Satpathy, Binod Bihari (not dated). History of Science and Technology in India. DDCE/History (M.A.)/SLM/Paper.  
Metals and Minerals in ancient India

<http://eprints.nias.res.in/374/1/B8-2013%20Minerals%20and%20Metals%20Heritage%20of%20India.pdf>  
Book

<https://dkprintworld.com/product/minerals-and-metals-in-ancient-india-2-vols-set/?srsltid=AfmBOori9WP3JicmeV0AwUo356QideRzYNWDH-MdePCV6y-aC2LYclF7>  
<https://geographyandyou.com/geoheritage-sites/zawar-worlds-oldest-zinc-mining-and-metallurgy-site>  
For TIN

[https://os.pennds.org/archaeobib\\_filestore/pdf\\_articles/bookchapters/2015\\_Upadhyay.pdf](https://os.pennds.org/archaeobib_filestore/pdf_articles/bookchapters/2015_Upadhyay.pdf)

<https://enrouteindianhistory.com/unearthing-a-precious-metal-gold-mining-in-ancient-india/>

## Assessment and Evaluation

Recommended Continuous Assessment Methods-: (It may vary for respective course subject but **TOTAL marks distribution will remain same**)

**Maximum Marks: 100**

Continuous Comprehensive Evaluation (CCE): 40 Marks

University Examination: 60 Marks

<b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):	<b>Class Test</b> <b>Assignment/Presentation</b>	20 Marks 20 Marks <b>Total Marks = 40</b>
<b>External Assessment:</b> University Examination: Time: 3 Hours	<b>Section (A)</b> - Five very short answer question (20 words each) <b>Section (B)</b> - Five short answer question (200 words each) <b>Section (C)</b> - Two long answer question (500 words each)	<b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b>

Continuous Comprehensive evaluation (CCE):	Quiz/Debate/Poster making/Group Discussion etc.	
<b>External Assessment :</b> Mid Term Examination	<b>Section(A):</b> Very Short Questions <b>Section (B):</b> Short Questions <b>Section(C):</b> Long Questions	<b>60</b>
<b>Any remarks/Suggestions:</b>		

<b>Practicum Paper: Scheme B-1 for Two Year PG Program</b>			
<b>Part A- Introduction</b>			
<b>Program: 2-Year PG</b>	<b>Class: M.Sc. II Semester</b>	<b>Year: 2025</b>	<b>Session: 2025-26</b>
<b>Subject: Geology</b>			
1	Course Code	M GEO0202-P	
2	Course Title	Economic and Fuel Geology	
3	Course Type	Practical Course	
4	Course Level	500	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	The Practicum Part will enhance the theoretical reasoning by directly exposing the students to representative samples/ models/ problems. This will help students improve the understanding of the subject <b>Economic and Fuel Geology</b> in totality. Knowledge on Ancient Indian Deposits	
7	Credit Value	4	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40
<b>Part B : Content of the Course</b>			
<b>Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 hrs per credit per week = 8 hrs of Lab per week</b>			
<b>L-T-P: 120 Hrs</b>			
<b>Topics</b>			<b>No. Of Lectures</b>
<ol style="list-style-type: none"> <li>Megascopic study of structures and fabrics of different ores and their associations; mineralogical and textural studies of common ore minerals under petrological microscope and ore microscope; exercises on the determination of reflectivity and microhardness of common ore minerals.</li> <li>Determination of elemental composition of minerals and rocks by flame photometer and atomic absorption spectrometer; preparation of thin sections and polished sections; etching and staining.</li> <li>Megascopic characterization of banded coals; proximate analysis of coals; completion of outcrops in the given maps and calculation of coal reserves; microscopic examination of polished coal pellets (identification of macerals in coal)</li> <li>Megascopic and microscopic study of cores and well cuttings; study of geological maps and sections of important oilfields of India; calculation of reserves.</li> </ol> <p>Activities:</p> <ol style="list-style-type: none"> <li>Group discussion, Posters on Ancient Indian deposits and trades</li> </ol>			<b>120 Hrs</b>
Keywords/ Tags: photometer , polished coal , macerals in coal			

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings :

- Dhana Raju R: Handbook of Mineral Exploration and Ore Petrology: Techniques & Applications Geol soc. India  
Acharyya SK, Mukhopadhyay G: Coal and Lignite Basins of India Geol soc. India  
Dr MSM Prakash, Dr M Venkataswamy: KOLAR GOLD MINES A Short History of Gold Mining and its Socio-Economic Impact Geol soc. India  
P Krishnamurthy: Rare Earth Element Occurrences and Deposits of India and Strategies for New Discoveries Geol soc. India  
Dhana Raju R: Handbook of Geochemistry: Techniques and Applications in Mineral Exploration Geol soc. India  
Singh MP 1998: Coal and Organic Petrology. Hindustan Publications ND  
Bateman, 1981: Economic Mineral Deposits. Wiley  
Dahlkamp F J 1993: Uranium Ore Deposits. Springer Verlag  
Durance E M, 1986: Radioactivity in Geology: Principles and Applications. Ellis  
Gaudin, A M, 1971: Principles of Mineral Dressing. Tata McGraw Hill  
Holson G D and Tiratsoo E N, 1985: Introduction of petroleum Geology. Gulf Pub  
Indian Minerals Year Book IBM (updates on [www.ibm.nic.in](http://www.ibm.nic.in))  
Krishnaswamy, S, 1972: India's Mineral Resources. Oxford and IBH  
Lewis, R S, and Clark, G.B., 1964, Elements of Mining, 3e Wiley, New York  
McKinstry, Hough Exton, 1948, Mining Geology. Prentice Hall  
Mookherjee, Asoke 2000: Ore Genesis - a holistic approach. Allied P  
Nettleton L L, 1940: Geophysical Prospecting for Oil. McGraw Hill  
North F K 1985: Petroleum Geology. Allen and Unwin  
R N P, 1996: Courses in Mining Geology. Oxford/ IBH  
Selley R C, 1998: Elements of Petroleum Geology. Academic Press  
Tissot B P and Welt DH 1984: Petroleum Formation and Occurrence. Springer  
Dahlkamp FJ 1993: Uranium Ore Deposits. Springer Verlag  
Durance EM, 1986: Radioactivity in Geology: Principles and Applications. Ellis H  
Holson GD and Tiratsoo E N, 1985: Introduction of petroleum Geology. Gulf Pub  
Nettleton L L 1940: Geophysical Prospecting for Oil  
North FK 1985: Petroleum Geology. Allen and Unwin  
Selley RC, 1998: Elements of Petroleum Geology. Academic Press  
Tissot BP and Welt DH 1984: Petroleum Formation and Occurrence. Springer Verlag  
Saspathy, Binod Bihari (not dated). History of Science and Technology in India. DDCE/History (M.A.)/SLM/Paper.<http://eprints.nias.res.in/374/1/B8-2013%20Minerals%20and%20Metals%20Heritage%20of%20India.pdf>  
Book  
<https://dkprintworld.com/product/minerals-and-metals-in-ancient-india-2-vols-set/?srsltid=AfmBOori9WP3JicmeV0AwUo356QideRzYNWDH-MdePCV6y-aC2LYclF7>  
<https://geographyandyou.com/geoheritage-sites/zawar-worlds-oldest-zinc-mining-and-metallurgy-site>  
For TIN  
[https://os.pennds.org/archaeobib\\_filestore/pdf\\_articles/bookchapters/2015\\_Upadhyay.pdf](https://os.pennds.org/archaeobib_filestore/pdf_articles/bookchapters/2015_Upadhyay.pdf)  
<https://enrouteindianhistory.com/unearthing-a-precious-metal-gold-mining-in-ancient-india/>

## Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

### Assessment and Evaluation

Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

**Theory Paper: Scheme B-1 for Two Year PG Program**

**Part A- Introduction**

<b>Program: 2-Year PG</b>	<b>Class: M.Sc. II Semester</b>	<b>Year: 2025</b>	<b>Session 2025-26</b>
<b>Subject: Geology</b>			
1	<b>Course Code</b>	<b>VAC (Employability and Entrepreneurship Skill Course)</b>	
2	<b>Course Title</b>	<b>Employability and Entrepreneurship Skill Course</b>	
3	<b>Course Type</b>	VAC	
4	<b>Pre-Requisite (if any)</b>	After Bachelor Degree with Geology Subject	
5	<b>Course Learning Outcome (CLO)</b>	Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Employability and Entrepreneurship Skill Course in the chosen field.</b> Students will also develop practical skill along with the theoretical reasoning and knowledge.	
6	<b>Credit Value</b>	2	
8	<b>Total Marks</b>	Max. Marks: 100 (40+60)	Minim Marks: 40

**Part B : Content of the Course**

**Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 Hrs per week**

**L-T-P: 30 Hrs**

**Topics**

**(A)**

The EESC Shall include such important of interest of the students and concerned faculty of the geology department depending upon the facilities available with the department or local industry or as per the demand of a skill and employability assessed by the student and faculty.

**OR**

If student does not choose a topic from (A) than he may opt for any one of the following fields for skill development.

**(B)**

The following topics suggested for here with

1. Resistivity Survey for Groundwater study theoretical knowledge practical skill development interpretation.
2. Geochemical Analysis of Groundwater.
3. GIS based data & map generation and interpretation.
4. Surveying Techniques.
5. As per the approval of the teacher in geology

Keywords/ Tags:

**Part C- Learning Resources**

**Text Books, Reference Books, Other Resources**

**Part D- Assessment and Evaluation**

## Assessment and Evaluation

Recommended Continuous Assessment Methods-: (It may vary for respective course subject but **TOTAL marks distribution will remain same**)

**Maximum Marks: 100**

Continuous Comprehensive Evaluation (CCE): 40 Marks

University Examination: 60 Marks

<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test</b> <b>Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)</b>- Five very short answer question (20 words each) <b>Section (B)</b>- Five short answer question (200 words each) <b>Section (C)</b>- Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>

Theory Paper: Scheme B-1 for Two Year PG Program			
Part A- Introduction			
Program: 2-Year PG	Class: M.Sc. III Semester	Year: 2025	Session: 2026-27
Subject: Geology			
1	Course Code	MGEO0301-T	
2	Course Title	Stratigraphy and Paleobiology	
3	Course Type	Core Course	
4	Course Level	500	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	<p>Students will acquire insight in the various fundamental and advance components and aspects of the Indian <b>Stratigraphy and Paleobiology</b> . Students will also develop theoretical reasoning and knowledge for practical use.</p> <p>Understanding of the Ancient Indian Knowledge of Indian terrain, Satapta-dwipas. Concept of Dash avatar of evolution of life.</p>	
7	Credit Value	6	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 6			
L-T-P: 90			
Unit	Topics		No. Of Lectures
I	<p><i>Ancient Indian knowledge about Indian Terrains and the concept of Sapta-dwipas. Dash-avatar concept of evolution of Life.</i></p> <p>Dharwar Craton: Archean Stratigraphic evolution, tectonic structures and distribution. Economic importance of Dharwar Craton.</p> <p>Bastar Craton: Archean Stratigraphic evolution and tectonic structures and distribution. Economic importance of Older metamorphics and Kotri – Dongargarh orogen. Singhbhum Craton: Archean Stratigraphy evolution, tectonic structures and distribution. economic importance of Singhbhum Craton. Cuddapah Proterozoic basin: Stratigraphy and economic importance.</p> <p>Activities: Poster presentation, Seminar-PPT</p>		18
II	<p>Bundelkhand Craton: Archean Stratigraphic evolution, tectonic structures and distribution. economic importance of Bundelkhand Craton.</p> <p>Aravalli/Rajasthan Craton: Litho-Tectonic structures, general stratigraphy and economic importance of Aravalli Craton. Vindhyan Proterozoic basin: Stratigraphy and economic importance Tectonic structures of Satpuda Mobile Belt (SMB). Stratigraphy and economic importance of Sausar Group, Mahakoshal Supergroup, Bijawar and Gwailor Group.</p> <p>Activities: Poster presentation, Seminar-PPT</p>		18

III	<p>Gondwana Supergroup: Geographical distribution, Stratigraphic Classification, and economic importance.</p> <p>Stratigraphic Classification and fossil records of Lameta and Bagh groups. Deccan traps: Distribution, Classification and economic importance.</p> <p>Tectonic characters of Kutch Basin in Jurassic. Triassic of Spiti valley.</p> <p>Siwalik group: Stratigraphy, distribution and fossil records of Siwalik Group. Tectonic Thrust zones of Himalayan Mobile Belt.</p> <p>Activities: Poster presentation, Seminar-PPT</p>	18
IV	<p>Modes of fossilization and uses of fossils. Morphology, classification, evolution, and geological history of: Trilobites, Graptolites, Echinoids and Corals, Brachiopoda, Gastropoda, Lamellibranchia and Cephalopoda.</p> <p>Activities: Poster presentation, Seminar-PPT</p>	18
V	<p>Succession of the vertebrate life through the geological time. Classification of vertebrates and general characters of various classes. Principles of evolution. Evolutionary history of Human, Elephant and Horse. Micropaleontology: Classification, separation of microfossils. Uses of microfossil. Morphology and geological history of foraminifera.</p> <p>Activities: Poster presentation, Seminar-PPT</p>	18
<p>Keywords/ Tags: Dharwar Craton, Bundelkhand Craton, Elephant and Horse, vertebrates</p>		

Part C- Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:

Krishnan, M S: Geology of India and Burma. Higginbothams, Madras  
Ravindra Kumar: Historical Geology and Stratigraphy of India. John Wiley  
Vaidyanadhan R and Ramakrishna M 2012: Geology of India. 2e, Geol. Soc. India.  
Wadia, D N : Geology of India. McMillan & Co.  
Ananthraman and Jain: Textbook of Palaeontology. GSI  
Andrew 1961: Studies in Palaeontology. John Wiley  
Boggs Sam Jr 1995: Principles of Sedimentary and Stratigraphy. Prentice Hall  
Doyle and Brennet MR 1996: Unlocking the Stratigraphy: Concepts and Application. Prentice  
Banner F T and Lord A R: Aspects of Micropalaeontology.  
Clarksen ENK 1998: Invertebrate Palaeontology and Evolution. Blackwell  
Glassner M P: Principles of Micropalaeontology.  
Haq B U and Boersma A: Introduction to Marine Micropalaeontology.  
Jones D J: Microfossils.  
Moore, Lalicher and Fischer: Invertebrate Palaeontology.  
Prothero DR 1998: Bringing Fossils to Life: An Introduction to Palaeobiology. McGr  
Romer A S: Vertebrate Palaeontology.  
Seward S E 1966: Plant Life through Ages. Heffner  
Shrock and Twenhofell: Palaeontology Invertebrate.  
Stearns CW and Carrol RL 1989: Palaeontology -the Record of Life. John Wiley  
Woods, Henry: Invertebrate Palaeontology.  
dash avatar and evolution  
<https://ijcrt.org/papers/IJCRT2401457.pdf>

saptadwipa concept

<https://timesofindia.indiatimes.com/etimes/trending/did-the-bhagavata-purana-describe-7-continent-before-cartographers/articleshow/113296961.cms>

[https://www.academia.edu/125732240/Sapta\\_Dwipa\\_Vasumathi\\_Seven\\_continents\\_in\\_Bhagavatha\\_Purana](https://www.academia.edu/125732240/Sapta_Dwipa_Vasumathi_Seven_continents_in_Bhagavatha_Purana)

<https://en.wikipedia.org/wiki/Jambudv%C4%ABpa>

## Assessment and Evaluation

Recommended Continuous Assessment Methods-: (It may vary for respective course subject but **TOTAL marks distribution will remain same**)

**Maximum Marks: 100**

Continuous Comprehensive Evaluation (CCE): 40 Marks

University Examination: 60 Marks

<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test</b> <b>Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)</b>- Five very short answer question (20 words each) <b>Section (B)</b>- Five short answer question (200 words each) <b>Section (C)</b>- Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>

**Practicum Paper: Scheme B-1 for Two Year PG Program**

**Part A- Introduction**

<b>Program: 2-Year PG</b>	<b>Class: M.Sc. III Semester</b>	<b>Year: 2025</b>	<b>Session: 2026-27</b>
<b>Subject: Geology</b>			
1	Course Code	MGEO0301-P	
2	Course Title	Stratigraphy and Paleobiology	
3	Course Type	Practical Course	
4	Course Level	500	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
5	Course Learning Outcome (CLO)	The Practicum Part will enhance the theoretical reasoning by directly exposing the students to representative samples/ models/ problems. This will help students improve the understanding of the subject <b>Stratigraphy and Paleobiology</b> in totality. Understanding of ancient Indian knowledge of Terrains	
6	Credit Value	4	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40

**Part B : Content of the Course**

**Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 hrs per credit per week = 8 hrs of Lab per week**

**L-T-P: 120 Hrs**

Topics		No. Of Lectures
<ol style="list-style-type: none"> <li>1. Plotting of tectonic features of major cratons.</li> <li>2. Plotting of proterozoic basins of India.</li> <li>3. Chronological ordering of various rock samples.</li> <li>4. Morphology of fossils of Trilobites, Graptolites, Echinoids and Corals, Brachiopoda, Gastropoda, Lamellibranchia and Cephalopoda class and phyllums.</li> <li>5. Study of microfossils.</li> </ol> <ol style="list-style-type: none"> <li>2. Group discussions on ancient Indian understanding on Terrains.</li> <li>3. Poster presentation on ancient Indian knowledge of Terrains and the concept of Saptadwipas.</li> </ol>	120 Hrs	
Keywords/ Tags: major cratons, proterozoic basins of India, microfossil		

Part C- Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:

- Krishnan, M S: Geology of India and Burma. Higginbothams, Madras  
Ravindra Kumar: Historical Geology and Stratigraphy of India. John Wiley  
Vaidyanadhan R and Ramakrishna M 2012: Geology of India. 2e, Geol. Soc. India.  
Wadia, D N : Geology of India. McMillan & Co.  
Ananthraman and Jain: Textbook of Palaeontology. GSI  
Andrew 1961: Studies in Palaeontology. John Wiley  
Boggs Sam Jr 1995: Principles of Sedimentary and Stratigraphy. Prentice Hall  
Doyle and Brennet MR 1996: Unlocking the Stratigraphy: Concepts and Application. Prentice  
Banner F T and Lord A R: Aspects of Micropalaeontology.  
Clarkeson ENK 1998: Invertebrate Palaeontology and Evolution. Blackwell  
Glassner M P: Principles of Micropalaeontology.  
Haq B U and Boersma A: Introduction to Marine Micropalaeontology.  
Jones D J: Microfossils.  
Moore, Lalicher and Fischer: Invertebrate Palaeontology.  
Prothero DR 1998: Bringing Fossils to Life: An Introduction to Palaeobiology. McGr  
Romer A S: Vertebrate Palaeontology.  
Seward S E 1966: Plant Life through Ages. Heffner  
Shrock and Twenhofell: Palaeontology Invertebrate.  
Stearns CW and Carrol RL 1989: Palaeontology -the Record of Life. John Wiley  
Woods, Henry: Invertebrate Palaeontology.

dash avatar and evolution

<https://ijcrt.org/papers/IJCRT2401457.pdf>

saptadwipa concept

<https://timesofindia.indiatimes.com/etimes/trending/did-the-bhagavata-purana-describe-7-continent-before-cartographers/articleshow/113296961.cms>

[https://www.academia.edu/125732240/Sapta Dwipa Vasumathi Seven continents in Bhagavatha Purana](https://www.academia.edu/125732240/Sapta_Dwipa_Vasumathi_Seven_continents_in_Bhagavatha_Purana)

<https://en.wikipedia.org/wiki/Jambudv%C4%ABpa>

## Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

### Assessment and Evaluation

Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

Theory Paper: Scheme B-1 for Two Year PG Program			
Part A- Introduction			
Program: 2-Year PG	Class: M.Sc. III Semester	Year: 2025	Session: 2026-27
Subject: Geology			
1	Course Code	MGEO0302-T	
2	Course Title	Petrology	
3	Course Type	Core Course	
4	Course Level	500	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	<p>Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Petrology</b>. Students will also develop theoretical reasoning and knowledge for practical use.</p> <p>Understanding of Ancient Indian knowledge base on rocks.</p>	
7	Credit Value	6	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 6 L-T-P: 90			
Unit	Topics		No. Of Lectures
I	<p><i>Ancient Indian knowledge base about various rocks and their classification. Stones used in great ancient structures</i></p> <p>Origin of primary basic magmas. Factors affecting magma composition. Silicate melt equilibria of Monary (Silica), Binary (Ab–An, Di–An), and Ternary (Ab–An–Di), and (Fo–Fa–Silica) silicate systems and their significance. Evolution of magma-differentiation and assimilation.</p> <p>Activities: Quiz, Seminar-PPT</p>		18
II	<p>Forms, Structures and textures of igneous rocks and their significance. Classification of igneous rocks. Reaction principle. Reaction series. Layered igneous structures. Petrogenesis of Lamprophyre.</p> <p>Activities: Quiz, Seminar-PPT</p>		18
III	<p>Origin of sediments. Modes of transportations of sediments. Primary, biogenic and chemical sedimentary structures. Sedimentary textures (clastic and non-clastic sedimentary rocks) Sedimentary environments: Continental (fluvial, lacustrine, aeolian and glacial), Transitional, and Marine environments. Evaporites and volcanoclastic sediments. Sedimentary facies. Facies modeling for marine, non-marine and mixed sediments.</p> <p>Activities: Quiz, Seminar-PPT, posters</p>		18

IV	<p>Kinds of metamorphism, prograde and retrograde metamorphism.. Metamorphic differentiation.</p> <p>Structures and textures of metamorphic rocks. Regional and contact metamorphism of pelitic and impure carbonate, and mafic rocks. Mineral assemblages and P/T conditions. Metamorphic mineral zones.</p> <p>Activities: Quiz, Seminar-PPT</p>	18
V	<p>Characteristics of different metamorphic grades, facies and facies series. Experimental and thermodynamic appraisal of metamorphic reactions. Plate tectonics and metamorphic zones. Paired metamorphic belts. Metasomatism and their important products and Granitization. Origin and types of migmatites.</p> <p>Activities: Quiz, Seminar-PPT</p>	18

Keywords/ Tags: Evolution of magma, Reaction principle, Transitional, and Marine environments

### Part C- Learning Resources

#### Text Books, Reference Books, Other Resources

##### Suggested Readings: -

- Ram S. Sharma, Editors, 2016: Metamorphic Petrology Concepts and Methods. Geol Soc of India, Bengaluru.
- Rathore, B S, 2021: Igneous Petrology for Beginners. Notion Press
- Sengupta, S 1997: Introductions of Sedimentology. Oxford IBH
- Best, M.G. 1986: Igneous and Metamorphic Petrology, CBS Publ.
- Bose, M.K.1997: Igneous Petrology, World Press
- Bucher, K & Frey, M. 1994: Petrogenesis of Metamorphic Rocks, Springer-V
- Hall, A. 1987: Igneous Petrology.
- Hyndman 1999: Petrology of Igneous and Metamorphic Rocks. McGraw
- Allen, P. 1997: Earth Surface Processes. Blackwell
- Davis, R A, 1992: Depositional Systems. Prentice hall
- Einsels, G 1992: Sedimentary Basins. Springer Verlag
- Miall AD, 2000: Principles of Sedimentary Basin Analysis. Springer Verlag
- Nichols, G. 1999: Sedimentology and Stratigraphy. Black well
- Pettijohn, F J: Sedimentary Rocks. 3rd ed.
- Reading, H G, 1996: Sedimentary Environments. Black well
- Tucker, M E 1989: Sedimentary Petrology. Blackwell.
- Kretz, R. 1994: Metamorphic crystallization, John Wiley
- Mc Birney, A.R. 1993: Igneous Petrology, Jones and Bartlet Publ
- Miyashiro, A: Metamorphism and Metamorphic Rocks. George Allen Unwin
- Phillpots, A. 1992: Igneous and Metamorphic Petrology, Prentice Hall.
- Turner, F.J. and Verhoogen J, 1982: Igneous and Metamorphic Petrology, McGraw
- Winkler, HGF: Petrogenesis of Metamorphic Rocks. Springer Verlag
- Winter, J D, 2005: Principles of Igneous and Metamorphic Petrology. 2e, PHI Delhi
- Yardley, B W. 1989: An Introduction to Metamorphic Petrology, Longman

<https://www.exoticindiaart.com/book/details/geology-in-ancient-vedic-literature-nak921/>

## Assessment and Evaluation

Recommended Continuous Assessment Methods-: (It may vary for respective course subject but **TOTAL marks distribution will remain same**)

**Maximum Marks: 100**

Continuous Comprehensive Evaluation (CCE): 40 Marks

University Examination: 60 Marks

<b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):	<b>Class Test</b> <b>Assignment/Presentation</b>	20 Marks 20 Marks <b>Total Marks = 40</b>
<b>External Assessment:</b> University Examination: Time: 3 Hours	<b>Section (A)</b> - Five very short answer question (20 words each) <b>Section (B)</b> - Five short answer question (200 words each) <b>Section (C)</b> - Two long answer question (500 words each)	<b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b>

Mid Term Examination	Section (B): Short Questions Section(C): Long Questions	
Any remarks/Suggestions:		

Practicum Paper: Scheme B-1 for Two Year PG Program			
Part A- Introduction			
Program: 2-Year PG	Class: M.Sc. III Semester	Year: 2025	Session: 2026-27
Subject: Geology			
1	Course Code	MGEO0302-P	
2	Course Title	Petrology	
3	Course Type	Practical Course	
4	Course Level	500	
5	Pre-Requisite (if any)	After completing 3 Year Bachelor Degree with Geology Subject	
6	Course Learning Outcome (CLO)	The Practicum Part will enhance the theoretical reasoning by directly exposing the students to representative samples/ models/ problems. This will help students improve the understanding of the subject <b>Petrology</b> in totality.  Understanding of Ancient Indians about rocks.	
7	Credit Value	4	
8	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 hrs per credit per week = 8 hrs of Lab per week L-T-P: 120 Hrs			
Topics			No. Of Lectures
<p>1. 1. Study of igneous rocks in hand specimen; study of igneous rocks in thin sections; structures and textures in igneous rocks; calculation of CIPW norms and Niggli values; plotting of chemical data on different variation diagrams for evaluation of magma and rock types; preparation of igneous rock slides.</p> <p>2. Study of sedimentary rocks in hand specimen; study of sedimentary rocks in thin section; study of primary, Grain-size Analysis by sieving Method: Plotting of size-distribution data as Frequency and Cumulative. Curves; Computation of Statistical Parameters and Interpretation. secondary and biogenic sedimentary structures in hand specimen; aerial photographs and field exercises related to palaeo-current data from different environments; exercises related to analysis and interpretation of depositional sedimentary environments; staining and mineral identification in carbonate rocks; detailed study of diagenetic features in thin sections; preparation of thin section of sedimentary rocks.</p> <p>3. Study of metamorphic rocks in hand specimen; study of metamorphic rocks in thin sections; structures and textures in metamorphic rocks; interpretation of reaction texture; plotting of chemical data on ACF, AKF and AFM diagrams; preparation of metamorphic rock slides.</p> <p>2. Group discussion on Ancient Indian knowledge base about various rocks and their classification.</p> <p>3. Poster presentation on Various important temples of India and their rocks.</p>			120 Hrs

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings: -

- Ram S. Sharma, Editors, 2016: Metamorphic Petrology Concepts and Methods. Geol Soc of India, Bengaluru.
- Rathore, B S, 2021: Igneous Petrology for Beginners. Notion Press
- Sengupta, S 1997: Introductions of Sedimentology. Oxford IBH
- Best, M.G. 1986: Igneous and Metamorphic Petrology, CBS Publ.
- Bose, M.K.1997: Igneous Petrology, World Press
- Bucher, K & Frey, M. 1994: Petrogenesis of Metamorphic Rocks, Springer-V
- Hall, A. 1987: Igneous Petrology.
- Hyndman 1999: Petrology of Igneous and Metamorphic Rocks. McGraw
- Allen, P. 1997: Earth Surface Processes. Blackwell
- Davis, R A, 1992: Depositional Systems. Prentice hall
- Einsels, G 1992: Sedimentary Basins. Springer Verlag
- Miall AD, 2000: Principles of Sedimentary Basin Analysis. Springer Verlag
- Nichols, G. 1999: Sedimentology and Stratigraphy. Black well
- Pettijohn, F J: Sedimentary Rocks. 3rd ed.
- Reading, H G, 1996: Sedimentary Environments. Black well
- Tucker, M E 1989: Sedimentary Petrology. Blackwell.
- Kretz, R. 1994: Metamorphic crystallization, John Wiley
- Mc Birney, A.R. 1993: Igneous Petrology, Jones and Bartlet Publ
- Miyashiro, A: Metamorphism and Metamorphic Rocks. George Allen Unwin
- Phillpots, A. 1992: Igneous and Metamorphic Petrology, Prentice Hall.
- Turner, F J. and Verhoogen J, 1982: Igneous and Metamorphic Petrology, McGraw
- Winkler, HGF: Petrogenesis of Metamorphic Rocks. Springer Verlag
- Winter, J D, 2005: Principles of Igneous and Metamorphic Petrology. 2e, PHI Delhi
- Yardley, B W. 1989: An Introduction to Metamorphic Petrology, Longman

<https://www.exoticindiaart.com/book/details/geology-in-ancient-vedic-literature-nak921/>

## Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

### Assessment and Evaluation

Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

**Theory Paper: Scheme B-1 for Two Year PG Program**

**Part A- Introduction**

<b>Program: 2-Year PG</b>	<b>Class: M.Sc. IV Semester</b>	<b>Year: 2025</b>	<b>Session: 2026-27</b>
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Subject: **Geology**

1	<b>Course Code</b>	MGEO0401-T	
2	<b>Course Title</b>	Mineral Exploration, Mining Geology and Mineral Dressing	
3	<b>Course Type</b>	Core Course	
4	<b>Course Level</b>	500	
5	<b>Pre-Requisite (if any)</b>	After completing 3 Year Bachelor Degree with Geology Subject	
6	<b>Course Learning Outcome (CLO)</b>	<p>Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Mineral Exploration, Mining Geology and Mineral Dressing</b>.</p> <p>Students will also develop theoretical reasoning and knowledge for practical use.</p> <p>Understanding of Ancient Indian skill and achievements in Exploration, Mining and metallurgy.</p>	
7	<b>Credit Value</b>	6	
8	<b>Total Marks</b>	Max. Marks: 100 (40+60)	Minimum Passing Marks:40

**Part B : Content of the Course**

**Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 6**

**L-T-P: 90**

<b>Unit</b>	<b>Topics</b>	<b>No. Of Lectures</b>
I	<p><i>Introduction to Ancient Indian achievements in knowledge of mineral exploration, mining and mineral dressing. Mahrouli Iron Pillar—Highest quality Iron (Steel) metallurgy. Ancient Zawar Pb-Zn deposits and large scale mining.</i></p> <p>Methods of surface and subsurface exploration, prospecting for economic minerals— drilling, sampling and assaying. Types and methods. Channel sampling and placer sampling, underground mine sampling. Geological controls of ore deposits and ore-guides.</p> <p>Activities: Quiz, Seminar-PPT</p>	18
II	<p>Geophysical techniques — gravity, electrical, magnetic, airborne and seismic. Borehole logging and surveys for deviation. Geomorphological and remote sensing techniques. Assaying and calculation of ore reserves. Classification of reserves (UNFC). Geochemical and geobotanical Exploration methods. Path finder elements. Primary dispersion patterns, syngenetic and epigenetic diffusion.</p> <p>Activities: Quiz, Seminar-PPT</p>	18
III	<p>Mining terminology, mine-supports, subsidence, mine ventilation, pumping of mine water. Classification of mining methods.</p>	18

	Alluvial mining and opencast mining. Introduction to Ocean Bottom Mining. Activities: Quiz, Seminar-PPT	
<b>IV</b>	Stopping methods: open stopping, timbered stope, and shrinkage stope. Haulage and winding. Coal mining: underground room and pillar method, long wall methods. Opencast strip mining. Introduction to equipment used in coal mining. Activities: Quiz, Seminar-PPT	18
<b>V</b>	Mineral Dressing: Scope of mineral dressing. Types of crushers and grinding mills. Laboratory sizing of particles. Industrial screening. Types of classifiers. Gravity separations, heavy-medium separation, magnetic separation, electrostatic separation, froth floatation technique of separation, and amalgamation. Thickening and dewatering. Activities: Quiz, Seminar-PPT, Posters	18
Keywords/ Tags: ore-guides, Borehole logging , Path finder elements, dewatering		

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings:

- Arogyaswamy, R N P, 1996: Courses in Mining Geology. Oxford/ IBH
- Dhana Raju P: Handbook of Mineral Exploration and Ore Petrology: Techniques & Applications Geol soc. India
- Krishnaswamy, S, 1972: India's Mineral Resources. Oxford and IBH
- Haldar, S K, 2009: Mineral Exploration: Principles and Applications. Elsevier
- Mukherjee, A D, 1999: Elements of Prospecting for Non Fuel Mineral Deposits. Allied Press
- Umeshwar Prasad 2000: Economic Geology. CBS
- Bateman, 1981: Economic Mineral Deposits. Wiley
- Deb, S., 1980: Industrial Minerals and Rocks of India. Allied P New Delhi
- Dobrin, M B, and Savit C H, 1988: Introduction to Geophysical Prospecting. McGraw
- Evans, J M 1993: Ore Geology and Industrial Minerals. Blackwell
- Hawkes, H and Webb J S, 1979: Geochemistry in Mineral Exploration. Harper NY
- Levinson, A A, 1974: Introduction to exploration geochemistry-T/B. Applied P IL
- Parasnis, D S, 1996: Principles of Applied Geophysics. 5e, Prentice Hall/ Springer
- Richards, R H and Locke, C E 1940, Text Book of Ore Dressing. McGraw Hill
- Richey J E: Elements of Engineering Geology. Sir Issac Pitman & Sons
- Taggart, A F, 1948, Handbook of Mineral Dressing. Wiley New York
- Trefethen N C: Textbook of Geology and Engineering Geology. McMillan.
- Metallurgy in ancient India
- <https://www.youtube.com/watch?v=vEwn0vylMdE>
- <https://www.scribd.com/document/435308900/Metallurgy-in-Ancient-India-pdf>
- <https://www.scribd.com/document/638313125/Metallurgy-in-India>
- Minerals and Mining in ancient India
- <https://www.exoticindiaart.com/book/details/minerals-and-mining-in-ancient-india-from-earliest-times-to-beginning-of-christian-era-uax073/>
- <https://www.researchgate.net/publication/289193892> Mining in ancient India - Glimpses of the glorious past
- Ancient Indian mining technology
- <https://www.researchgate.net/publication/388461071> Ancient Indian Mining Technology - Rasayana Vidya
- <https://www.slideshare.net/slideshow/mining-and-metallurgy-of-ancient-india/122061814>
- <https://geographyandyou.com/geoheritage-sites/zawar-worlds-oldest-zinc-mining-and-metallurgy-site>
- For TIN
- [https://os.pennds.org/archaeobib\\_filestore/pdf\\_articles/bookchapters/2015\\_Upadhyay.pdf](https://os.pennds.org/archaeobib_filestore/pdf_articles/bookchapters/2015_Upadhyay.pdf)
- <https://enrouteindianhistory.com/unearthing-a-precious-metal-gold-mining-in-ancient-india/>

## Assessment and Evaluation

Recommended Continuous Assessment Methods:- (It may vary for respective course subject but **TOTAL marks distribution will remain same**)

**Maximum Marks: 100**

Continuous Comprehensive Evaluation (CCE): 40 Marks

University Examination: 60 Marks

<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test</b> <b>Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)</b>- Five very short answer question (20 words each) <b>Section (B)</b>- Five short answer question (200 words each) <b>Section (C)</b>- Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>

**Practicum Paper: Scheme B-1 for Two Year PG Program**

**Part A- Introduction**

<b>Program: 2-Year PG</b>	<b>Class: M.Sc. IV Semester</b>	<b>Year: 2025</b>	<b>Session: 2026-27</b>
<b>Subject: Geology</b>			
1	<b>Course Code</b>	MGE0401-P	
2	<b>Course Title</b>	Mineral Exploration, Mining Geology and Mineral Dressing	
3	<b>Course Type</b>	Practical Course	
4	<b>Course Level</b>	500	
5	<b>Pre-Requisite (if any)</b>	After completing 3 Year Bachelor Degree with Geology Subject	
6	<b>Course Learning Outcome (CLO)</b>	The Practicum Part will enhance the theoretical reasoning by directly exposing the students to representative samples/ models/ problems. This will help students improve the understanding of the subject <b>Mineral Exploration, Mining Geology and Mineral Dressing</b> in totality. Understanding of Ancient Indian skill and achievements in Exploration, Mining and metallurgy.	
7	<b>Credit Value</b>	4	
8	<b>Total Marks</b>	Max. Marks: 100 (40+60)	Minimum Passing Marks:40

**Part B : Content of the Course**

**Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 hrs per credit per week = 8 hrs of Lab per week**

**L-T-P: 120 Hrs**

<b>Topics</b>	<b>No. Of Lectures</b>
Geological mapping: Learning to interpret and create geological maps and mapping structural features like folds and faults. Geochemical methods: Analyzing soil, water, and rock samples for trace elements to identify potential mineralization. Calculation of ore reserve estimation. Weighted volume estimation methods, Volume estimation by triangular method, volume by the method of polygon, volume by prismoidal formula. sampling calculation based on minimum stopping width, calculation of average assay from core drill samples, Tonnage factor and its calculation. Ore deposit evaluation: Assessing the size, grade, and economic viability of ore deposits.  Group discussion on Ancient Indian knowledge and achievement in Mineral Mining and metallurgy.  Poster presentation of major ancient mining sites and trades.	120 Hrs

Keywords/ Tags: Geochemical methods, Mining methods, ore samples

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings:

Arogyaswamy, R N P, 1996: Courses in Mining Geology. Oxford/ IBH

Dhana Raju R: Handbook of Mineral Exploration and Ore Petrology: Techniques & Applications Geol soc. India

Krishnaswamy, S, 1972: India's Mineral Resources. Oxford and IBH

Haldar, S K, 2009: Mineral Exploration: Principles and Applications. Elsevier

Mukherjee, A D, 1999: Elements of Prospecting for Non Fuel Mineral Deposits. Allied Press

Umeshwar Prasad 2000: Economic Geology. CBS

Bateman, 1981: Economic Mineral Deposits. Wiley

Deb, S., 1980: Industrial Minerals and Rocks of India. Allied P New Delhi

Dobrin, M B, and Savit C H, 1988: Introduction to Geophysical Prospecting. McGraw

Evans, J M 1993: Ore Geology and Industrial Minerals. Blackwell

Hawkes, H and Webb J S, 1979: Geochemistry in Mineral Exploration. Harper NY

Levinson, A A, 1974: Introduction to exploration geochemistry-T/B. Applied P IL

Parasnis, D S, 1996: Principles of Applied Geophysics. 5e, Prentice Hall/ Springer

Richards, R H and Locke, C E 1940, Text Book of Ore Dressing. McGraw Hill

Richey J E: Elements of Engineering Geology. Sir Issac Pitman & Sons

Taggart, A F, 1948, Handbook of Mineral Dressing. Wiley New York

Trefethen N C: Textbook of Geology and Engineering Geology. McMillan.

Metallurgy in ancient India

<https://www.youtube.com/watch?v=vEwn0vylMdE>

<https://www.scribd.com/document/435308900/Metallurgy-in-Ancient-India-pdf>

<https://www.scribd.com/document/638313125/Metallurgy-in-India>

Minerals and Mining in ancient India

<https://www.exoticindiaart.com/book/details/minerals-and-mining-in-ancient-india-from-earliest-times-to-beginning-of-christian-era-uax073/>

<https://www.researchgate.net/publication/289193892> Mining in ancient India -  
Glimpses of the glorious past

Ancient Indian mining technology

<https://www.researchgate.net/publication/388461071> Ancient Indian Mining Technology -  
Rasayana Vidya

<https://www.slideshare.net/slideshow/mining-and-metallurgy-of-ancient-india/122061814>

<https://geographyandyou.com/geoheritage-sites/zawar-worlds-oldest-zinc-mining-and-metallurgy-site>

For TIN

[https://os.pennds.org/archaeobib\\_filestore/pdf\\_articles/bookchapters/2015\\_Upadhyay.pdf](https://os.pennds.org/archaeobib_filestore/pdf_articles/bookchapters/2015_Upadhyay.pdf)

<https://enrouteindianhistory.com/unearthing-a-precious-metal-gold-mining-in-ancient-india/>

## Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

### Assessment and Evaluation

Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

**Theory Paper: Scheme B-1 for Two Year PG Program**

**Part A- Introduction**

<b>Program: 2-Year PG</b>		<b>Class: M.Sc. IV Semester</b>		<b>Year: 2025</b>	<b>Session: 2026-27</b>
<b>Subject: Geology</b>					
1	<b>Course Code</b>	MGE00402-T			
2	<b>Course Title</b>	Environmental Geology and Geochemistry			
3	<b>Course Type</b>	Core Course			
4	<b>Course Level</b>	500			
5	<b>Pre-Requisite (if any)</b>	After completing 3 Year Bachelor Degree with Geology Subject			
5	<b>Course Learning Outcome (CLO)</b>	Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Environmental Geology and Geochemistry</b> . Students will also develop theoretical reasoning and knowledge for practical use. Understanding of holistic outlook of environment in ancient India.			
6	<b>Credit Value</b>	6			
8	<b>Total Marks</b>	Max. Marks: 100 (40+60)		Minimum Passing Marks:40	
<b>Part B : Content of the Course</b>					
<b>Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 6</b>					
<b>L-T-P: 90</b>					
<b>Unit</b>	<b>Topics</b>				<b>No. Of Lectures</b>
I	Environmental understanding and practices and holistic concept in ancient India. Environmental Planning in Saraswati-Indus Valley civilization. Modern Concept of Environmental Geology. Classification of Environment. Positive and Negative Feedback Mechanism in environment. Earth's Heat Budget. Stefan-Boltzmann Equation, Global Warming and Causes of Climate Change. Earth's natural hazardous processes and its impact on environment— Seismic, landslides and coastal hazards. Activities: Quiz, Seminar-PPT, Posters				18
II	Impact assessment of degradation and contamination of surface water and ground water quality due to industrialization and urbanization. Soil profiles, soil types; and soil quality degradation due to irrigation, use of fertilizer and pesticides. Badlands: - forms, characteristics of badland systems, stages, causes and mitigation. Yamuna – Chambal badlands of India. Activities: Quiz, Seminar-PPT, Posters				18
III	Wetlands: Ramsar conference resolution, classification, natural and artificial wetlands, problems of reclamation of wetlands, use of wetlands, major wetlands of India. Water logging problems. Causes of floods; flood zones of India. Flood hazards and management. Environmental problems related to dams and reservoirs.				18

	<p>Activities: Quiz, Seminar-PPT, Posters</p>	
IV	<p>Impacts of mining activities on the environment. Environmental management in mining areas. Environmental pollution due to industries, energy resources, and urbanization. Desertification and Degradation of land. Anti-desertification measures. Environmental pollution, hazards due to nuclear and thermal power energy establishments.</p> <p>Activities: Quiz, Seminar-PPT, Posters</p>	18
V	<p>Cosmic abundance of elements. Composition of the planets and meteorites. Composition and structure of the earth: Crust, mantle and core. Geochemical Classification of the elements. Geochemical Cycle. Mineral Stability Series. Principle and equation of thermodynamics in geochemistry. Geochemistry of Igneous, Sedimentary and metamorphic rocks. Principle of geochemical Prospecting.</p> <p>Activities: Quiz, Seminar-PPT, Posters</p>	18
<p>Keywords/ Tags: Earth's Heat Budget, Soil profiles, Badlands, Geochemical Cycle</p>		

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings :

- Patwardhan A M. 1999: The Dynamic Earth System. Prentice Hall
- Subramaniam V. 2001: Textbook in Environmental Science. Narosa international
- Sumit K 1992: Environmental Hazards. Routledge
- T.E. Graedel & P.J. Crutzen, 1993: Atmospheric Change. W H Freeman and Co
- Bell F G. 1999: Geological Hazards. Rout ledge London
- Carla W. Montgomery, 2011. Environmental Geology. 9e, McGraw Hill
- Hsai-Yang Fang 1997: Introduction to Environmental Geotechnology, CRC Press
- Valdiya K S 1987: Environmental Geology- Indian context. Tata-McGraw
- Gunter Faure, 1991. Principles and Applications of Inorganic Geochemistry: A Comprehensive Textbook. Macmillan Coll Div
- Kula C. Misra. 2012. Introduction to Geochemistry: Principles and Applications. Wiley
- Rathore, B.S.; Basics of Crystallography, Mineralogy and Geochemistry. Notion Press India, 2020.
- William M. White. 2015. Isotope Geochemistry. (Wiley Works) Bell F G. 1999: Geological Hazards. Rout ledge London.
- Smith K. 1992: Geological Hazards. Rout ledge London
- Nipunage, D.S. and Kulkarni, D.K. (2010). Deo-rahati: An Ancient Concept of Biodiversity Conservation. Asian Agri-History. Volume 14(2), 185-196.
- Pandey, Archana (2016). Society and Environment in Ancient India (Study of Hydrology). International Journal of Humanities and Social Science Invention. Volume 5(2), 26-31. ISSN (online) 2319-7722. [www.ijhssi.org/](http://www.ijhssi.org/) 335 Attitudes towards Environment, Science and Technology
- Satpathy, Binod Bihari (not dated). History of Science and Technology in India. DDCE/History (M.A.)/SLM/Paper.
- Tanwar, Renu (2016). Environment Conservation in Ancient India. IOSR Journal of Humanities and Social Sciences. Volume 21(9), Ver. 11, 01-04.
- Narayanan, Vasudha (2001). Water, Wood and Wisdom: Ecological perspectives from the Hindu Traditions. Daedalus. Volume 130 (4), 179-206.
- Vahia, Mayank (2015). Evaluating the Claims of Ancient Indian Achievements in Science. Current Science. Volume 108(12), 25th June 2015, 2145-48.
- <https://egyankosh.ac.in/bitstream/123456789/64796/1/Unit18.pdf>

## Assessment and Evaluation

Recommended Continuous Assessment Methods-: (It may vary for respective course subject but **TOTAL marks distribution will remain same**)

**Maximum Marks: 100**

Continuous Comprehensive Evaluation (CCE): 40 Marks

University Examination: 60 Marks

<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test</b> <b>Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)</b>- Five very short answer question (20 words each) <b>Section (B)</b>- Five short answer question (200 words each) <b>Section (C)</b>- Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>

**Practicum Paper: Scheme B-1 for Two Year PG Program**

**Part A- Introduction**

<b>Program: 2-Year PG</b>		<b>Class: M.Sc. IV Semester</b>	<b>Year: 2025</b>	<b>Session: 2026-27</b>
<b>Subject: Geology</b>				
1	<b>Course Code</b>	<b>MGEO0402-P</b>		
2	<b>Course Title</b>	<b>Environmental Geology and Geochemistry</b>		
3	<b>Course Type</b>	Practical Course		
4	<b>Course Level</b>	500		
5	<b>Pre-Requisite (if any)</b>	After completing 3 Year Bachelor Degree with Geology Subject		
5	<b>Course Learning Outcome (CLO)</b>	The Practicum Part will enhance the theoretical reasoning by directly exposing the students to representative samples/ models/ problems. This will help students improve the understanding of the subject <b>Environmental Geology and Geochemistry</b> in totality. Understanding of Ancient Indian worldview on Environment.		
6	<b>Credit Value</b>	4		
8	<b>Total Marks</b>	Max. Marks: 100 (40+60)	Minimum Passing Marks:40	

**Part B : Content of the Course**

**Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 hrs per credit per week = 8 hrs of Lab per week**

**L-T-P: 120 Hrs**

<b>Topics</b>		<b>No. Of Lectures</b>
<ol style="list-style-type: none"> <li>1. 1.Determination of Potential for pollution of groundwater with DRASTIC parameter.</li> <li>2. Determination of Surface water quality and application of Water Quality Index</li> <li>3. Study of seismic and flood prone in India; hydrochemistry analysis surface water and subsurface water; classification of groundwater for use in drinking, irrigation and industrial purposes; presentation of chemical analysis; data and plotting; chemical classification diagram; evaluation of environmental impact of air pollution and groundwater pollution; deforestation; landslides.</li> <li>4. Preparation and interpretation of geochemical maps; Rock/ sediments/ water/ soil analysis.</li> <li>5. Preparation of classificatory and variation diagrams, REE normalized plots and their interpretation.</li> <li>2. Group discussions on Ancient Indian Understanding of the Holistic concept of Environment.</li> <li>3. (a) Essay writing Vedic Concern related to the Environment (b) Ancient Indian concern related to use of arms of Mass Destruction (Brahmastra).</li> </ol>	120 Hrs	

**Keywords/ Tags: DRASTIC parameter, Water Quality Index, drinking, irrigation, industrial**

## Part C- Learning Resources

### Text Books, Reference Books, Other Resources

#### Suggested Readings :

- Patwardhan A M. 1999: The Dynamic Earth System. Prentice Hall
- Subramaniam V. 2001: Textbook in Environmental Science. Narosa international
- Sumit K 1992: Environmental Hazards. Routledge
- T.E. Graedel & P.J. Crutzen, 1993: Atmospheric Change. W H Freeman and Co
- Bell F G. 1999: Geological Hazards. Rout ledge London
- Carla W. Montgomery, 2011. Environmental Geology. 9e, McGraw Hill
- Hsai-Yang Fang 1997: Introduction to Environmental Geotechnology, CRC Press
- Valdiya K S 1987: Environmental Geology- Indian context. Tata-McGraw
- Gunter Faure, 1991. Principles and Applications of Inorganic Geochemistry: A Comprehensive Textbook. Macmillan Coll Div
- Kula C. Misra. 2012. Introduction to Geochemistry: Principles and Applications. Wiley
- Rathore, B.S.; Basics of Crystallography, Mineralogy and Geochemistry. Notion Press India, 2020.
- William M. White. 2015. Isotope Geochemistry. (Wiley Works) Bell F G. 1999: Geological Hazards. Rout ledge London.
- Smith K. 1992: Geological Hazards. Rout ledge London
- Nipunage, D.S. and Kulkarni, D.K. (2010). Deo-rahati: An Ancient Concept of Biodiversity Conservation. Asian Agri-History. Volume 14(2), 185-196.
- Pandey, Archana (2016). Society and Environment in Ancient India (Study of Hydrology). International Journal of Humanities and Social Science Invention. Volume 5(2), 26-31. ISSN (online) 2319-7722. [www.ijhssi.org/](http://www.ijhssi.org/) 335 Attitudes towards Environment, Science and Technology
- Satpathy, Binod Bihari (not dated). History of Science and Technology in India. DDCE/History (M.A.)/SLM/Paper.
- Tanwar, Renu (2016). Environment Conservation in Ancient India. IOSR Journal of Humanities and Social Sciences. Volume 21(9), Ver. 11, 01-04.
- Narayanan, Vasudha (2001). Water, Wood and Wisdom: Ecological perspectives from the Hindu Traditions. Daedalus. Volume 130 (4), 179-206.
- Vahia, Mayank (2015). Evaluating the Claims of Ancient Indian Achievements in Science. Current Science. Volume 108(12), 25th June 2015, 2145-48.
- <https://egyankosh.ac.in/bitstream/123456789/64796/1/Unit18.pdf>

## Pattern of Marks Distribution PRACTICAL PAPER for NEP PG courses

### Assessment and Evaluation

Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	15	Viva Voce on Practical	10
Attendance in the lab	10	Practical Record File	10
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)	15	Table work / Experiments	40
<b>TOTAL</b>	<b>40</b>		<b>60</b>

Theory Paper: Scheme B-1 for Two Year PG Program			
Part A- Introduction			
Program: 2-Year PG		Class: M.Sc. IV Semester	Year: 2025
Session: 2026-27			
Subject: Geology			
1	Course Code	VAC (Employability and Entrepreneurship Skill Course)	
2	Course Title	Employability and Entrepreneurship Skill Course	
3	Course Type	VAC	
4	Pre-Requisite (if any)	After Bachelor Degree with Geology Subject	
5	Course Learning Outcome (CLO)	Students will acquire insight in the various fundamental and advance components and aspects of the subject <b>Employability and Entrepreneurship Skill Course</b> in the chosen field. Students will also develop practical skill along with the theoretical reasoning and knowledge.	
6	Credit Value	2	
7	Total Marks	Max. Marks: 100 (40+60)	Minimum Passing Marks:40
Part B : Content of the Course			
Total No. Of Lectures- Tutorial- Practicum ( in hours per week): 2 Hrs per week			
L-T-P: 30 Hrs			
	Topics		
	(A) The EESC Shall include such important of interest of the students and concerned faculty of the geology department depending upon the facilities available with the department or local industry or as per the demand of a skill and employability assessed by the student and faculty.		
	OR if student does not choose a topic from (A) than he may opt for any one of the following fields for skill development. (B)The following topics suggested for here with 1. Geological Survey and Mapping 2. Geochemical Analysis of ores/mineral 3. Preparation of mining plans for mining operation. 4. Ancient Indian skill as per the choice of the faculties in geology		
Keywords/ Tags:			
Part C- Learning Resources			
Text Books, Reference Books, Other Resources			

## Assessment and Evaluation

Recommended Continuous Assessment Methods-: (It may vary for respective course subject but **TOTAL marks distribution will remain same**)

**Maximum Marks: 100**

Continuous Comprehensive Evaluation (CCE): 40 Marks

University Examination: 60 Marks

<p><b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE):</p>	<p><b>Class Test Assignment/Presentation</b></p>	<p>20 Marks 20 Marks <b>Total Marks = 40</b></p>
<p><b>External Assessment:</b> University Examination: Time: 3 Hours</p>	<p><b>Section (A)-</b> Five very short answer question (20 words each) <b>Section (B)-</b> Five short answer question (200 words each) <b>Section (C)-</b> Two long answer question (500 words each)</p>	<p><b>02 Marks x 05 Questions = 10 Marks</b> <i>(All 5 Questions to be attempted)</i> <b>06 Marks x 05 Questions = 30 Marks</b> <i>(5 Questions to be attempted out of total 8 Questions)</i> <b>10 Marks x 02 Questions = 20 Marks</b> <i>(2 Questions with each having internal choice)</i> <b>Total Marks = 60</b></p>