

**H.P. University  
Structure and Syllabus**

**Of  
Geology**

**For  
B.Sc. Undergraduate Programme  
Based on:**



**(Effective from Academic Session July, 2018-2019)**

## **Comprehensive Continuance Assessment (CCA) and End Term - Examination Scheme in Geology of Three years**

### **Scheme of Examination for every course except Skill enhancement course\***

English shall be the medium of instructions and Examinations.

Examinations shall be conducted at the end of year as per the academic calendar notified by H.P. University Shimla-5

Each course of 6 credits will carry 100 marks (theory + practical) and will have following components:

<b>1. Theory</b>	<b>50 marks</b>
<b>i) Comprehensive Continuous Assessment</b>	<b>30 marks</b>
The Comprehensive Continuous Assessment will have the following components:	
a) Assignment/Quiz/Seminar/model/ Mid-Term Examination	15 marks
b) Attendance	05 marks
c) Lab Seminar /Lab CCA	10 marks
<b>ii) End-Term Examination</b>	<b>50 marks</b>
<b>II. Practical</b>	<b>20 marks</b>
The Practical examination will have the following components:	
i) Performing the two practical exercises assigned by the examiner	10 marks
ii) viva-voce examination	05 marks
ii) Practical note book and regularity during practical classes	05 Marks

**{Theory Paper (CCA + Year based Examination) +Practical [30 +50 +20] =100 marks}**

\* Each Skill Enhancement course will be of 4 credits and scheme of examination for these courses is as under:

**{CCA + Year Based Examination [30 + 70] =100 marks}**

**Criterion for marks on the basis of Class-room attendance (0 - 5 marks)**

Under component CCA/ IA are defined as follows:

- a) Attendance 75 - 80% = 3 marks
- b) Attendance 81 – 90 % = 4 marks
- c) Attendance 91% and above = 5 marks
- d) Candidates securing 75% Attendance after condonation will not be entitled to get any mark.

# **COURSE CONTENTS**

## **Core Courses (CC) for Geology**

**(1-4)**

**(Credits: 06 each)**

## PROPOSED SCHEME FOR ANNUAL SYSTEM IN B. SC. WITH GEOLOGY

Year	Discipline specific core courses DSC *Credits	Ability enhancement Compulsory Courses AECC *Credits	Skill enhancement Compulsory Course SECC *Credits	Discipline Specific Elective DSE *Credits
<b>First Year</b>	DSC-1 Physical Geology and Geomorphology GEOL 101 (TH) 04* GEOL 101 (PR) 02*  DSC-2 Structural Geology and Mineralogy GEOL 201 (TH) 04* GEOL 201 (PR) 02*	AECC-1 English/Hindi/MIL/ Environmental Sciences 04*		
<b>Second Year</b>	DSC -3 Petrology GEOL 201(TH) 04* GEOL 201(PR) 02*  DSC-4 Stratigraphy and Paleontology GEOL 202 (TH) 04* GEOL 202 (PR) 02		SECC-1 Geochemistry GEOL 203 (TH) 04*	
<b>Third Year</b>			SECC -2 Photo Geology and Remote Sensing GEOL 301 (TH) 04*	DSE-1 Applied and Economic Geology GEOL 302(TH) 04* GEOL 302 (PR) 02*  DSE-2 Environmental Geology and Geohydrology GEOL 303(TH) 04* GEOL 303 (PR) 02*

## FIRST YEAR

### PHYSICAL GEOLOGY AND GEOMORPHOLOGY

Name of the Course	Geology-DSC 1: Physical Geology and Geomorphology
Credits	Theory-04
Theory	60 Lectures
Code	GEOL-101 TH
Yearly based Examination	50 marks (3 Hrs)
Continuous Comprehensive Assessment (CCA)	30 marks

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance. Midterm Exam=**15 marks**, Class test/seminar/assignments/quiz =**10 marks**, Attendance=**05 marks**; a) **>=75% to 80% : 3 marks** b) **>= 80% to 90%= 4 marks** c) **>= 90% and above = 5 Mark**

#### Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), Section B (Unit I and II), Section C (Unit III and IV), Section D (Unit V and VI) and Section E (Unit VII and VIII). Examiner will set nine questions in all, question number 1 (One) will be compulsory and comprise one question each from all the Units. Each question from section B, C, D and E will carry 10 marks. Question Number 1 (Section-A), will consist of ten sub-questions each of 1 mark of various types such as: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*

2. *The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and ten sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

### Physical Geology and Geomorphology (GEOL 101TH)

**Unit-I:** Introduction to geology and its scope, Earth and solar system: origin, size, shape, mass, density and its atmosphere.

**Unit-II:** A brief account of various theories regarding the origin and age of the earth; Brief idea of interior of earth and its composition.

**Unit-III:** Weathering, Mass wasting and erosion: factors, types and their effects; Soil: development and types.

**Unit-IV:** Earthquakes: nature of seismic waves, their intensity and magnitude scale; Origin and prediction of earthquake; Earthquake Zones of India. Volcanoes: types, products and causes of volcanism.

**Unit-V:** Basic principles of Geomorphology, Geomorphic mapping- tools and techniques, Epigene/exogenic processes: degradation and aggradation. Hypogene/endogenic processes.

**Unit-VI:** Diastrophism; Geological work of wind, glacier, river, underground water and ocean. Drainage Pattern: Development, analysis of stream activity and its relation to the structures.

**Unit-VII:** Earth as a dynamic system. Elementary idea of continental drift, sea-floor spreading and mid- oceanic ridges. Paleomagnetism and its application.

**Unit-VIII:** Plate Tectonics: the concept, plate margins, orogeny, deep sea trenches, island arcs and volcanic arcs.

### **PRACTICAL (GEOL 101PR)**

<b>Name of the Course</b>	<b>Geology -DSC 1 LAB: Physical Geology and Geomorphology</b>
Credits	<b>02</b>
Code	GEOL-101 (PR)
Yearly based Examination	<b>20 marks (3 Hrs)</b>
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 10, Viva Voce = 5 Marks and Practical Record Book = 5 Marks	

#### **Physical Geology:**

Study of important geomorphological models; Reading topographical maps of the Survey of India; Identification of geomorphic features.

#### **Geomorphology:**

Formation of various Landform Contour Maps, Calculation of area on toposheets and the study of some important landforms in the field.

#### **BOOKS SUGGESTED:**

1. Principles of Physical Geology by Arthur Holmes
2. The Earth's Dynamic Surface by K. Siddharatha, 2014.
3. Basic concepts of Physical Geology by Spencer
4. A text book of geology by G B Mahapatra.
5. Introduction to Physical Geology by A K Dutta.
6. Earth Surface Processes by P. Allen
7. Geomorphology: A systematic Analysis of Late Cenozoic Landforms (3rd Edition) by A L Bloom.
8. Global Tectonics and crustal evolution by P Keary and F J Vine.
9. Introduction to Geomorphology by V S Kale and A Gupta.
10. Tectonics by E Moors and R J Twiss.
11. The Dynamic Earth System by A M Patwardhan.
12. Geomorphology and Global tectonic by M A Summerfield.
13. Dynamic Himalaya by K S Valdia.
14. Principles of Geomorphology by W D Thornbury.

## STRUCTURAL GEOLOGY AND MINERALOGY

Name of the Course	Geology-DSC 2: Structural geology and Mineralogy
Credits	Theory-04
Theory	60 Lectures
Code	GEOL-102 TH
Yearly based Examination	50 marks (3 Hrs)
Continuous Comprehensive Assessment (CCA)	30 marks

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance. Midterm Exam=**15 marks**, Class test/seminar/assignments/quiz =**10 marks**, Attendance=**05 marks**; a)  $\geq 75\%$  to **80%** : **3 marks** b)  $\geq 80\%$  to **90%**= **4 marks** c)  $\geq 90\%$  and above = **5 Mark**

### Instructions for Paper Setters and Candidates:

- The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), Section B (Unit I and II), Section C (Unit III and IV), Section D (Unit V and VI) and Section E (Unit VII and VIII). Examiner will set nine questions in all, question number 1 (One) will be compulsory and comprise one question each from all the Units. Each question from section B, C, D and E will carry 10 marks. Question Number 1 (Section-A), will consist of ten sub-questions each of 1 mark of various types such as: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
- The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and ten sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

### Structural Geology and Mineralogy (GEOL 102TH)

**Unit-I:** Introduction to Structural Geology; contours, topographic and geological maps; Elementary idea of bed, dip and strike; Outcrop, effects of various structures on outcrop. Clinometer/Brunton compass and its use.

**Unit-II:** Elementary idea of types of deformation; Folds: nomenclature and types of folds;

**Unit-III:** Faults: nomenclature, geometrical and genetic classifications, normal, thrust and slip faults; window, Klippe and Nappe.

**Unit-IV:** Definition, kinds and significance of joints and unconformity.

**Unit-V:** Definition and scope of mineralogy; Physical characters of minerals depending upon specific gravity, light, heat, electricity and magnetism; Classification of minerals; Isomorphism, Polymorphism, Pseudomorphism.

**Unit-VI:** Study of physical and chemical properties, classification, occurrence and uses of following groups of minerals and their species: Silica family, Feldsper family, Feldspathoids.

**Unit-VII:** Study of physical and chemical properties, classification, occurrence and uses of following groups of minerals and their species: -Olivine, Pyroxene, Amphibole, Mica.

**Unit-VIII:** General Principals of optics; elements of optics; Isotropism and anisotropism; General idea about refractive index, double refraction, extinction, pleochroism and interference colours; Study of optical properties of the minerals given in the unit VI and VII of the course.

### **PRACTICAL (GEOL 102 PR)**

<b>Name of the Course</b>	<b>Geology –DSC 2 LAB: Structural Geology and Mineralogy</b>
Credits	<b>02</b>
Code	GEOL-102 (PR)
Yearly based Examination	<b>20 marks (3 Hrs)</b>
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 10, Viva Voce = 5 Marks and Practical Record Book = 5 Marks	

#### **Structural Geology:**

Study of clinometers/Brunton compass; Identification of different types of folds/faults from block models; Exercises on structural problems: preparation of cross section profile from a geological map.

#### **Mineralogy:**

Study of physical properties of minerals mentioned in theory course; Use of polarizing microscope; Study of optical properties of common rock forming minerals mentioned in theory course.

#### **BOOKS SUGGESTED:**

1. Structural Geology by M. P. Billings.
2. Elements of Structural Geology by E S Hills.
3. A text book of geology by G B Mahapatra.
4. Structural Geology, A Practical Approach by R P Singh.
5. Manual of Geological Maps by N W Gokhale.
6. A textbook of Mineralogy by E S Dana and W E Ford. (Reprints).
8. Mineralogy by L G Berry, B Mason and R V Dietrich.
9. Optical Mineralogy by D W Nesse.
10. Rutley's Element of Mineralogy by H H Read (Rev. Ed.).
11. Mineralogy by Berry and Mason.

## SECOND YEAR

### PETROLOGY

Name of the Course	Geology-DSC 3: Petrology
Credits	Theory-04
Theory	60 Lectures
Code	GEOL-201 TH
Yearly based Examination	50 marks (3 Hrs)
Continuous Comprehensive Assessment (CCA)	30 marks

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance. Midterm Exam=**15 marks**, Class test/seminar/assignments/quiz =**10 marks**, Attendance=**05 marks**; a)  $\geq 75\%$  to **80%** : **3 marks** b)  $\geq 80\%$  to **90%**= **4 marks** c)  $\geq 90\%$  and above = **5 Mark**

#### Instructions for Paper Setters and Candidates:

- The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), Section B (Unit I and II), Section C (Unit III and IV), Section D (Unit V and VI) and Section E (Unit VII and VIII). Examiner will set nine questions in all, question number 1 (One) will be compulsory and comprise one question each from all the Units. Each question from section B, C, D and E will carry 10 marks. Question Number 1 (Section-A), will consist of ten sub-questions each of 1 mark of various types such as: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
- The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and ten sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

### PETROLOGY (GEOL 201TH)

#### Igneous Petrology

**Unit-I:** Magma: definition, composition, types and origin; Forms of igneous rocks; textures and structures of igneous rocks.

**Unit-II:** Reaction principle; Differentiation and Assimilation; Crystallization of unicomponent and bicomponent (mix-crystals); Bowen's reaction series.

**Unit-III:** Mineralogical and chemical classification of igneous rocks.

**Unit-IV:** Detailed petrographic description of Granite, Granodiorite, Rhyolite, Syenite, Peridotite, Diorite, Gabbro, Basalt.

## **Sedimentary Petrology**

**Unit-V:** Processes of formation of sedimentary rocks; Classification, textures and structures of sedimentary rocks.

**Unit-VI:** Petrographic details of important siliciclastic and carbonate rocks such as - conglomerate, breccia, sandstone, greywacke, shale, limestone.

## **Metamorphic Petrology**

**Unit-VII:** Process and products of Metamorphism; Type of metamorphism. Factors, zones and grade of metamorphism; Textures, structures and classification of metamorphic rocks.

**Unit-VIII:** Petrographic details of some important metamorphic rocks such as - slate, phyllite, schist, gneiss, quartzite, marble.

## **PRACTICAL (GEOL 201 PR)**

<b>Name of the Course</b>	<b>Geology –DSC 3 LAB: Petrology</b>
Credits	<b>02</b>
Code	GEOL-201 (PR)
Yearly based Examination	<b>20 marks (3 Hrs)</b>
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 10, Viva Voce = 5 Marks and Practical Record Book = 5 Marks	

### **Igneous Petrology:**

Identification of rocks: On the basis of their physical properties in hand specimen; and optical properties in thin sections.

### **Sedimentary and metamorphic Petrology:**

Identification of sedimentary and metamorphic rocks both in hand specimen and thin sections.

### **BOOKS SUGGESTED:**

1. Igneous & Metamorphic petrology by F J Turner and J Verhoogen.
2. Igneous petrology by M K Bose.
3. Principles of Petrology by G W Tyrell.
4. Petrology, Igneous, Sedimentary and Metamorphic rocks by W G Ehlers and H Blatt.
5. The study of rocks in thin sections by W W Moorhouse.
6. Principles of Sedimentology by Friedman and Sanders.
7. Sedimentary rocks by F J Pettijohn.
8. A text book of sedimentology by C Prasad.
9. Introduction to sedimentology by S Sengupta.
10. Metamorphic petrology by F J Turner.
11. Petrology of Metamorphic Rocks by R Mason.
12. Petrogenesis of Metamorphic Rocks by H G C Winkler.

## STRATIGRAPHY AND PALEONTOLOGY

Name of the Course	Geology-DSC 4: Stratigraphy and Paleontology
Credits	Theory-04
Theory	60 Lectures
Code	GEOL-202 TH
Yearly based Examination	50 marks (3 Hrs)
Continuous Comprehensive Assessment (CCA)	30 marks

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance. Midterm Exam=**15 marks**, Class test/seminar/assignments/quiz =**10 marks**, Attendance=**05 marks**; a) **>=75% to 80% : 3 marks** b) **>= 80% to 90%= 4 marks** c) **>= 90% and above = 5 Mark**

### Instructions for Paper Setters and Candidates:

- The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), Section B (Unit I and II), Section C (Unit III and IV), Section D (Unit V and VI) and Section E (Unit VII and VIII). Examiner will set nine questions in all, question number 1 (One) will be compulsory and comprise one question each from all the Units. Each question from section B, C, D and E will carry 10 marks. Question Number 1 (Section-A), will consist of ten sub-questions each of 1 mark of various types such as: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
- The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and ten sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

### Stratigraphy and Paleontology (GEOL202TH)

**Unit I:** Introduction to stratigraphic nomenclature.

Brief account of Archaic rocks.

- Dharwar Super Group of Karnataka.
- Stratigraphy of the Cuddapah super Group and Vindhyan Super Group in their type area.

**Unit II:** Distribution of Palaeozoic rocks in India.

- Palaeozoic of Kashmir
- Gondwana Super Group (lower Gondwana sequence, upper Gondwana).
- Sequence and classification and their marker fossils.
- Umria marine beds.

**Unit III:** Distribution of Mesozoic rocks in India.

- Triassic of Spiti.
- Jurassic of Kutch.

- Cretaceous rocks of Trichinopoly and Pondicherry.
- Bagh beds and lameta formation.

**Unit IV:** Deccan traps-intertrappean.

- Shiwaliks Super group, classification and significant vertebrate faunas.
- Subathu, Dharamshala, Dagshai and Kasauli Groups.
- Karewa beds of Kashmir.

**Unit-V:** Palaeontology: Definition of Fossils, characters, binomial nomenclature in taxonomy, mode of preservation, condition of fossilization and significance of fossils;

**Unit VI:** Study, classification, morphology, distribution and Geological history of the classes.

- Phylum Mollusca: Pelecypoda, Gastropoda and Cephalopoda.
- Phylum Brachiopoda, Arthropoda(class trilobite)
- Phylum Echinodermata, Phylum Protochordata (Graptoloidea)

**Unit VII:** Introduction to reptiles and their classification, distribution, their appearance and extinction Mesozoic reptiles with special reference to India.

Evolutionary trends of following:

- Man
- Horse
- Elephant

**Unit VIII:** Introduction of plant kingdom- Classification

Description, morphology of the following plant fossils.

- Glossopteris, Gangmopteris, Vertebraia, Ptilophyllum, lepidodendron, Williamsonia and Schizoneura.

**PRACTICAL (GEOL 202 PR)**

<b>Name of the Course</b>	<b>Geology –DSC 4 LAB:</b> Structural Geology and Mineralogy
Credits	<b>02</b>
Code	GEOL-202 (PR)
Yearly based Examination	<b>20 marks (3 Hrs)</b>
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 10, Viva Voce = 5 Marks and Practical Record Book = 5 Marks	

## **Stratigraphy:**

- Recognition of stratigraphic rocks their mineral contents, textures, structures and rock type area.
- Preparation of stratigraphic columns according to ascending order of rocks of Precambrian.
- Preparation of stratigraphic columns according to ascending order of rocks of Paleozoic.
- Preparation of stratigraphic columns according to ascending order of rocks of Mesozoic.
- Preparation of stratigraphic columns according to ascending order of rocks of Tertiary.
- Preparation of stratigraphic columns according to ascending order of rocks of Extra peninsular India.
- Study of some type areas in the field.

## **Paleontology:**

Description and identification of following:

- Mollusca, Brachiopoda, Echinodermata, Graptolite, Trilobite
- Study of the models/ fossils of the reptiles of different ages.
- Study of the Models/Fossils of the man, horse and elephant.
- Megascopic study of the following plant
- Glossopteris, Gangmopteris, Vertebraia, Ptilophyllum, Lepidodendron, Williamsonia, Schizoneura.

## **BOOKS SUGGESTED:**

1. Geology of India by D Wadia.
2. Geology of India and Burma by M S Krishnan.
3. Fundamentals of Historical Geology & Stratigraphy of India by Ravindra Kumar.
4. Principles of Invertebrate Paleontology by R R Shrock and W H Twenhoffel.
5. Outlines of Paleontology by H H Swinerton.
6. Paleontology: Evolution & Animal Distribution by P C Jain and M S Anantharaman.
7. Fossil Invertebrate by U Lehmann.
8. Organic evolution by Rastogi.

## Skill Enhancement Compulsory Course

### GEOCHEMISTRY

Name of the Course	Geology- SECC 1: Geochemistry
Credits	Theory-04
Theory	30 Lectures
Code	GEOL-203 TH
Yearly based Examination	50 marks (3 Hrs)
CCA/ Skill Exam/ Project file/dissertation	50 marks

CCA: Based on midterm exam, class test/seminar/assignments/quiz and attendance. Midterm Exam=15 marks, Class test/seminar/assignments/quiz =10 marks, Attendance=05 marks; a)  $\geq 75\%$  to 80% : 3 marks b)  $\geq 80\%$  to 90%= 4 marks c)  $\geq 90\%$  and above = 5 Mark

#### Instructions for Paper Setters and Candidates:

- The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), Section B (Unit I and II), Section C (Unit III and IV), Section D (Unit V and VI) and Section E (Unit VII and VIII). Examiner will set nine questions in all, question number 1 (One) will be compulsory and comprise one question each from all the Units. Each question from section B, C, D and E will carry 10 marks. Question Number 1 (Section-A), will consist of ten sub-questions each of 1 mark of various types such as: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
- The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and ten sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

### Geochemistry (GEOL 203TH)

**Unit-I:** Introduction to geochemistry: basic knowledge about crystal chemistry. Types of chemical bonds, coordination number; Colloids in geological systems, ion exchanges and geological evidence for earlier colloids; Elementary idea of Periodic Table.

**Unit-II:** Cosmic abundance of elements; Composition of the planets and meteorites; Geochemical evolution of the earth and geochemical cycles.

**Unit-III:** Gold Schmidt's geochemical classification of elements; Distribution of major, minor and trace elements in igneous, metamorphic and sedimentary rocks.

**Unit-IV:** Elements of geochemical thermodynamics; Isomorphism and polymorphism; Isotope geochemistry.

**BOOKS SUGGESTED:**

1. Hoefs, J., 1980. Stable Isotope Geochemistry. Springer-Verlag.
2. Klein, C. and Hurlbut, C.S., 1993. Manual of Mineralogy. John Wiley and Sons, New York.
3. Krauskopf, K.B., 1967. Introduction to Geochemistry. McGraw Hill.
4. Mason, B. and Moore, C.B., 1991. Introduction to Geochemistry. Wiley Eastern.
5. Rollinson, H.R., 1993. Using geochemical data: Evaluation, Presentation, and Interpretat

## THIRD YEAR

### SKILL ENHANCEMENT COMPULSORY COURSE PHOTO GEOLOGY AND REMOTE SENSING

Name of the Course	Geology- SECC 2: Photo Geology and Remote Sensing
Credits	Theory-04
Theory	30 Lectures
Code	GEOL-301 TH
Yearly based Examination	50 marks (3 Hrs)
CCA/ Skill Exam/ Project file/dissertation	50 marks

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance. Midterm Exam=**15 marks**, Class test/seminar/assignments/quiz =**10 marks**, Attendance=**05 marks**; a)  $\geq 75\%$  to **80%** : **3 marks** b)  $\geq 80\%$  to **90%**= **4 marks** c)  $\geq 90\%$  and above = **5 Mark**

#### Instructions for Paper Setters and Candidates:

- The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), Section B (Unit I and II), Section C (Unit III and IV), Section D (Unit V and VI) and Section E (Unit VII and VIII). Examiner will set nine questions in all, question number 1 (One) will be compulsory and comprise one question each from all the Units. Each question from section B, C, D and E will carry 10 marks. Question Number 1 (Section-A), will consist of ten sub-questions each of 1 mark of various types such as: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.*
- The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and ten sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

### Photo Geology and Remote Sensing (GEOL 301TH)

**Unit-I:** Elementary idea about Photo geology: electro-magnetic spectrum, types & geometry of aerial photographs; factors affecting aerial photography.

**Unit-II:** Fundamentals of remote sensing; remote sensing systems; remote sensing sensors; signatures of rocks, minerals and soils. Application of remote sensing in geosciences and geomorphological studies.

**Unit-III:** Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification.

**Unit-IV:** Introduction to Geographic Information System (GIS); components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing.

**Books Recommended:**

1. Bhatta, B., 2008. Remote Sensing and GIS. Oxford, New Delhi.
2. Gupta, R.P., 1990. Remote Sensing Geology. Springer Verlag.
3. Lilleasand, T.M. and Kiffer, R.W., 1987. Remote Sensing and Image Interpretation. John Wiley.
4. Pandey, S.N., 1987. Principles and Application of Photogeology. Wiley Eastern, New Delhi.
5. Sabbins, F.F., 1985. Remote Sensing – Principles and Applications. Freeman.
6. Siegal, B.S. and Gillespie, A.R., 1980. Remote Sensing in Geology. John Wiley.
7. Rampal K.K. 1999. Hand book of aerial photography and interpretation. Concept publication.

## APPLIED AND ECONOMIC GEOLOGY

Name of the Course	Geology-DSE 1: Applied and Economic Geology
Credits	Theory-04
Theory	60 Lectures
Code	GEOL-302 TH
Yearly based Examination	50 marks (3 Hrs)
Continuous Comprehensive Assessment (CCA)	30 marks

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance. Midterm Exam=**15 marks**, Class test/seminar/assignments/quiz =**10 marks**, Attendance=**05 marks**; a) **>=75% to 80% : 3 marks** b) **>= 80% to 90%= 4 marks** c) **>= 90% and above = 5 Mark**

### Instructions for Paper Setters and Candidates:

1. The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), Section B (Unit I and II), Section C (Unit III and IV), Section D (Unit V and VI) and Section E (Unit VII and VIII). Examiner will set nine questions in all, question number 1 (One) will be compulsory and comprise one question each from all the Units. Each question from section B, C, D and E will carry 10 marks. Question Number 1 (Section-A), will consist of ten sub-questions each of 1 mark of various types such as: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and ten sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.

### Applied and Economic Geology (GEOL302TH)

**Unit I:** Elements of magnetic, electromagnetic, radiometric and seismic methods of mineral exploration; Principal methods of geological prospecting.

**Unit II:** Introduction of mining methods; -Open cast and underground mining.

**Unit III:** Remote sensing techniques and other visual imageries. Basic idea about remote sensing, satellite imageries, spectral bands. Brief idea about the application of remote sensing in ground water exploration and glaciology.

**Unit IV:** Engineering properties of rocks and other structural materials; Geological considerations relating to the design of Dams, Tunnels, Bridges, canals and Highways.

**UNIT V:** Economic Geology its definition, scope and terminology; Syngenetic - Epigenetic minerals deposits; Classification of mineral deposits

**Unit VI:** Fundamentals of Ore genesis; Control of ore mineralization; Magmatic and hydrothermal processes

**Unit VII:** Oxidation and Supergene enrichment; Mechanical and residual concentration.

**Unit VIII:** Physical properties, chemical composition, mode of occurrence, Geographical and Geological distribution and use of the following Ore deposits of India.

- Iron, Manganese and Copper.
- Lead, Zinc and Aluminum.
- Mica
- Magnesite
- Gypsum

### **PRACTICAL (GEOL 302 PR)**

<b>Name of the Course</b>	<b>Geology –DSC 1 LAB: Applied and economic Geology</b>
Credits	<b>02</b>
Code	GEOL-302 (PR)
Yearly based Examination	<b>20 marks (3 Hrs)</b>
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 10, Viva Voce = 5 Marks and Practical Record Book = 5 Marks	

#### **Applied Geology:**

Familiarization about instruments used in Geological prospecting; Study of models related to open-cast and underground mining; Megascopic study of rocks used for construction purposes; Interpretation of satellite imageries for lithology, soil, surface water and Glaciers; Geological field study of an area undergoing opencast/ underground mining.

#### **Economic Geology:**

Megascopic study of physical chemical properties and identification of following ore minerals:-

- Iron: Magnetic, Hematite, Pyrite, Ilmenite.
- Manganese: Pyrolucite, Psilomaline, Rhodonite, Rhodocrosite.
- Copper: Cuperite, Chalcopyrite, Chalcocite, Malachite.
- Lead Zinc and Tin: Zincite, Spharlrute, Cassitirite, Galena, Cerussite
- Aluminium:Crundum, Bauxite, Spinel.

#### **BOOKS SUGGESTED:**

1. Course in mining geology by R.M, P Arogayaswami.
2. Elements of Mining technology by G.d Deshmukh .
3. Geology of engineers by Prabin Singh.
4. Handbook of Prospecting by R.M Perarl .
5. Remote Sensing Techniques by George Joseph.
6. Applied Geology by Nealson and Nealson
7. Economic Mineral Deposits by A.M Batman.

8. Principles of Economic Geology by Emmons.
9. Mineral deposits by W. Lindgren.
10. Economic minerals of India by P.C Pandey.
11. Ore Deposits by C.S Park and Mac Diarmid.

## ENVIRONMENTAL GEOLOGY AND GEOHYDROLOGY

Name of the Course	Geology-DSE 1: Environmental geology and Geohydrology
Credits	Theory-04
Theory	60 Lectures
Code	GEOL-303 TH
Yearly based Examination	50 marks (3 Hrs)
Continuous Comprehensive Assessment (CCA)	30 marks

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance. Midterm Exam=**15 marks**, Class test/seminar/assignments/quiz =**10 marks**, Attendance=**05 marks**; a)  $\geq 75\%$  to **80%** : **3 marks** b)  $\geq 80\%$  to **90%**= **4 marks** c)  $\geq 90\%$  and above = **5 Mark**

### Instructions for Paper Setters and Candidates:

1. The question paper will consist of five sections: Section A (compulsory, covering syllabus from all the units), Section B (Unit I and II), Section C (Unit III and IV), Section D (Unit V and VI) and Section E (Unit VII and VIII). Examiner will set nine questions in all, question number 1 (One) will be compulsory and comprise one question each from all the Units. Each question from section B, C, D and E will carry 10 marks. Question Number 1 (Section-A), will consist of ten sub-questions each of 1 mark of various types such as: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each sections B, C, D and E and ten sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.

## Environmental Geology and Geohydrology (GEOL 303TH)

**Unit I:** Fundamental principles of environmental geology, its definition and scope.

- Geologic hazards,
- Landslides, its causes and remedial measures, prevention and identification

**Unit II:** Earthquakes hazard, its causes and remedies.

- Predications of Earthquakes.
- Construction in earthquakes prone area.
- Volcanic hazards, its causes and remedies.

**Unit III:** Atmosphere, its pollution, causes and remedies.

Deforestation and causes and effects

Basic idea about global warming and its future projections

**Unit IV:** Water pollution, pollutants and remedies. Elementary idea of water quality and destructive effects of water pollution. Waste disposal and its management.

**Unit V: Hydrological Cycles- Distribution of water on earth crust**

- Types of Ground Water, meteoric water, juvenile and magmatic waters. Characters of Zones of aeration, saturation and Water table

**Unit VI: classification of aquifer**

- Unconfined, confined, leaky and bounded aquifers.
- Runoff, Rainfall, evaporation and Transpiration.
- Hydro geological properties of rock and soil, permeability and porosity their relations to ground water motions. Its determination in lab and field.
- Transmissivity, storativity specific yield, specific retention and diffusivity

**Unit VII: Surface investigations:**

- Geophysical exploration, electric resistivity, seismic, gravity and magnetic methods
- Sub-surface investigations of ground water: electrical, traditional and allied logging methods, test drilling
- Fluctuations of water level and its causes
- Quality of ground water – chemical analysis

**Unit VIII: Principles governing ground water movement**

- Darcy law, its application range, validity, Reynold's number and its application
- Well hydraulics and water wells, methods of constructing shallow and deep wells.
- Various recharging methods with Indian examples.
- Spring wells, origins, classification, distribution and important hot water springs in India.

**PRACTICAL (GEOL 303 PR)**

<b>Name of the Course</b>	<b>Geology –DSC 2 LAB: Environmental geology and Geohydrology</b>
Credits	<b>02</b>
Code	GEOL-303 (PR)
Yearly based Examination	<b>20 marks (3 Hrs)</b>
<b>Distribution of Marks: Identification/Maps/ Problem/ Field work = 10, Viva Voce = 5 Marks and Practical Record Book = 5 Marks</b>	

**Environmental Geology:**

Identification and classification of Landslides

Generation of seismic maps and Iso-seismal maps and their interpretation.

Generation of land degradation maps with special emphasis on hilly terrain using satellite imageries.

Measurement of Water pollution levels using water quality kit.

Field study of Geo- environmentally sensitive zone.

**Geohydrology:**

Well logs, water quality analysis, study of Bore hole drilling in field

**BOOKS SUGGESTED:**

1. Environmental geology by K.S Valdiya.
2. Geology and Environment by Coats.
3. Understanding The Earth by Gunter Gass .
4. Environmental geology by Flawn.
5. Geology in Environmental Planning by Howarde and Remson
6. Hydrogeology by Davis and Wiest.
7. Applied Hydrogeology by C.W Felter.
8. Ground Water Hydrogeology by D.K Todd.
9. Ground Water by N.M Raghunath.
10. Ground Water Survey and investigation by Gautam Mahajan