

**KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY,**

**JALGAON.**

**F. Y. B. Sc. SEMESTER I AND II – GEOLOGY SYLLABUS AS PER NEP 2024-25**



**Kavayitri Bahinabai Chaudhari  
North Maharashtra University, Jalgaon  
National Education Policy – 2020**

**Proposed Curriculum for Undergraduate Programme in  
Geology**

**In**

**Affiliated Colleges under KBCNMU**

**With Effect from 2024-2025**

*Submitted by Geology Subject Committee NEP 2020*

## Curriculum Structure for Degree Program B. Sc., Hons in Geology

- ❖ Name of the Degree Program: **B. Sc., Hons.**
- ❖ Discipline Core: **Geology**
- ❖ Total Credits for the Program: **44/88/132/176/220**
- ❖ Starting year of implementation: **2024-25**

### **Preamble:**

The new curriculum of B.Sc. Honours/Research Geology is framed under National Educational Policy (NEP 2020) is to prepare their students for society at large.

The contents of the syllabi have accommodated the widening horizons of the discipline of Earth Sciences. They do reflect the current changing needs of the students: specifically, for the courses that have social impact like Hydrogeology, Fuel Geology, Engineering Geology, Remote Sensing etc.

The well-organized curricula include basics as well as advanced concepts in Geosciences spread over three years of Graduation. The syllabus lists new practical exercises so that the students get hands-on experience of the latest techniques that are in current usage in Geosciences.

The curriculum is designed to inspire the students to develop exquiteness to pursuing higher education and to boost research mindset in Geology. Encourage the learners to become an entrepreneur, as also enable them to get employed in various organizations at National and International level like Research Institutes, Industries, Educational Institutes and in the various concerning departments of State and Central Government.

The overall syllabus does not compromise with the Principle of giving all the basic and sound fundamental foundation of the subject required for the learned to be a undergraduate.

### **Introduction:**

Geology is the study of everything we should know about the history of the 4.5 billion years of the Earth and evolution of life.

Geologists study society's important problems, like Energy, Water, Mineral, Metal and Rock as a resource; the Environment; Climate change; Natural hazards; and construction projects like Roads, Bridges, or Dams; Impacts of developments on the environment; to mention a few. Geologists are also responsible for exploring and finding resources required by a modern society, or even for our own survival.

We require trained Geologists to work in the fields of mining, oil and gas, environmental science, city planning, water & resource management, atmospheric & space science, oceanography, geotechnical engineering, hydrogeology, education & research, and many others.

The syllabus is therefore evolved according to the need to be a trained Geologist required as a Human Resource in our country.

### **Program Objectives (POs):**

Inspiring our B.Sc. Honours/Research students to be life-long learners in a diverse global community and prepare them to pursue a Geosciences career through innovative and hands-on involvement in the classroom, laboratory, field activity and internship.

Within 4 years of students with the B. Sc. Honours/Research degree in Geology from KBCNM University, Jalgaon our alumni should possess the knowledge and skills to:

1. Achieve excellence in academic and scientific research in the field of Geology.
2. Develop and implement ways and means to ensure quality performance and output of Geology program.
3. Use modern technology in education and scientific research in Geology.
4. Get involved in advanced training to improve the skills of degree holders in Geology and related disciplines.
5. Create academic and scientific environment to attract outstanding faculty, researchers and students.
6. Improve the national and international interactions with academic institutions and research centers.
7. Prepare the students to develop a mindset to apply scientific methods in understanding the earth sciences
8. Develop competence in basic lab skills, including use of modern instrumentation and computers.
9. Prepare the graduate students to handle diverse career opportunities through student centered learning and student-faculty interaction using a blend of traditional, current, and integrative pedagogical techniques in educational research.

### **Program Outcome (PO):**

The Program outcome is to equip the students with scientific knowledge to be able to explore the Earth's holistic information and applying it to solve societal problems. The Program is dedicated to the enhancement of teaching, research as part of contribution to understanding and community relevance in the region. It is aimed:

1. To possess a good command of fundamentals in Geology and its relationship to other disciplines.
2. To get acquainted with theoretical, practical and field aspects in the sections of Geology and interrelations of materials of Earth.
3. To design and conduct experiments in Geology.
4. To develop skills in laboratory techniques in analysis of Geological materials.

5. To equip the student learners to be able to frame policies and legislation for Mining, Minerals and Groundwater etc.
6. To prepare students for writing field reports, giving presentations, and participating in discussions.
7. To develop skills to use computer software, applications and field techniques in Geology.
8. To understand and get familiar to the principles of research methodology.
9. To be able to demonstrate content knowledge appropriate to professional career goals,
10. To be able to communicate and disseminate geologic knowledge, findings and interpretations in reports to the stake holders in society.

**Duration:** The course duration for B.Sc. Honours/Research as per NEP-2020 program shall be consists of Four Years, spread over 8 semesters.

**Medium of instruction:** The medium of instruction for the courses shall be English.

**Assessment Framework:**

Type of Course	College Assessment Marks	University Assessment Marks
Theory	20	30
Practical	20	30
Field Projects	40	60
On Job Training /Internship	40	60

**Cognitive Levels (CL):**

B.Sc Honours/ Reasearch programme involved year	Semesters	Levels	Completion of Programme
First Year	I	4.5	Certificate
	II	4.5	
Second Year	III	5.0	Diploma
	IV	5.0	
Third Year	V	5.5	Degree
	VI	5.5	
Fourth Year	VII	6.0	BSc. Hon. / BSc. Hon. with research
	VIII	6.0	

With Effect from 2024-2025

Submitted by Geology Subject Committee NEP 2020

**Semester-wise Code structure for B. Sc (Honours/Research) Programme as per NEP 2020, for Affiliated Colleges w.e.f – June 2024.**

**B. Sc (Honours/Research) – First Year, SEMESTER – I, Level – 4.5**

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/Week			Marks (Total 100)			
					T	P	Total	Internal (CA)		External (UA)	
								T	P	T	P
DSC-1	DSC	GE-111	Earth System Science	2	2	--	2	20	--	30	--
DSC-2	DSC	GE -112	Mineral Science	2	2	--	2	20	--	30	--
DSC-3	DSC	GE -113	Practical Based on GE-111 and GE- 112	2	--	4	4	--	20	--	30
MIN-1	MIN	GE -114	Introduction to Earth Science	2	2	--	2	20	--	30	--
MIN-2	MIN	GE -115	Practical Based on GE-114	2	--	4	4	--	20	--	30
OE-1	OE	GE -116	Geogenic Disaster Management	2	2	--	2	20	--	30	--
SEC-1	SEC	GE -117	Geoheritage and Geotourism	2	2	--	2	20	--	30	--
VEC-1	VEC	EA-118	Environmental Awareness	2	2	--	2	20	--	30	--
IKS	IKS	IK-119	Ayurveda Medicine in Ancient India	2	2	--	2	20	--	20	--
CC-1	CC	CC-120	Select any one of the following A) Sports B) Yoga	2	2	--	2	20	--	30	--
AEC-1	AEC	EG-101	English -1	2	2	--	2	20	--	30	--

**B. Sc (Honours/Research) – First Year, SEMESTER – II, Level – 4.5**

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks (Total 100)			
					T	P	Total	Internal (CA)		External (UA)	
								T	P	T	P
DSC-4	DSC	GE-121	Petrology	2	2	--	2	20	--	30	--
DSC-5	DSC	GE-122	Palaeontology	2	2	--	2	20	--	30	--
DSC-6	DSC	GE-123	Practical Based on GE-121 and GE- 122	2	--	4	4	--	20	--	30
MIN-3	MIN	GE-124	Fundamental of Mineral Science	2	2	--	2	20	--	30	--
MIN-4	MIN	GE-125	Practical Based on GE-124	2	--	4	4	--	20	--	30
OE-2	OE	GE-126	Urban Geology	2	2	--	2	20	--	30	--
SEC-2	SEC	GE-127	Gemology and Gem Testing	2	2	--	2	20	--	30	--
SEC-3	SEC	GE-128	Practical Based on GE-127	2	--	4	4	--	20	--	30
VEC-2	VEC	CI-129	Constitution of India	2	2	--	2	20	--	30	--
CC-2	CC	CC-130	Select any one of the following A) NSS B) NCC	2	2	--	2	20	--	30	--
AEC-2	AEC	EG-102	English -2	2	2	--	2	20	--	30	--
<b>Cumulative Credits For First Year – 44</b>											

## Semester I

Course Title/Code: <b>DSC-01</b> <b>Earth System Science</b>	Course Credits: <b>2</b>
Course Code: <b>DSC-01</b>	L-T-P per week: <b>2-0-0</b>
Total Contact Hours: <b>30</b>	Duration of Lecture: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Specific Objectives:

- To describe the existence of our solar system and comprehend the history of Earth and surrounding spheres.
- To apply the fundamental principles of geology to understand geological processes and issues.

### Course Specific Outcomes:

After successful completion of this course, students will be able to:

- Analyze, development, understand the scope, and limitations of Principles of Geosciences.
- Institute the ability to Access, evaluate, earth science information and compare it with current models of solid earth processes.
- Develop insight regarding origin of Universe, solar system and Earth, the diversity in minerals, rocks, structure and Fossils from Earth, Natural resources etc.
- Understand the applications of Processes of Earth System Science.

## GEOLOGY DSC- 01

### GE- 111 Earth System Science

Unit	Topics	Sub-topics	Lecture Hours	Marks
<b>I</b>	<b>Earth as a Planet</b>	a. Introduction to Geology: Definition of Geology, branches, scope and importance of geology society.  b. Historical Geology (Introduction): Concept of Geological Time, Geological events and life distribution through Geological Time Scale.  c. Origin of the Universe (Big Bang Theory), Origin of the Solar System (Nebular, Tidal and Recent Hypothesis), Components of Solar system- Definition and classification of Planets (Jovian, Terrestrial), Meteorites and comets. Geochronology and age of the Earth (Solar system): A brief account of the historical methods. Determination of age by U/Pb,	09	10

		<p>Th/Pb, K/Ar and Carbon Dating method.</p> <p>d. Earth: Its size, shape (definition of geodesy) and density, temperature, pressure and magnetism within the Earth.</p>		
<b>II</b>	<b>Structure of the Earth</b>	<p>a. Earth's Crust, Mantle and Core (Lithosphere, Asthenosphere, Barysphere and Cryosphere).</p> <p>b. Evolution of the Earth's Crust, Mantle and Core (Earth's crustal evolution: Introduction, Early crust; Types of crust and crustal growth rates; concept of craton and continent).</p> <p>c. Evolution of the Oceans (Introduction, Formation of the Oceans), Present day hypsographic curve.</p> <p>d. Earth's Atmosphere: (Introduction, Classification of Atmosphere, Introduction to Atmospheric circulation, land-air-sea interactions), Hydrosphere (Introduction to ocean currents, types, causes and significance), Biosphere (Ecology and food chain) and Pedosphere.</p>	07	08
<b>III</b>	<b>Dynamic Processes</b>	<p>a. Definitions and examples of Exogenic and Endogenic processes of the earth.</p> <p>b. Erosional and Depositional landforms of</p> <p>i. Rivers (Fluvial): Erosional Landforms: Valley (gully, gorge, rift valley), Waterfall, Potholes, River terraces, Meanders and Ox-bow lake. Depositional landforms: Flood plain, Alluvial fan, Levees and Delta.</p> <p>ii. Oceans (Sea): Erosional Landforms: Sea cliff, wave-cut platforms, sea arches and stacks. Depositional landforms: Beaches, Ocean floor deposit (bathyal and abyssal)</p> <p>iii. Wind (Aeolian): Erosional Landforms: Deflation armour, Ventifacts, Rock Columns, Pinnacles, Yardangs and Mushroom Rock. Depositional landforms: Loess, Dunes and their types.</p> <p>iv. Ice (Glacial): Erosional Landforms: Cirques, Glacial Horns, Trim lines, U-shaped valley, Roche</p>	06	07



		Moutonnée and Aretes. Depositional landforms: Moraine, Esker, Kame, Drumlin and Kettle Holes		
<b>IV</b>	<b>Causes of Dynamic Processes</b>	a. Plate Tectonics: i. Definition of Plates. ii. Characters of plates. iii. List of plates. iv. Introduction to convergent, divergent and conservative plate boundaries. v. Sea floor spreading and convection currents.  b. Volcanoes: Structure of volcano, Type, Products of volcano, Earth's volcanic belts.  c. Earthquakes: Elastic rebound theory, Earthquake waves, Mercalli scale and Richter's scale, Earthquake zones in India	08	05

**Suggested Readings:**

1. Geology: Chakranarayan and Kulkarni, NiraliPrakashan, Pune.
2. Concepts in Geology: Chakranarayan & Others, Scientifica Pub. Pune.
3. A Text Book of Geology: Mukherjee P.K., The World Press Pub. Kolkatta.
4. General Geology: Radhakrishnan.
5. Concepts of Geomorphology: Gupta and Kale
6. Geology: Chakranarayan and Kulkarni, Nirali Prakashan, Pune.
7. Principles of Physical geology: Arthur Holmes, Thomas Nelson Pub. London.
8. Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.

## Semester I

Course Title/Code: <b>DSC 2</b> <b>GE- 112: Mineral Science</b>	Course Credit: <b>2</b>
Course Code: <b>GE - 112</b>	L -T- P per week: <b>2 - 0 - 0</b>
Total Contact Hours: <b>30</b>	Duration of Lectures: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Objectives:

- To understand the characteristics of common rock-forming minerals and their genesis.
- To understand general description and different silicate groups of minerals.
- To understand optical properties of minerals.
- To understand atomic arrangement in crystals and classification of crystals based on crystal
- Symmetry.

### Course Outcomes for Mineral Science

After successful completion of this course, students will be able to:

- Students can identify the minerals on their physical and optical properties.
- Students will be able distinguish different silicate groups of minerals.
- Students will know the mineral forming process.
- Students will be able to find the symmetry in crystals and classify crystals based on symmetry elements.

## GEOLOGY DSC - 02

### GE- 112: Mineral Science

Unit	Topics	Sub-topics	Lecture Hours	Marks
<b>I</b>	<b>Introduction</b>	1. Introduction: Definition, branches and scope of Mineralogy. 2. Importance, uses and conservation of minerals.	02	02
<b>II</b>	<b>Chemistry of Minerals</b>	1. Major elements constituting minerals, Atoms and Ions. 2. Geochemical affinity and Geochemical classification of elements.	02	02

		<p>3. Isomorphism and polymorphism.</p> <p>4. Silicate structures- Definition and types.</p>		
<b>III</b>	<b>Rock Forming Minerals</b>	<p>1. Processes of mineral formation in Igneous, Sedimentary and Metamorphic rocks.</p> <p>2. Composition of common rock forming minerals.</p> <p>3. Physical properties of Minerals: Color, Streak, Lustre, Transparency, Translucency, Opaque, Forms, Hardness, Fracture, Cleavage, Piezoelectric property, Specific Gravity and Luminescence (Phosphorescence and Fluorescence).</p>	10	10
<b>IV</b>	<b>Optical Mineralogy</b>	<p>1. Nature of light- ordinary and plane polarized light.</p> <p>2. Double refraction of light.</p> <p>3. Nicol's prism and polaroids.</p> <p>4. Petrological microscope- Its parts and uses.</p> <p>5. Optical properties of Minerals:</p> <p>a. In plane polarized light (IPL/PPL): Colour, Pleochroism, Form, Cleavage, Relief and Twinkling.</p> <p>b. In between crossed Nicols (BXN): Isotropism, Anisotropism, Extinction Positions (straight, oblique and symmetrical), Extinction Angle and Interference Colours.</p>	06	06
<b>V</b>	<b>Crystallography</b>	<p>1. Definition and conditions conducive for the formation of crystals.</p> <p>2. Crystal morphology: Faces, forms, hedrons, edges, solid angles, interfacial angle and its measurement by Contact Goniometer, law of constancy of Interfacial Angle.</p> <p>3. Symmetry of crystals: Plane, Axis and Center of symmetry, Crystallographic and Geometric Symmetry. Crystallographic axes- lettering and ordering of crystallographic axes, parameters, axial ratio, indices, Parameter System of Weiss,</p>	10	10

		<p>Index System of Miller and Law of rational indices.</p> <p>4. Descriptive Crystallography: Introduction to 32 point groups and crystal classification into six systems.</p> <p>5. Study of crystallographic axes, elements of symmetry, forms present with indices of</p> <p>a. Cubic/ Isometric System, Galena Type.</p> <p>b. Tetragonal System, Zircon Type.</p> <p>c. Orthorhombic System, Barytes Type.</p>		
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### Suggested Readings:

1. Geology: Chakranarayan and Kulkarni, NiraliPrakashan, Pune.
2. Concepts in Geology: Chakranarayan&others, NiraliPrakashan, Pune.
3. Rutley's Elements of Mineralogy: Gribble, CBS Pub., New Delhi.
4. Text Book of Mineralogy: Dana, J. D. Wiley Eastern, New Delhi.
5. Mineralogy 3rd Edition by Perkins Dexter
6. An introduction to the Rock Forming Minerals (Vol.696): Deer, W. A., Howie,R.A.,&Zussman,J.(1992),London:Longman
7. A Handbook of Minerals, Crystals, Rocks and Ores: Alexander, P. O., New India Publishing Agency, New Delhi.

## Semester I

Course Title/Code: <b>GE- 113</b> <b>Practical Based on GE-111 and GE-112</b>	Course Credits: <b>2</b>
Course Code: <b>DSC-03</b>	L-T-P per week: <b>0-0-4</b>
Total Contact Hours: <b>60</b>	Duration of Practical: <b>4 Hours</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Specific Objectives:

- To develop mineral identification skills in laboratory by handling various rock forming minerals, ore minerals and crystal models.
- To get acquainted with practical in the sections of Geology and interrelations of materials of Earth.

### Course Specific Outcomes:

On completion of the course, the students will be able to:

- Explain the physical properties, optical properties, crystal identification parameters in various minerals and crystal models.
- Distinguish crystals based on type, relationship between crystallographic axes, symmetry elements and crystal forms with indices.
- Classify the terrestrial and Jovian planets based on their composition.
- Understand the layered nature of the earth, bathymetry of the ocean and results of endogenic and exogenic processes through geomorphologic landforms.

## GEOLOGY DSC-03 Lab Course

### GE- 113 Practical Based on GE-111 and GE-112

Unit No.	Topic	Marks
I	<b>Study of Physical Properties of Minerals</b> 1. Introduction to physical properties of Minerals and Ore Minerals	
II	<b>Descriptive Mineralogy</b> 1. Rock forming minerals: Quartz crystal, Amethyst, Milky Quartz, Rosy quartz, Chalcedony, Flint, Jasper, Agate, Opal, Orthoclase, Muscovite, Biotite, Garnet, Hornblende, Olivine, Talc, Appophyllite, Fluorite, Calcite, Barytes, Gypsum, Apatite and Corundum. 2. Ore Minerals: Graphite, Galena, Pyrite, Magnetite and	

Unit No.	Topic	Marks
	Magnesite, Bauxite.	30
III	<p><b>Crystallography</b></p> <p>1. Study of crystal models of following crystal system w.r.t. crystallographic axes, elements of symmetry, forms present with indices -</p> <p>a. Cubic system- Galena type.</p> <p>b. Tetragonal system- Zircon type.</p> <p>c. Orthorhombic system- Baryte type.</p> <p>2. Measurement of interfacial angle by contact goniometer.</p>	
IV	<p><b>Optical Mineralogy</b></p> <p>1. Study of petrological microscope to understand behavior of light through minerals.</p> <p>2. Study optical properties of minerals under PPL or IPL and BXN or BCN..</p> <p>3. Optical properties of minerals- Quartz, Biotite, Hornblende, Garnet, Plagioclase and Augite.</p>	
V	<p><b>General Geology</b></p> <p>Components of Solar system- Jovian Planets, Terrestrial, Meteorites and comets.</p> <p>Earth's Crust, Mantle and Core (Lithosphere, Asthenosphere, Barysphere and Cryosphere).</p> <p>Bathymetric Map of World and India.</p>	
	<p><b>Geomorphic Landforms</b></p> <p>Erosional and Depositional landforms of</p> <p>a. Rivers (Fluvial): Erosional Landforms: Valley (gully, gorge, rift valley), Waterfall, Potholes, River terraces, Meanders and Ox-bow lake.</p>	

Unit No.	Topic	Marks
VI	<p>Depositional landforms: Flood plain, Alluvial fan, Levees and Delta.</p> <p>b. Oceans (Sea): Erosional Landforms: Sea cliff, wave-cut platforms, sea arches and stacks.</p> <p>Depositional landforms: Beaches, Ocean floor deposit (bathyal and abyssal)</p> <p>c. Wind (Aeolian): Erosional Landforms: Deflation armour, Ventifacts, Rock Columns, Pinnacles, Yardangs and Mushroom Rock.</p> <p>Depositional landforms: Loess, Dunes and their types.</p> <p>d. Ice (Glacial): Erosional Landforms: Cirques, Glacial Horns, Trim lines, U-shaped valley, Roche Moutonnée and Aretes.</p> <p>Depositional landforms: Moraine, Esker, Kame, Drumlin and Kettle Holes</p>	

### Suggested Readings:

1. Rutley's Elements of Mineralogy: Gribble, CBS Pub., New Delhi.
2. Text Book of Mineralogy: Dana, J. D. Wiley Eastern, New Delhi.
3. Mineralogy: Dexter Perkins, 3rd Edition, Pearson Education
4. Geology: Chakranarayan and Kulkarni, Nirali Prakashan, Pune.
5. Concepts in Geology: Chakranarayan & Others, Scientifica Pub. Pune.
6. A Text Book of Geology: Mukherjee P.K., The World Press Pub. Kolkatta.
7. General Geology: Radhakrishnan.
8. Concepts of Geomorphology: Gupta and Kale
9. Principles of Physical geology: Arthur Holmes, Thomas Nelson Pub. London.
10. Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.
11. A Handbook of Minerals, Crystals, Rocks and Ores: Alexander, P. O., New India Publishing Agency, New Delhi.

## Semester I

Course Title/Code: <b>MIN- 114</b> <b>Introduction to Earth Science</b>	Course Credits: <b>2</b>
Course Code: <b>MIN-01</b>	L-T-P per week: <b>2-0-0</b>
Total Contact Hours: <b>30</b>	Duration of Lecture: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Specific Objectives:

- To apply the fundamental principles of geology to understand geological processes and issues.
- To describe the existence of our solar system and comprehend the history of Earth and surrounding spheres.

### Course Specific Outcomes:

After successful completion of this course, students will be able to:

- Analyze, development, understand the scope, and limitations of fundamental principles of earth sciences.
- Institute the ability to Access, evaluate, earth science information and compare it with current models of solid earth processes.
- Develop insight regarding origin of Universe, solar system and Earth, the diversity in minerals, rocks, structure and Fossils from Earth, Natural resources etc.
- Understand the applications of Processes of Earth Science.

## GEOLOGY MIN- 01

### GE- 114 Introduction to Earth Science

Unit	Topics	Sub-topics	Lecture Hours	Marks
<b>I</b>	<b>Earth as a Planet</b>	1. Introduction to Geology and its branches. 2. Understanding the earth through Astronomy, Geology, Meteorology, and Oceanography. 3. Definitions of the terms: Astronomy, Cosmology, Space, Galaxy, Milky Way, Andromeda, Constellation, Stars, Protostar, Nebula, Black hole, Dark matter, Supernova, Meteorites and Asteroids. 4. Big Bang Theory. 5. Solar System: Components of Solar system. Definition and classification of Planets. (Jovian and Terrestrial)	7	4



<b>II</b>	<b>Earth's Structure</b>	<p>1. Introduction to Atmosphere, Hydrosphere, Biosphere, Crust, Mantle, Core, Lithosphere, Baryshpere, Asthenosphere and Cryosphere</p> <p>2. Size, mass, density, rotation and revolution of the Earth</p>	3	8
<b>III</b>	<b>Hydrosphere and Atmosphere (Dynamic Processes)</b>	<p>1. Definitions and examples of Exogenic and Endogenic processes of the earth.</p> <p>2. Concept of geomorphic cycle.</p> <p>3. Introduction to the landforms of</p> <p>a) Rivers (Fluvial): Valley (gully, gorge, rift valley), waterfall, potholes, alluvial fan, flood plain, river terraces, levees, meanders, ox-bow lake, delta.</p> <p>b) Oceans (Sea): Sea cliff and wave-cut platforms, sea arches and stacks, beaches,</p> <p>c) Wind (Aeolian): Deflation armour, ventifacts, rock columns and pinnacles, yardangs, mushroom rock, dunes and their types</p>	7	5
<b>IV</b>	<b>Plate tectonics (Causes of Dynamic Processes)</b>	<p>1. Introduction to the terms: Shield, Craton, Platform, Orogenic belt, Mid-oceanic ridge, Island arc, Sea-trenches, Sea-floor spreading, transform fault and Continental drift</p> <p>2. Plate tectonics: Definition of Plates, Characters of plates, List of plates and Introduction to convergent, divergent and transform fault boundaries</p> <p>3. Mountains: Definition and Types</p> <p>4. Volcanoes: Structure and Products of volcano.</p> <p>5. Earthquakes: Elastic rebound theory, Earthquake waves and Richter's scale</p> <p>6. Fundamentals of sea floor spreading and mantle convective currents.</p>	9	7
<b>V</b>	<b>Soil</b>	<p>1. Definition and formation of soil</p> <p>2. Soil profile</p>	1	2
<b>VI</b>	<b>Understanding Stratigraphic Records</b>	<p>1. Concept of Time in Geological studies</p> <p>2. Standard Stratigraphic / Geological time scale</p> <p>3. Principles of Stratigraphy</p> <p>a. Uniformitarianism, Catastrophism, Neptunism</p> <p>b. Order of Superposition</p> <p>c. Faunal Succession</p>	3	4

**Suggested Readings:**

1. Concepts in Geology: Chakranarayan & Others, Scientific Pub. Pune.
2. Principles of Physical geology: Arthur Holmes, Thomas Nelson Pub. London.
3. A Text Book of Geology: P.K.Mukherjee, The World Press Pub. Kolkatta.
4. General Geology: Radhakrishnan.
5. Textbook of Physical Geology: Mahapatra, CBS Pub. New Delhi
6. Duff, P. M. D., & Duff, D. (Eds.). (1993). Holmes' principles of physical geology. Taylor & Francis.
7. Emiliani, C. (1992). Planet earth: cosmology, geology, and the evolution of life and environment. Cambridge University Press.
8. Gross, M. G. (1977). Oceanography: A view of the earth.
9. Concepts of Geomorphology: Gupta and Kale

## Semester I

Course Title/Code: <b>GE- 115</b> <b>Practical Based on GE-114</b>	Course Credits: <b>2</b>
Course Code: <b>MIN-02</b>	L-T-P per week: <b>0-0-4</b>
Total Contact Hours: <b>60</b>	Duration of Practical: 4 Hours
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Specific Objectives:

- To develop skills in preparation of topographic maps in laboratory.
- To study the various geomorphic processes and landforms.
- To get acquainted with practical in the sections of earth science and interrelations of materials of Earth.

### Course Specific Outcomes:

After successful completion of this course, students will be able to:

- Understand and construct the practical approach in Geology.
- Acquired skills in preparation of topographic maps, structural maps and study physiographic divisions of India and tectonic plates across the world.
- Classify the terrestrial and Jovian planets based on their composition.
- Understand the layered nature of the earth and bathymetry of the ocean and results of endogenic and exogenic processes through geomorphologic landforms.

### GEOLOGY MIN-02 Lab Course

#### GE- 115 Practical Based on GE-114

Unit No.	Topic	Marks
I	<b>Maps and Profiles</b> 1. Map of India showing physiographic divisions 2. Map of world showing major tectonic plates 3. Study of Topsheet 4. Identification of soil profile	
II	<b>Topographic and Geologic Maps</b> 1. Study of Contour Maps showing landforms at least 5 2. Geological Maps with horizontal beds at least 2	

Unit No.	Topic	Marks
III	<p><b>Geomorphic Features</b></p> <p>1. Erosional and Depositional landforms of</p> <p>a. Rivers (Fluvial): Erosional Landforms: Valley (gully, gorge, rift valley), Waterfall, Potholes, River terraces, Meanders and Ox-bow lake. Depositional landforms: Flood plain, Alluvial fan, Levees and Delta.</p> <p>b. Oceans (Sea): Erosional Landforms: Sea cliff, wave-cut platforms, sea arches and stacks. Depositional landforms: Beaches, Ocean floor deposit (bathyal and abyssal)</p> <p>c. Wind (Aeolian): Erosional Landforms: Deflation armour, Ventifacts, Rock Columns, Pinnacles, Yardangs and Mushroom Rock. Depositional landforms: Loess, Dunes and their types.</p> <p>d. Ice (Glacial): Erosional Landforms: Cirques, Glacial Horns, Trim lines, U-shaped valley, Roche Moutonnée and Aretes. Depositional landforms: Moraine, Esker, Kame, Drumlin and Kettle Holes</p> <p>2. Study of Volcanoes: Lava dome, Composite cone, Shield cone</p>	30
IV	<p><b>Historical Geology</b></p> <p>Stratigraphic Time Scale: Chronostratigraphic and Geochronological Units. Geological and Biological Events with numerical ages. Major and Minor Mass extinction events.</p>	
V	<p><b>General Geology</b></p> <p>Components of Solar system- Jovian Planets, Terrestrial, Meteorites and comets. Earth's Crust, Mantle and Core (Lithosphere, Asthenosphere, Barysphere and Cryosphere). Bathymetric Map of World and India.</p>	

**Suggested Readings:**

1. Geology: Chakranarayan and Kulkarni, Nirali Prakashan, Pune.
2. Concepts in Geology: Chakranarayan & Others, Scientifica Pub. Pune.
3. A Text Book of Geology: Mukherjee P.K., The World Press Pub. Kolkatta.
4. General Geology: Radhakrishnan.
5. Concepts of Geomorphology: Gupta and Kale
6. Manual of Geological Maps: Gokhale N. W., CBS Publishers and Distributors.
7. A Handbook of Minerals, Crystals Rocks And Ores: Alexander, Pramod O

## Semester I

Course Title/Code: <b>OE-01</b> <b>Geogenic Disaster Management</b>	Course Credits: <b>2</b>
Course Code: <b>OE-01</b>	L-T-P per week: <b>2-0-0</b>
Total Contact Hours: <b>30</b>	Duration of Lecture: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Specific Objectives:

- To create awareness about the conservation of environment with geological perspective.
- To provide knowledge about various geogenic disasters and their management.

### Course Specific Outcomes:

After successful completion of this course, students will be able to:

- Know the basic fundamentals of earth science as applied to the interaction between human activity and the natural environment.
- Recognize the occurrence and availability of both surface and subsurface water resources and the role of the hydrologic cycle and pollution.
- Understand the role of plate tectonics in causing earthquakes and how this understanding can aid the assessment of seismic hazard.

## GEOLOGY OE-01

### GE- 116 Geogenic Disaster Management

Unit	Topics	Sub-topics	Lecture Hours	Marks
<b>I</b>	<b>Environmental Geology</b>	a. Introduction, Scope, Concepts and Objectives of Environmental Geology b. Physical, Biological and Socio-geological Environment and Bio-geochemical cycles. c. Environmental Risk Assessment: Introduction and Methodology d. Air Pollution, Water Pollution and Soil Pollution e. Conservation of Natural Resources	12	10
<b>II</b>	<b>Geogenic</b>	a. Definitions, types, natural hazard zones,	13	14

	<b>disasters and hazards</b>	<p>difference between hazard and disaster</p> <p>b. Risk assessment, Natural hazard zonation maps</p> <p>c. Role of Geologist in planning disaster management</p> <p>d. Geogenic hazards: Earthquake, Volcanoes, Cyclones, Floods, Drought, Mass movements, Mining Hazards, Coastal Hazards (Tsunami)</p>		
<b>III</b>	<b>Solid Waste Management</b>	<p>Generation, Collection, Segregation, Characterization, Disposal, Recycling and Reuse, Its effect with Geoscientific perspective</p>	05	06

### Suggested Readings:

1. Valdiya, K.S., (1987) Environmental Geology-India. Context. Tata McGraw Hill New Delhi.
2. Thornbury W.D., (1997) Principles of Geomorphology Wiley Eastern Ltd. ,New Delhi
3. Keller, E.A. (2000) Environmental Geology. Shales E. Merril Publishing Co., Columbus, Ohio.
4. Montgomery, C., (1984) Environmental Geology. John Wiley and Sons, London.
5. Bird, Eric, (2000) Coastal Geomorphology: An Introduction. John Wiley & Sons, Ltd. Singapore.
6. Liu, B.C., 1981) Earthquake Risk and Damage, Westview.
7. Sharma J. P., Environmental Studies, Laxmi Publications (P) Ltd, New Delhi UGC Document on LOCF Geology 42

## Semester I

Course Title/Code: <b>SEC - 01</b> <b>GE- 112: Geoheritage and Geotourism</b>	Course Credit: <b>2</b>
Course Code: <b>GE - 112</b>	L -T- P per week: <b>2 - 0 - 0</b>
Total Contact Hours: <b>30</b>	Duration of Lectures: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Objectives:

- To understand concept of Geoheritage and Geotourism.
- Information of Geoheritage and Geotourism sites in Maharashtra and other states of India.
- To understand the importance of field visits to geological sites.
- Students will study Conservation of Geoheritage sites, people's responsibilities and government laws.

### Course Outcomes for Geoheritage and Geotourism.

- After successful completion of this course, students will be able to:
- Students will know the concept and location of Geoheritage and Geotourism sites of India.
- Students will understand importance Geoheritage and Geotourism.
- Students can know ideas about fossil wood and rock types.
- Students will know their responsibilities for awareness of Geoheritage and Geotourism.

## GEOLOGY SEC - 01

### GE- 112: Geoheritage and Geotourism

Unit	Topics	Sub-topics	Lecture Hours	Marks
<b>I</b>	<b>Introduction to Heritage - Geodiversity Geoheritage</b>	a) Definition and introduction to Geotourism. Geoconservation. b) Importance of studying Geological heritage. Geoheritage site -meaning, distribution in India.	03	03
<b>II</b>	<b>Geoheritage places in Maharashtra</b>	a) Ajantha and Verul village in Aurangabad district, b) Lonar village Buldhana district, c) Mahabaleshwar and Panchgani, Satara district, d) Nighoj village Ahmednagar district, e) Wadadam village, Gadchiroli district.	04	04
<b>III</b>	<b>Geoheritage places in other states of India</b>	Andhra Pradesh Cuddapah District, Chittor District Vishakhapatnamand	14	14



			Bhimunipatnam.		
		Kerala	Angadipuram; Malapuram District Varkala; Thiruvananthapuram District		
		Tamilnadu	Tiruvakkarai; South Arcot District Sattanur; Tiruchirapalli District, St. Thomas Mount, Madras. Kulakkalnattam Section, Perambalur District.		
		Gujarat	Kadan Dam, Panch Mahals District.		
		Rajasthan	Pali District, Rajpura-Dariba Udaipur Dist. Bhojunda; Chittaurgarh District, Akal; Jaisalmer Dist. Kishangarh, Ajmer District Jodhpur District, Satur; Bundi District		
		Karnataka	St Mary Island Udupi District, Mardihalli; Chitradurga District, Lalbagh; Bangalore, Kolar Gold fields, Kolar District		
		Chattisgarh	Manendragarh, Surguja District		
		Himachal Pradesh	Saketi; Sirmur district.		
		Odisha	Nomira; Keonjhar district.		
		Jharkhand	Mandro; Sahibganj district		
		Nagaland	Pungro district.		
		Sikkim	Namchi, South district.		
<b>IV</b>	<b>Recognition and importance of sites</b>	a) Recognition of Geological and Geomorphological heritage in India. b) Importance of Geology and geography in tourism, natural and climatic regions of India. c) Important places of attraction for geological sites.		05	05
<b>V</b>	<b>Geoheritage sites Conservation</b>	a) Guidelines for selection of Geosites; Geoheritage laws, Role of local, state and national governments; b) Current status of Geoheritage protection in the country; Global geoheritage and protection laws.		04	04

### **Suggested Readings**

- 1) A Monograph on National geoheritage monuments of India, Indian National Trust for Art and Cultural Heritage, Natural Heritage Division, New Delhi
- 2) Ranawat, P. S., George, S., 2016 Potential Geoheritage&Geotourism Sites in India International Journal of Scientific and Research Publications, Volume 9, Issue 6, June 2019
- 3) EzzouraErrami, Margaret Brocx (Ed.) 2009. Geoheritage, Geoparks and Geotourism Conservation and Management Series Springer. P 268.
- 4) Geoheritage and Geotourism resources edited by N. Santangelo and E. Valente
- 5) Principles of Geotourism by A. Chen, Y. Lu, Young C.Y.NG

## Semester II

Course Title/Code: <b>DSC - 4</b> <b>GE - 121: Petrology</b>	Course Credit: <b>2</b>
Course Code: <b>GE - 121</b>	L -T- P per week: <b>2 - 0 - 0</b>
Total Contact Hours: <b>30</b>	Duration of Lectures: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Specific Objectives:

- To understand different types of rocks, their distinguishing properties and the rock cycle.
- To understand the process, involve in formation of different rock types.
- To understand their mineral compositions and classification.

### Course Specific Outcomes:

On completion of the course, the students will be able to:

- Students will be able to identify different rock types.
- Students will understand process, involve in formation of different rock types.
- Compare and difference between various igneous, sedimentary and metamorphic rocks.

## GEOLOGY DEC - 04

### DSE- 121: Petrology

Unit No.	Topic	Sub Topic	Lecture Hours	Marks
I	Introduction	i) Introduction: a) Science of Petrology. b) Definition of petrology. c ) Petrography. d) Petrogenesis. e) Lithology. f) Scope of petrology. ii) Classification of rocks iii) Characteristics of Igneous,Sedimentary and metamorphic rocks	03	03

Unit No.	Topic	Sub Topic	Lecture Hours	Marks
		iv) Rock cycle		
II	Igneous Petrology	i) Definition of Magma and Lava ii) Forms of igneous bodies. a) Extrusive forms: Fissuretype & Central types. b) Intrusive forms: (i) Concordant forms: Sill, Lopolith, Laccoliths, Phocolith. (ii) Discordant forms: Dyke, Batholiths (Stock & Boss) Chonolith. iii) Structures & textures in igneous rocks: a) Structures: Definition and types: vesicular, amygdaloidal, ropy, pillow, columnar. b) Textures: i) Definition ii) Crystallinity and Granularity iii) Types- equigranular, inequigranular and glassy. iv) Crystallisation of Unicomponent magma v) Tabular classification of igneous rocks based on color index, mode of occurrence and quartz and feldspar content.	09	09
III	Sedimentary Petrology	i) Introduction and definition of weathering, transportation, deposition. ii) Weathering – physical, chemical & biological weathering. iii) Classification: (a) Classification of sediments (Wentworth) based on size. (b) Classification based on the products of weathering.	09	09

Unit No.	Topic	Sub Topic	Lecture Hours	Marks
		iv) Structures & textures: (a) Structures: (i) Definition, Brief introduction to physical, chemical & biological structures. (ii) Study of formation of Stratification (Bed, stratum, Lamina), graded bedding, current bedding, ripple marks & mud cracks. (b) Textures: Definition and study of clastic, non-clastic & bio-clastic textures.		
IV	Metamorphic Petrology	i) Definition and general characters. ii) Agents of metamorphism- temperature, pressure, chemically active fluids (water & gases) iii) Types of metamorphism: Introduction (a) Catalastic. (b) Thermal (c) Dynamothermal metamorphism iv) Depth zones & metamorphism. v) Grade of metamorphism. vi) Structures in metamorphic rocks- granulose, schistose, gneissose.	09	09

#### Suggested Readings:

1. Petrology of Igneous, Sedimentary & Metamorphic: Ehlers & Blatt, CBS PUB. New Delhi.
2. Principles of Petrology, GW Tyrell, CBS PUB. New Delhi.
3. Petrology: An Introduction to the study of rocks in thin sections: Moorhouse, CBS Pub. New Delhi.
4. Concepts in Geology: Chakranarayan & others Nirali Prakashan, Pune.

## Semester II

Course Title/Code: <b>DSC-05</b> <b>Palaeontology</b>	Course Credits: <b>2</b>
Course Code: <b>DSC-05</b>	L-T-P per week: <b>2-0-0</b>
Total Contact Hours: <b>30</b>	Duration of Lecture: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Specific Objectives:

- To acquire knowledge of discovering and describing fossils and their taxonomic classification.
- To introduce to interpreting Paleoclimate and Paleoenvironment conditions.

### Course Specific Outcomes:

After successful completion of this course, students will be able to:

- The study of Palaeontology consists the aspects of the age of the earth, geobiological events, chronological order of rocks and extinction of life through the geologic time.
- The knowledge of palaeontology would enable the students to understand the changes that occurred in the history of the earth and relate them to their field observations.

## GEOLOGY DSC- 05

### GE- 122 Palaeontology

Unit	Topics	Sub-topics	Lecture Hours	Marks
<b>I</b>	<b>Introduction to Palaeontology</b>	i) Definition and introduction of Palaeontology ii) Branches of Palaeontology iii) Introduction to the origin of life.	03	02
<b>II</b>	<b>Process of Fossilizations</b>	i) Definition of mega fossils. ii) Conditions of fossilization. iii) Modes of fossil preservation: Petrification, permineralisation, carbonization, silicification, cast and mould and tracks and trails. iv) Techniques in collection. a) Separation. b) Illustration. c) Description. d) Recording & preservation of Faunal and	10	08

		floral fossils v) Uses of fossils vi) Geological Time Scale		
<b>III</b>	<b>Invertebrate Palaeontology</b>	Study of fossils based on. i) Systematic position ii) Hard part (internal & external) morphology. iii) Geological history of the following a) Phylum Mollusca. • Pelecypoda (Bivalvia) • Gastropoda • Cephalopoda (Nautilus, Ammonoites) b) Phylum Brachiopoda: Difference between bivalves & brachiopods. c) Phylum Echinodermata: d) Phylum Arthropoda : • Trilobites: Head, Thorax & Pygidium.	13	12
<b>IV</b>	<b>Microfossils</b>	Definition and importance of Microfossils and their uses.	02	04
<b>V</b>	<b>Vertebrate Palaeontology</b>	Introduction to Vertebrate Palaeontology	02	04

### Suggested Readings:

1. A text book of Geology, Kulkarni et al., Nirali Publication, Pune
2. Palaeontology invertebrate, Woods, H., CBS Publication
3. Invertebrate Palaeontology and Evolution, Clarkson, E.N.K., Allen and Unwin Publication
4. Palaeontology: Evolution and Animal Distribution, Jain, P.C. and Anantharaman, MS., Vishal Publication.
5. Microfossils, Howard Armstrong and Martin Brasier, Blackwell Publishing Ltd.
6. Michael Benton, (2005) Vertebrate Palaeontology, Blackwell Publishing

## Semester II

Course Title/Code: <b>GE- 123</b> <b>Practical Based on GE-121 and GE-122</b>	Course Credits: <b>2</b>
Course Code: <b>DSC- 06</b>	L-T-P per week: <b>0-0-4</b>
Total Contact Hours: <b>60</b>	Duration of Practical: 4 Hours
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Specific Objectives:

- To acquire practical knowledge of describing the petrological properties of Igneous, Sedimentary and Metamorphic rocks.
- To develop skills of identification of fossils in laboratory based on morphological characters, chronology and occurrences.

### Course Specific Outcomes:

After successful completion of this course, students will be able to:

- Learn to identify, describe and classify Igneous, sedimentary and metamorphic rocks using hand specimens.
- Study the age of earth, chronological ordering of rocks and appearance and evolution of life through the geologic time.

## GEOLOGY DSC-06 Lab Course

### GE- 123 Practical Based on GE-121 and GE-122

Unit No.	Topic	Marks
I	<b>Igneous Petrology:</b> Granite, Diorite, Gabbro, Graphic Granite, Pegmatite, Rhyolite, Trachyte, Basalt, Obsidian and Dunite.	30
II	<b>Sedimentary Petrology:</b> Conglomerate, Breccia, Siliceous sandstone, Shale, Mudstone, Limestone, Shell limestone.	
III	<b>Metamorphic Petrology:</b> Slate, Hornblende schist, Mica – Garnet Schist, Biotite Gneiss, Marble, Quartzite.	
IV	<b>Modes of Preservation of Fossils:</b> Silicification, Petrification, Carbonization, Imprints, Cast and Mould, Tracks and Trails	
V	<b>Palaeontology:</b> Unio, Meretrix, Ostrea, Arca, Turritella, Turbo, Cypraea, Physa, Conus, Ammonoite. Terebratula, Productus, Echinus.	



### **Suggested Readings:**

1. A text book of Geology, Kulkarni et al., Nirali Publication, Pune
2. Mineralogy: Dexter Perkins, 3rd Edition, Pearson Education
3. Principles of Petrology: G. W. Tyrell
4. Igneous, Metamorphic and Sedimentary Petrology: Ehler and Blatt
5. Petrology (Igneous, Sedimentary and Metamorphic): Blatt and Tracy.
6. Petrography of the Igneous and Metamorphic rocks in India: S. C. Chatterjee
7. Introduction to Sedimentology, Sengupta S. M., 2nd Edition, CBS Publishers
8. Palaeontology invertebrate, Woods, H, CBS Publication
9. Invertebrate Palaeontology and Evolution, Clarkson, E.N.K., Allen and Unwin Publication
10. Palaeontology: Evolution and Animal Distribution, Jain, P.C. and Anantharaman, MS., Vishal Publication.

## Semester II

Course Title/Code: <b>MIN 3</b> <b>GE- 124: Introduction to Mineralogy</b>	Course Credit: <b>2</b>
Course Code: <b>GE - 124</b>	L -T- P per week: <b>2 - 0 - 0</b>
Total Contact Hours: <b>30</b>	Duration of Lectures: <b>1 Hour</b>
College Assesment (CA) Marks: <b>20</b>	University Assesment (UA) Marks: <b>30</b>

### Course Objectives:

- To understand the characteristics of common rock-forming minerals and their genesis.
- To understand general description and different silicate groups of minerals.
- To understand optical properties of minerals.
- To understand atomic arrangement in crystals and classification of crystals based on crystal Symmetry.

### Course Outcomes for Mineral Science

After successful completion of this course, students will be able to:

- Students can identify the minerals on their physical and optical properties.
- Students will be able distinguish different silicate groups of minerals.
- Students will know the mineral forming process.
- Students will able to identify crystals based on their morphology and system.

## GEOLOGY MIN - 03

### GE- 124: Introduction to Mineralogy

Unit	Topics	Sub-topics	Lecture Hours	Marks
<b>I</b>	<b>Introduction</b>	1. Introduction: Definition, branches and scope of Mineralogy. 2. Importance, uses and conservation of minerals.	02	02
<b>II</b>	<b>Chemistry of Minerals</b>	1. Major elements constituting minerals, Atoms and Ions. 2. Geochemical affinity and Geochemical classification of elements.	02	02

		<p>3. Isomorphism and polymorphism.</p> <p>4. Silicate structures- Definition and types.</p>		
<b>III</b>	<b>Rock Forming Minerals</b>	<p>1. Processes of mineral formation in Igneous, Sedimentary and Metamorphic rocks.</p> <p>2. Composition of common rock forming minerals.</p> <p>3. Physical properties of Minerals: Color, Streak, Lustre, Transparency, Translucency, Opaque, Forms, Hardness, Fracture, Cleavage, Piezoelectric property, Specific Gravity and Luminescence (Phosphorescence and Fluorescence).</p>	10	10
<b>IV</b>	<b>Optical Mineralogy</b>	<p>1. Nature of light- ordinary and plane polarized light.</p> <p>2. Double refraction of light.</p> <p>3. Nicol's prism and polaroids.</p> <p>4. Petrological microscope- Its parts and uses.</p> <p>5. Optical properties of Minerals:</p> <p>a. In plane polarized light (IPL/PPL): Colour, Pleochroism, Form, Cleavage, Relief and Twinkling.</p> <p>b. In between crossed Nicols (BXN): Isotropism, Anisotropism, Extinction Positions (straight, oblique and symmetrical), Extinction Angle and Interference Colours.</p>	06	06
<b>V</b>	<b>Crystallography</b>	<p>1. Definition and conditions conducive for the formation of crystals.</p> <p>2. Crystal morphology: Faces, forms, hedrons, edges, solid angles, interfacial angle and its measurement by Contact Goniometer, law of constancy of Interfacial Angle.</p> <p>3. Symmetry of crystals: Plane, Axis and Center of symmetry, Crystallographic and Geometric Symmetry. Crystallographic axes- lettering and ordering of crystallographic axes, parameters, axial</p>	10	10

		<p>ratio, indices, Parameter System of Weiss, Index System of Miller and Law of rational indices.</p> <p>4. Descriptive Crystallography: Introduction to 32 point groups and crystal classification into six systems.</p> <p>5. Study of crystallographic axes, elements of symmetry, forms present with indices of</p> <p>a. Cubic/ Isometric System, Galena Type.</p> <p>b. Tetragonal System, Zircon Type.</p> <p>c. Orthorhombic System, Barytes Type.</p>		
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**Suggested Readings:**

1. Geology: Chakranarayan and Kulkarni, NiraliPrakashan, Pune.
2. Concepts in Geology: Chakranarayan&others, NiraliPrakashan, Pune.
3. Rutley's Elements of Mineralogy: Gribble, CBS Pub., New Delhi.
4. Text Book of Mineralogy: Dana, J. D. Wiley Eastern, New Delhi.
5. OpticalMineralogy: Kerr,P.F.(1959),McGraw-Hill.
6. AnintroductiontotheRock Forming Minerals (Vol.696):  
Deer,W.A.,Howie,R.A.,&Zussman,J.(1992),London:Longman
7. A Handbook of Minerals, Crystals, Rocks and Ores: Alexander, P. O.,  
New India Publishing Agency, New Delhi.

## Semester II

Course Title/Code: <b>MIN - 03</b> <b>GE- 125: Practical based on GE 124</b>	Course Credit: <b>2</b>
Course Code: <b>GE - 125</b>	L -T- P per week: <b>0 - 0 - 4</b>
Total Contact Hours: <b>60</b>	Duration of Lectures: <b>4 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Objectives:

- Identify different types of minerals based on their physical properties.
- To understand working of petrological microscope and optical properties of minerals.
- To understand crystals and classification of crystals based on crystal symmetry with help of wooden models.

### Course Outcomes for Mineral Science

- Students will gain practical knowledge of mineral study
- They can easily identify mineral based of their physical properties.
- Student will know petrological microscope works.
- Student will learn optical properties of minerals.
- Students can distinguish different crystal system.

### GEOLOGY MIN 04 Lab Course

#### GE- 125: Practical based on GE 124

Unit	Topics	Marks
<b>I</b>	<b>Study of Physical Properties of Minerals</b> 1. Introduction to physical properties of Minerals and Ore Minerals	<b>30</b>
<b>II</b>	<b>Descriptive Mineralogy</b> 1. Rock forming minerals: Quartz crystal, Amethyst, Milky Quartz, Rosy quartz, Chalcedony, Flint, Jasper, Agate, Opal, Orthoclase, Muscovite, Biotite, Garnet, Hornblende, Olivine, Talc, Appophyllite, Fluorite, Calcite, Barytes, Gypsum, Apatite and Corundum. 2. Ore Minerals: Graphite, Galena, Pyrite, Magnetite and Magnesite.	
<b>III</b>	<b>Crystallography</b> 1. Study of crystal models of following crystal system w.r.t. crystallographic axes, elements of symmetry, forms present with indices of a. Cubic system- Galena type. b. Tetragonal system- Zircon type.	

	c. Orthorhombic system- Baryte type. 2. Measurement of interfacial angle by contact goniometer.	
<b>IV</b>	<b>Optical Mineralogy</b> 1. Study of petrological microscope to understand behavior of light through minerals. 2. Study optical properties of minerals. 3. Optical properties of minerals- Quartz, Biotite, Hornblende, Garnet, Plagioclase and Augite.	

**Suggested Readings:**

1. Rutley's Elements of Mineralogy: Gribble, CBS Pub., New Delhi.
2. Text Book of Mineralogy: Dana, J. D. Wiley Eastern, New Delhi.
3. Mineral Science: Cornelis Klein, John Wiley and Sons (22<sup>nd</sup> edition).

## Semester II

Course Title/Code: <b>OE - 2</b> <b>GE- 126: URBAN GEOLOGY</b>	Course Credit: <b>2</b>
Course Code: <b>GE - 126</b>	L -T- P per week: <b>2 - 0 - 0</b>
Total Contact Hours: <b>30</b>	Duration of Lectures: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Objectives:

- To understand Importance of geology in urban life.
- Surveying methods in urban areas.
- Effect of pollutants on geosphere, hydrosphere and biosphere within urban and urbanizing areas
- GIS survey of urban areas.

### Course Outcomes for Urban Geology

- After successful completion of this course, students will be able to:
- Students will learn importance of Geology in urban areas
- They will gain knowledge of application of various geotechnical methods for surveying in urban areas.
- They will learn GIS importance in surveying in Urban areas.

## GEOLOGY OE - 02

### GE- 126: URBAN GEOLOGY

Unit	Topics	Sub-topics	Lecture Hours	Marks
<b>I</b>	<b>Geology and Society</b>	a) Necessity of Geology in Urban life. b) Geology in Urban Constructions c) Geotechnical feature and mapping for subsurface in Metropolitan areas. d) Building materials, Excavation and cutting in urban areas.	04	03
<b>II</b>	<b>Geology and Urban Agriculture</b>	a) Soil studies, Chemistry and geochemistry of soil in relation to ground water and fertilizer b) Effect of pollutants on vegetable contamination	03	03
<b>III</b>	<b>Urban land use</b>	a) Geotechnical site characterization, b) Geotechnical and land use mapping, c) Decision making in urban landuse, d) Geological problems in construction of underground structures in urban areas.	05	05

<b>IV</b>	<b>Urban water</b>	a) Water logging in built-up areas, b) Source of water, Standards for various uses of water. c) Sources of contamination. Waste waters: Sources and its disinfection and treatment.	06	05
<b>V</b>	<b>Urban wastes and Treatment</b>	a) Geotechnical characterization for waste sites, Domestic waste, Industrial waste, Mine drainage, Power production waste, Radioactive waste, b) Need for special purpose mapping for selection of waste disposal sites.	08	10
<b>VI</b>	<b>GIS in Urban Geology</b>	a) GIS-An introduction, Application in Urban development, Application in landuse, Application in GW Exploration.	04	04

**Suggested Readings:**

1. Huggenberger, P. and Eptin, J. 2011 Urban Geology: Process-Oriented Concepts for Adaptive and Integrated Resource Management. Springer
2. Lollino, G. et al. (Ed.), Engineering Geology for Society and Territory. Springer



## Semester II

Course Title/Code: <b>SEC - 2</b> <b>GE- 127: Gemology</b>	Course Credit: <b>2</b>
Course Code: <b>GE - 127</b>	L -T- P per week: <b>2 - 0 - 0</b>
Total Contact Hours: <b>30</b>	Duration of Lectures: <b>1 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Objectives:

- To understand various aspects of Gemology.
- The formation and occurrence of gemstones in nature
- Students will acquire knowledge of different types of gemstones.
- To understand difference between synthetic and natural gemstone.
- To understand gemstone uses in healing, wellness purposes and fashion industries.

### Course Outcomes for Gemology

- Students will be able identify different gemstones.
- Students will know the instrument use in industries to study gemstone.
- Students will learn formation and occurrence of gemstones in nature.
- Students will learn enhancement of gemstones.

## **GEOLOGY SEC - 02**

### **GE- 127: Gemology**

<b>Unit</b>	<b>Topics</b>	<b>Sub-topics</b>	<b>Lecture Hours</b>	<b>Marks</b>
<b>I</b>	<b>Introduction to Gemology</b>	a) Definition of Minerals, Gemstone and Gemology. b) Scope of Gemology c) The Geological Sources of Gems Rocks and processes that formed them. d) Gem regions. e) Gem recovery methods. f) Uses of Gemstone	04	02
<b>II</b>	<b>Properties of Gemstones</b>	a) Gemstones – Basic qualities of gemstones the 4 'C's Colour, Clarity, Carat and Cut. b) Physical and optical properties. c) Chemical composition and crystallographic divisions. d) Differences and similarities between Minerals and Gemstones	04	04
<b>III</b>	<b>Gemstone classification</b>	a) Precious gemstones and Semi-precious gemstones,	03	03

		b) Gemstone Varieties – Natural, Cultured and imitation, Synthetic and stimulant Gemstones.		
<b>IV</b>	<b>Gemstone Enhancements</b>	a) Cutting styles, critical angle, composite stones, gemstone polishing, lapidary techniques and gemstone carving. b) Methods of staining, heat treatment, diffusion treatment, fracture filling, cavity filling, coatings, dyeing, laser drilling, atomic irradiation and their detection	08	08
<b>V</b>	<b>Common Gemstones</b>	Garnet, Amethyst, Aquamarine, Diamond, Emerald, Pearl, Ruby, Peridot, Sapphire, Opal, Tourmaline, Topaz, Citrine, Turquoise, Zircon, Tanzanite.	06	07
<b>VI</b>	<b>Introduction to Instruments used in Gem Industry</b>	a) Hand lens (10x), Polariscope, Dichroscope, Refractometer, Spectroscope, Chelsea Filter, UV & X-ray equipment, Gem Microscope, Electron microprobe, scanning electron microscope, spectrophotometers, Raman spectroscopy, Quantitative cathodoluminescences.	05	06

## References

1. Karanth R.V. (2000) Gems and Gem Industry in India, Geological society of India
2. Read, P. G. (1991) Gemmology, Butterworth-Heinemann Ltd.
3. Webster, R. and edited by Anderson, B.W. (1983) Gems: Their Sources, Descriptions and Identification, Butterworth-Heinemann Ltd.
4. Sinkankas, J. (1969) Mineralogy: A First Course, Van Nostrand Reinhold Company.
5. Karanth R.V (2008) Gemstones Enchanting Gifts of Nature, Geological society of India
6. Fareeduddin & R. H. Mitchell (2012) Diamonds and their Source rocks in India, Geological society of India
7. Babu T.M (1998) Diamonds in India, Geological Society of India
8. Read P.G. (2005), Gemmology (3rd edition), Elsevier.

## Semester II

Course Title/Code: <b>SEC – 03 : Practical</b> <b>GE- 128:</b> Practical based on GE 127	Course Credit: <b>2</b>
Course Code: <b>GE - 128</b>	L -T- P per week: <b>0 - 0 - 4</b>
Total Contact Hours: <b>60</b>	Duration of Lectures: <b>4 Hour</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA) Marks: <b>30</b>

### Course Objectives:

- To understand physical and optical properties of gemstone.
- To understand Crystal forms, habits and growth features of various gem stones.
- To learn Systematic Identification of Gemstone using instruments.

### Course Outcomes for Gemology

- Students will gain practical knowledge of identifying various gemstones with the help of physical properties.
- They will know instruments used in gemstone identification.
- They will gain knowledge of identifying natural and artificial gemstone.

## GEOLOGY SEC - 03

### Practical based on GE 127

Unit	Practical	Marks
<b>Practical I</b>	Megascopic Identification of Crystals and Minerals Study of Crystal forms, habits and growth features of various gem stones	30
<b>Practical II</b>	Systematic Identification using instruments Specific gravity, R.I. Dichroism, anisotropism, chelsea filter effect, Spectra, luminescenes, inclusions.	
<b>Practical III</b>	Distinguishing gem stones of the same colour form on the basis of various physical and optical properties identification of natural, cultured and imitation pearls.	

### References

1. Peter Read, Gemmology (3rd Edition)
2. Liddicoat: Handbook of gem identification
3. John Sinkankas: Mineralogy, Oxford
4. Karanth R.V. Gem and Gem Industry, Oxford IBH
5. Babu T.M.: Diamonds in India