

H.P. University  
Structure and Syllabus

Of  
**Geology**

for  
B.Sc. Undergraduate Programme  
Based on:

U.G.C. Choice Based Credit  
System (CBCS)  
Model Curriculum



**(Effective from Academic Session July, 2016)**

## GENERAL INSTRUCTIONS/ GUIDELINES FOR EXECUTION OF CURRICULUM

I. The B.Sc. Geology will be of three years duration semester-based Choice Based Credit System [CBCS] course.

II. There will be broadly three types of courses for B.Sc. Geology degree program.

1. The Core Courses (14 courses for B.Sc. Geology; and 4 discipline specific papers) will be of 6- credits each including 2 credits assigned to the practical component. Thus a candidate will have to pass 14 courses for earning  $14 \times 6 = 84$  credits during six semesters. Each of the 6-credits courses will carry 100 marks. These 100 marks will be split into marks assigned for Theory [TH]: 40 marks; Practical [P]: 30 marks and Internal Assessment [IA]: 30. The Internal Assessment [30 marks] will include one Multi Choice Questions (MCQ)-based examination of 25 marks each [25 or 50 questions of 1.0 or 0.5 mark each as the case may be]; and Classroom Attendance Incentive marks (5 marks). The Lab-based practical will be of 2-hours [One credit]. A total of  $14 \times 6 = 84$  credits could be accumulated under these courses during the B.Sc. Geology degree program.

2. The Elective Courses will be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/ subject/ domain or nurtures the candidate's proficiency / skill. The Elective Courses will include;

Discipline Specific Elective [DSE] Courses: A total of 4 courses offered under the main discipline/ subject of study is referred to as Discipline Specific Elective. These courses are discipline related and/ or interdisciplinary in nature. A total of  $4 \times 6 = 24$  credits could be accumulated under DSE courses during the B.Sc. Geology degree program.

Generic Elective [GE] Courses: A total of 4 courses of 6-credits each including 2 credits assigned for the practical component of each of these courses i.e. one

course per 1st to 4th semester will be studied by the candidates. An elective course chosen from an unrelated discipline/ subject, with an intention to seek exposure beyond discipline(s) of choice is called Generic Elective Course. The purpose of this category of papers is to offer the students the option to explore disciplines of interest beyond the choices they make in Core and Discipline Specific Elective papers. Further, a course offered in a discipline/ subject may be treated as an elective by other discipline/ subject and vice versa and such electives may also be referred to as Generic Elective Course. A total of  $4 \times 6 = 24$  credits could be accumulated under GE courses during the Geology degree program.

3. Ability Enhancement Compulsory Courses [AECC]: Ability Enhancement Courses are of two types; Ability Enhancement Compulsory Courses [AECC] and Skill Enhancement Courses [SEC]. A total of  $4 \times 4 = 16$  credits could be accumulated under these courses during the B.Sc. Geology degree program i.e.  $4 \times 2 = 8$  credits for AECC, and  $4 \times 2 = 8$  credits for SEC courses.

The AECC courses are the mandatory courses based upon the content that leads to knowledge enhancement; i. Environment Science and ii. English/ Hindi/ MIL Communication. All these are mandatory courses for obtaining a B.Sc. degree in the concerned subject. These courses are mandatory for all disciplines. SEC courses are value-based and/ or skill-based and are aimed at providing hands-on-training, competencies, skills etc. A minimum of two such courses for obtaining an B.Sc. degree are selected amongst the courses designed to provide value-based and/ or skillbased knowledge and may contain both theory and lab/ hands-on training. The main purpose of these courses is to provide students life-skills in hands-on mode so as to increase their employability.

III. Practical [P] component has been included in every core and discipline/ generic specific elective paper. The list of practical's to be conducted by the candidates has been provided alongside each of such courses. The marks (30 marks) for the practical examination will be split as follows;

Practical write up & performance: 20

Practical record/ notebook: 5 marks

Viva voce: 5 marks

IV. Classroom Attendance Incentive: Those candidates who have greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to per cent attendance) will be awarded CCA marks as follows:

75% but < 80% 1 marks

80% but <85% 2 marks

85 but <90% 3 marks

90% but < 95% 4 marks

95% TO 100% 5 marks

V. The admission to B.Sc. Geology programme of Himachal Pradesh University will be as per guidelines of Himachal Pradesh University, Shimla from time to time.

i. The candidate should have passed 10+2 (class XII) Examination or its equivalent from a recognized Board/University with any of the three subjects out of Physics, Chemistry and Biology or any other science subjects with 50% or equivalent grade (for SC/ST candidates marks of eligibility will be 45% or equivalent grade). ii. In case of candidates who are studying in University/ Board/ College/ Schools in any of the foreign countries the eligibility/ Qualifying marks will be the same as recognized/equivalent to 10+2 by the University or the association of the Indian University with 50% marks of equivalent grade (for SC/ST candidates, eligibility will be 45% marks or equivalent grade). iii. The candidate who has appeared in

the qualifying examination but whose result has so far not been declared can also apply but his/her eligibility for the entrance test will be purely provisional subject to the condition that he/she has to produced a passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling. iv. The candidate shall not be more than 22 years of age as on 01st July of the year of admission. Date of birth as recorded in the Secondary Education Board/ University Certificate Only will be considered as authentic.

### **Details of Courses for B.Sc. Undergraduate Program**

<b>Course</b>	<b>*Credits</b>	
	Theory+ Practical	Theory+Tutorials
<b>I. Core Course</b>	12X4= 48	12X5=60
<b>(12 Papers)</b>		
04 Courses from each of the		
03 disciplines of choice		
<b>Core Course Practical / Tutorial*</b>	12X2=24	12X1=12
<b>(12 Practical/ Tutorials*)</b>		
04 Courses from each of the		
03 Disciplines of choice		
<b>II. Elective Course</b>	6x4=24	6X5=30
<b>(6 Papers)</b>		
Two papers from each discipline of choice		
including paper of interdisciplinary nature.		
<b>Elective Course Practical / Tutorials*</b>	6 X 2=12	6X1=6
<b>(6 Practical / Tutorials*)</b>		
Two Papers from each discipline of choice		

including paper of interdisciplinary nature

**Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester**

**III. Ability Enhancement Courses**

**1. Ability Enhancement Compulsory** **2 X 4=8** **2X4=8**

**(2 Papers of 4 credits each)**

**Environmental Science**

**English/MIL Communication**

**2. Skill Enhancement Course** **4 X 4=16** **4 X 4=16**

**(Skill Based)**

**(4 Papers of 4 credits each)**

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**Total credit= 132**

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**Total credit= 132**

**Proposed scheme for choice based credit system in B. Sc. with  
Geology**

Semister	<b>Discipline Specific CORE COURSE/s DSC (12) *Credits</b>	<b>Ability Enhancement Compulsory Course/s AECC (2) *Credits</b>	<b>Skill Enhancement Compulsory Course/s SEC (4) *Credits</b>	<b>Discipline Specific Elective DSE (6) *Credits</b>
I	<b>DSC-1 Geology Physical and Structural Geology GEOL 101 (TH) 04* GEOL 101 (PR) 02* DSC-2 Paper -1 (TH+PR) 04+02* DSC-3 Paper-</b>	<b>AECC-1 English/Hindi/MIL/ Environmental Sciences 04*</b>		

	<b>1(TH+PR) 04+02*</b>			
II	DSC-2 Geology Crystallography and Mineralogy GEOL 201 (TH) 04* GEOL 201 (PR) 02* <b>DSC-2 Paper - 2(TH+PR) 04+02*</b> <b>DSC-3 Paper- 2(TH+PR) 04+02*</b>	<b>AECC-2 English/Hindi/MIL/ Environmental Sciences 04*</b>		
III	DSC-3 Geology Petrology GEOL 301(TH) 04* GEOL 301(PR) 02* <b>DSC-2 Paper- 3(TH+PR) 04+02*</b> <b>DSC-3 Paper- 3(TH+PR) 04+02*</b>		SEC-1 Geology Geomorphology and Geotectonics GEOL 302 (TH) 04*	
IV	DSC-4 Geology Stratigraphy and Palaeontology GEOL 401 (TH) 04* GEOL 401 (PR) 02* <b>DSC-2 Paper- 4(TH+PR) 04+02*</b>  <b>DSC-3 Paper-4 (TH+PR) 04+02*</b>		SEC-2 Geology Environmental Geology GEOL 402 (TH) 04*	
V			SEC-3 Geology Geochemistry GEOL 501 (TH) 04*	DSE -1 Geology Economic Geology and Hydrology GEOL 502 (TH) 04* GEOL 502 (PR) 02* <b>DSE-2 Paper- 1(TH+PR) 04+02*</b> <b>DSE-3 Paper- 1(TH+PR) 04+02*</b>

VI			SEC -4 Geology Photo Geology and Remote Sensing GEOL 601 (TH) 04*	DSE -2 Geology Elements of Applied Geology GEOL 602 (TH) 04* GEOL 602 (PR) 02* <b>DSE-2 Paper- 2(TH+PR) 04+02*</b> <b>DSE-3 Paper- 2(TH+PR) 04+02*</b>

Total Credits= 132

## Discipline Specific Core Course

### Semester –I

### Physical and Structural Geology

Name of the Course	<b>Geology-DSC 1: Physical and Structural Geology (Credits: Theory-04) Theory: 60 Lectures</b>
Code	GEOL-101 TH
Semester Term End Examination	<b>50 marks (3 Hrs)</b>
Continuous Comprehensive Assessment	<b>20 marks</b>



**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance.  
 Midterm Exam=**10 marks**, Class test/seminar/assignments/quiz =**05 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 selecting one questions each from 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 marks of types: 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 seven sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

## Physical and Structural Geology (Theory) (4 Credits)

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 and erosion: factors, types and their effects;

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: 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-VI: Elementary idea of types of deformation; Folds: nomenclature and types of folds;

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

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

### Books Recommended:

1. Arthur Holmes, 1992. Principles of Physical Geology. Chapman and Hall, London.
2. K. Siddharatha, 2014. The Earth's Dynamic Surface. Kosalaya Publications Pvt Ltd.

3. Spencer, E.V., 1962. Basic concepts of Physical Geology. Oxford & IBH.
4. Mahapatra, G.B., 1994. A text book of geology. CBS Publishers.
5. A.K. Datta, 1996. Introduction to Physical Geology. Kalyani Publishers.
6. Billings, M.P., 1972. Structural Geology. Prentice Hall.
7. Hills, E.S., 1963. Elements of Structural Geology. Farrod and Sons, London.
8. Mahapatra, G.B., 1994. A text book of geology. CBS Publishers
9. Singh, R. P., 1995. Structural Geology, A Practical Approach. Ganga Kaveri Publ., Varanasi.
10. N.W.Gokhale., 1994. Manual of Geological Maps. CBS Publishers

## Physical and Structural Geology- Lab.

Name of the Course	Geology -DSC 1 LAB: Physical and Structural Geology (Credits: -02)
Code	GEOL-101 (PR)
Semester Term End Examination	30 marks (3 Hrs)
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 20 Viva Voce = <b>5 Marks</b> , Practical Record Book= <b>5 Marks</b>	

### Practicals (02 Credits)

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

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.

### Semester –II

## Crystallography and Mineralogy

Name of the Course	<b>Geology-DSC 2: Crystallography and Mineralogy (Credits: Theory-04) Theory: 60 Lectures</b>

Code	GEOL-201 TH
Semester Term End Examination	<b>50 marks (3 Hrs)</b>
Continuous Comprehensive Assessment (CCA)	<b>20 marks</b>

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance.  
Midterm Exam=**10 marks**, Class test/seminar/assignments/quiz =**05 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 selecting one questions each from 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 marks of types: 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 seven sub-questions from section A.(Compulsory question number 1). The duration of the examination will be 3 hours.*

## Crystallography and Mineralogy (04 credits)

Unit-I: Crystals and their characters.

Unit-II: Crystal form, face, edge, solid angle; Interfacial angle and their measurements; Crystallographic axes and angles.

Unit-III: Crystal parameters, Weiss and Miller system of notations;

Unit-IV: Symmetry elements and description of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems.

Unit-V: Introduction to Mineralogy, Definition and characters of mineral;

Unit-VI: Common physical properties of minerals; Chemical composition and diagnostic physical properties of minerals such as: Quartz, Orthoclase, Microcline, Hypersthene, Hornblende, Garnet, Muscovite, Biotite, Chlorite, Olivine, Gypsum, Tourmaline, Kyanite, Beryl, Realgar, Calcite.

Unit-VII: Polarizing microscope, its parts and functioning; Ordinary and polarized lights; Common optical properties observed under ordinary, polarized lights and crossed nicols.

**Unit-VIII:** Optical properties of some common rock forming minerals (Quartz, Orthoclase, Microcline, Olivine, Augite, Hornblende, Muscovite, Biotite, Garnet, Calcite)

Books Recommended:

1. Dana, E.S. and Ford, W.E., 2002. A textbook of Mineralogy (Reprints).
2. Flint, Y., 1975. Essential of crystallography, Mir Publishers.
3. Phillips, F.C., 1963. An introduction to crystallography. Wiley, New York.

4. Berry, L.G., Mason, B. and Dietrich, R.V., 1982. Mineralogy. CBS Publ.
5. Nesse, D.W., 1986. Optical Mineralogy. McGraw Hill.
6. Read, H.H., 1968. Rutley's Element of Mineralogy (Rev. Ed.). Thomas Murby and Co.
7. Berry and Mason, 1961. Mineralogy. W.H. Freeman & Co.
8. Kerr, B.F., 1995. Optical Mineralogy 5th Ed. Mc Graw Hill, New York.

## Crystallography and Mineralogy- Lab.

Name of the Course	Geology –DSC- 2 LAB: Crystallography and Mineralogy (Credits: -02)
Code	GEOL-201 (PR)
Semester Term End Examination	30 marks (3 Hrs)
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 20 Viva Voce = <b>5 Marks</b> , Practical Record Book= <b>5 Marks</b>	

- Crystallography:

Study of symmetry elements of normal class of Isometric, Tetragonal, Hexagonal, Trigonal, Orthorhombic, Monoclinic and Triclinic systems.

- 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.

### Semester –III

## Petrology

Name of the Course	<b>Geology-DSC 3: Petrology (Credits: Theory-04) Theory: 60 Lectures</b>
Code	GEOL-301 TH
Semester Term End Examination	<b>50 marks (3 Hrs)</b>
Continuous Comprehensive Assessment (CCA)	<b>20 marks</b>

**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance.  
Midterm Exam=**10 marks**, Class test/seminar/assignments/quiz =**05 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 selecting one questions each from Unit. 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 marks of types: 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 seven sub-questions from section A.(Compulsory question number 1). The duration of the examination will be 3 hours.*

## Petrology (04 Credits)

### 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.

### Books Recommended:

1. Turner, F.J. & Verhoogen, J., 1960, Igneous & Metamorphic petrology. McGraw Hill Co.
2. Bose, M.K., 1997. Igneous petrology. World press
3. Tyrell, G. W., 1989. Principles of Petrology. Methuren and Co (Students ed.).

4. Ehlers, WG, and Blatt, H., 1987. Petrology, Igneous, Sedimentary and Metamorphic rocks, CBS Publishers
5. Moorhouse, WW., 1969. The study of rocks in thin sections. Harper and sons.
6. Friedman & Sanders, 1978. Principles of Sedimentology. John Wiley and sons.
7. Pettijohn, F.J., 1975. Sedimentary rocks, Harper & Bros. 3rd Ed.
8. Prasad, C., 1980. A text book of sedimentology.
9. Sengupta. S., 1997. Introduction to sedimentology. Oxford-IBH.
10. Turner, F.J., 1980. Metamorphic petrology. McGraw Hill.
11. Mason, R., 1978. Petrology of Metamorphic Rocks. CBS Publ.
12. Winkler, H.G.C., 1967. Petrogenesis of Metamorphic Rocks. Narosa Publ.

## **Petrology - Lab.**

Name of the Course	Geology –DSC- 3 LAB: Petrology (Credits: -02)
Code	GEOL-301 (PR)
Semester Term End Examination	30 marks (3 Hrs)
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 20 Viva Voce = <b>5 Marks</b> , Practical Record Book= <b>5 Marks</b>	

## Practicals (02 Credits)

- 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.

## Semester –IV

## **Stratigraphy and Palaeontology**

Name of the Course	<b>Geology-DSC 4: Stratigraphy and Palaeontology (Credits: Theory-04) Theory: 60 Lectures</b>
Code	GEOL-401 TH
Semester Term End Examination	<b>50 marks (3 Hrs)</b>

Continuous Comprehensive Assessment (CCA)	<b>20 marks</b>
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**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance.  
 Midterm Exam=**10 marks**, Class test/seminar/assignments/quiz =**05 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 selecting one questions each from 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 marks of types: 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 seven sub-questions from section A.(Compulsory question number 1). The duration of the examination will be 3 hours.*

**Straigraphy and Palaeontology (04 Credits)**

Unit I: Definition, Principle of stratigraphy; Geological Time Scale and stratigraphic classification and correlation; Physiographic division of India.

Unit II: Study of following Precambrian succession: Dharwar, Cuddapha and Vindhyan Supergroups; Brief idea of Palaeozoic succession of northwestern Himalaya; Triassic of Spiti; Jurassic of Kutch; Cretaceous of Tiruchirapalli;

Unit III: Study type localities of Gondwana and Deccan Trap.

Unit IV: Palaeogene-Neogene sequences of northwest Himalaya .

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

Unit VI: Morphology and geological distribution of gstopods, pelecypods, cephalopods.

Unit VII: Morphology and geological distribution of trilobite and brachiopods.

Unit VIII: Evolutionary history of horse and man; Morphology, distribution and significance of Gondwana flora.

**Books Recommended:**

1. Wadia, D., 1973. Geology of India. Mc Graw Hill Book co.
2. Krishnan, M.S., 1982. Geology of India and Burma, 6th Edition. CBS Publ.
3. Ravindra Kumar, 1985. Fundamentals of Historical Geology & Stratigraphy of India. Wiley Eastern.

4. Shrock, R.R. & Twenhoffel, W.H., 1952. Principles of Invertebrate Paleontology. CBS Publ.
5. Swinerton, HH., 1961. Outlines of Paleontology. Edward Arnold Publishers
6. Jain, P.C. & Anantharaman, M.S., 1983. Paleontology: Evolution & Animal Distribution. Vishal Publ.
7. Lehmann, U., 1983. Fossil Invertebrate. Cambridge Univ. Press.
8. Rastogi, 1988. Organic evolution. Kedrnath and Ramnath Publ.

## Stratigraphy and Palaeontology - Lab.

Name of the Course	Geology –DSC- 4 LAB: Stratigraphy and Palaeontology (Credits: -02)
Code	GEOL-401 (PR)
Semester Term End Examination	30 marks (3 Hrs)
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 20 Viva Voce = <b>5 Marks</b> , Practical Record Book= <b>5 Marks</b>	

### Practicals (02 Credits)

- I. Morphological characters, systematic position and age of fossil genera pertaining to brachiopods, pelecypods, cephalopods, trilobite and gastropods.
- II. Preparation of lithostratigraphic maps of India showing distribution of important geological formations.

## Discipline Specific Elective

### Semester –V

Name of the Course	<b>Geology-DSE 1: Economic Geology and Hydrology. Credits: Theory-04 Theory: 60 Lectures</b>
Code	GEOL-502 TH
Semester Term End Examination	<b>50 marks (3 Hrs)</b>
Continuous Comprehensive Assessment (CCA)	<b>20 marks</b>



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**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance.  
Midterm Exam=**10 marks**, Class test/seminar/assignments/quiz =**05 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 selecting one questions each from Unit. 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 marks of types: 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 seven sub-questions from section A.(Compulsory question number 1). The duration of the examination will be 3 hours.*

Economic Geology and Hydrology (04 Credits)

Unit-I: Concept of ore and ore deposits, ore minerals and gangue minerals; Tenor of ores; Metallic and non-metallic ore minerals; Strategic, Critical and essential minerals.

Unit-II: Processes of formation of ore deposits; Magmatic, contact metasomatic, hydrothermal and placer.

Unit-III: Study of important metallic (Cu, Pb, Zn Mn, Fe, Au, Al) and non-metallic (industrial) minerals (gypsum, limestone, magnesite, mica).

Unit-IV: Distribution of coal and petroleum in India;

Unit-V: Definition of hydrogeology, Hydrological cycle and artificial recharge.

Unit-VI:Hydrological parameters - Precipitation, evaporation, transpiration and infiltration.

Unit-VII: Origin of groundwater; Vertical distribution of groundwater; Types of aquifers; Water bearing properties of rocks - Porosity and Permeability; specific yield, specific retention.

Unit-VIII: Surface and subsurface geophysical and geological methods of ground water exploration; Groundwater provinces of India.

**Books Recommended:**

1. Brown, C. and Dey, A.K.1955. Indian Mineral Wealth. Oxford Univ.
2. Gokhale, K.V.G.K. and Rao, T.C., 1983. Ore Deposits of India. East West Press Pvt. Ltd.
3. Jense, M.L. and Bateman A.M., 1981. Economic Mineral Deposits. John Wiley and Sons.
4. Krishnaswamy, S., 1979. India's Minerals Resources. Oxford and IBH Publ.
5. Deb, S., 1980. Industrial minerals and Rocks of India. Allied Publishers Pvt. Ltd.

6. Umeshwar Prasad, 2003. Economic Geology. CBS Publishers and distributors.
7. Sharma, N.L. and Ram, K.V.S., 1972. Introduction to India's Economic Minerals, Dhanbad.
8. Karanth, K. R., 1989. Hydrogeology. Tata McGraw Hill Publ.
9. Raghunath, H. M., 1990. Groundwater. Wiley Eastern Ltd.
10. Subramaniam, V., 2000. Water-Kingston Publ. London.

## Economic Geology and Hydrology - Lab.

Name of the Course	Geology –DSE- 1 LAB: Economic Geology and Hydrology (Credits: -02)
Code	GEOL-502 (PR)
Semester Term End Examination	30 marks (3 Hrs)
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 20 Viva Voce = <b>5 Marks</b> , Practical Record Book= <b>5 Marks</b>	

### Practicals (02 Credits)

Economic Geology: Study of ore and economic minerals in hand specimen; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.

Hydrology: Study of hydro-geological models, Estimation of porosity and permeability from the given data; Preparation and interpretation of Hydrological and water table maps.

### Semester –VI

### **Discipline Specific Elective**

Name of the Course	<b>Geology-DSE 2: Elements of Applied Geology (Credits: Theory-04) Theory: 60 Lectures</b>
Code	GEOL-602 TH
Semester Term End Examination	<b>50 marks (3 Hrs)</b>
Continuous Comprehensive Assessment (CCA)	<b>20 marks</b>

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**CCA:** Based on midterm exam, class test/seminar/assignments/quiz and attendance.  
Midterm Exam=**10 marks**, Class test/seminar/assignments/quiz =**05 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 selecting one question each from Unit. 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 types: 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 seven sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

Elements of Applied Geology (04 Credits)

Unit-I: Engineering properties of rocks and Soils.

Unit-II: Soil and Soil groups of India.

Unit-III: Dam, types and their geological and environmental considerations; Geological problem of reservoirs.

Unit-IV: Tunnels: geology, structure, seepage problem and role of water table;

Unit-V: Landslides: classification, causes and preventative measures.

Unit-VI: Mineral exploration: Elementary idea of geological and geophysical prospecting.

Unit-VII: Elementary idea of mining.

Unit-VIII: Environmental considerations for mining.

**Books Recommended:**

1. Valdiya, K.S., 1987. Environmental Geology – Indian Context. Tata McGraw Hill.
2. Rajendran S., 2007. Mineral Exploration : Recent Strategies.
3. Dobrin, M.B. & Savit, CH., 1988. Introduction to Geophysical Prospecting, McGraw-Hill.
4. Arogyaswamy, R.N.P., 1973. Courses in Mining Geology. Oxford and IBH Publ.
5. Parasins, D.S., 1997. Principles of applied geophysics. Chapman Hall.
6. Krynine D.P. and Judd W.R., 1957. Principles of Engineering Geology & Geotechnics. McGraw-Hill Book
7. Kesavulu, N.C., 2009. A text book of engineering geology. Macmillan P publishing India Ltd.
8. Crozier. M.J., 1989. Landslides: causes, consequences and environment. Academic Press.
9. Readman, J.H., 1979. Techniques in Mineral exploration. Applied Science Publishers.
- 10 Parbin Singh., 2008. Engineering and General Geology. S.K. Kataria and Sons.

## Elements of Applied Geology - Lab.

Name of the Course	Geology –DSE- 2 LAB: Elements of Applied Geology (Credits: -02)
Code	GEOL-602 (PR)
Semester Term End Examination	30 marks (3 Hrs)
<b>Distribution of Marks:</b> Identification/Maps/ Problem/ Field work = 20 Viva Voce = <b>5 Marks</b> , Practical Record Book= <b>5 Marks</b>	

### Practicals (02 Credits)

Surveying by Plane Table/Theodolite; Preparation of engineering geological maps; Engineering properties and identification of building stones. Identification of various models of landslide, tunnel and dam. Study of soil profiles.

## Skill Enhancement Courses

### Semester – III

#### Skill Enhancement Course

Name of the Course	<b>Geology-SEC 1 Geomorphology and Geotectonics (Credits: Theory-04) Theory: 30 Lectures</b>

Code	<b>GEOL-302 TH</b>
Semester Term End Examination	<b>50 marks (3 Hrs)</b>
CCA/ Skill Exam/ Project file/dissertation	<b>50 marks</b>

### **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 ), section C(Unit II),section D(Unit III) and section E(Unit VI). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and unit IV respectively. 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 marks of types: 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 seven sub-questions from section A. (Compulsory question number 1). The duration of the examination will be 3 hours.*

## Geomorphology and Geotectonics (4 Credits)

Unit-I: Basic principles of Geomorphology, geomorphological cycles, weathering and erosion; Geomorphic mapping- tools and techniques.

Unit-II: Epigene/exogenic processes: degradation and aggradation. Hypogene/endogenic processes; Diastrophism; Geological work of wind, glacier, river, underground water and ocean.

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

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

### **Books Recommended:**

1. Allen, P., 1997. Earth Surface Processes. Blackwell
2. Bloom, A.L., 1998. Geomorphology: A systematic Analysis of Late Cenozoic Landforms (3rd Edition). Pearson Education, Inc.
3. Keary, P. and Vine, F.J., 1997. Global Tectonics. Blackwell and crustal evolution. Butterworth-Heinemann.
4. Kale, V.S. and Gupta, A., 2001. Introduction to Geomorphology. Orient Longman Ltd.
5. Moores, E and Twiss. R.J., 1995. Tectonics. Freeman.

6. Patwardhan, A. M., 1999. The Dynamic Earth System. Prentice Hall.
7. Summerfield, M.A., 2000. Geomorphology and Global tectonic. Springer Verlag.
8. Valdia, K.S., 1988. Dynamic Himalaya. Universities Press, Hyderabad.
9. WD Thornbury, 2002. Principles of Geomorphology. CBS Publ. New Delhi.

## **Semester – IV**

### **Skill Enhancement Course**

<b>Name of the Course</b>	<b>Geology-SEC 2 Environmental Geology (Credits: Theory-04) Theory: 30 Lectures</b>
<b>Code</b>	<b>GEOL-402 TH</b>
<b>Semester Term End Examination</b>	<b>50 marks (3 Hrs)</b>
<b>CCA/ Skill Exam/ Project file/dissertation</b>	<b>50 marks</b>

#### **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 ), section C(Unit II),section D(Unit III) and section E(Unit VI). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and unit IV respectively. 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 marks of types: 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 seven sub-questions from section A.(Compulsory question number 1). The duration of the examination will be 3 hours.*

#### **Environmental Geology (4 Credits)**

Unit-I: Earth and its spheres: atmosphere, hydrosphere, lithosphere, biosphere and Man; Earth Material.

Unit-II: Energy budget: Solar radiation; Global environments: coastal, riverine, desertic, tropical, cold, polar; Concept of global warming and climate change.

Unit-III: Geological hazards: Earthquakes, volcanism, landslides, avalanches, floods, droughts; Hazard mitigation.

Unit IV: Resource Management: Energy resources (Conventional and non-conventional), watershed management, landuse planning, management of water resources.

## Books Recommended:

1. Verma, V.K., 1986. Geomorphology Earth surface processes and form. McGraw Hill.
2. Chorley, R. J., 1984. Geomorphology. Methuen.
3. Selby, M.J., 1996. Earths Changing Surface. Oxford University Press UK.
4. Thornbury W. D., 1997. Principles of Geomorphology Wiley Eastern Ltd., New Delhi.
5. Valdiya, K. S., 1987. Environmental Geology - Indian Context. Tata McGraw Hill New Delhi.
6. Keller, E. A., 2000. Environmental Geology. Shales E. Merril Publishing Co., Columbus, Ohio.
7. Montgomery, C., 1984. Environmental Geology. John Wiley and Sons, London.
8. Bird, Eric, 2000. Coastal Geomorphology: An Introduction. John Wiley & Sons, Ltd. Singapore.
9. Liu, B.C., 1981. Earthquake Risk and Damage, Westview.

## Semester – V

### Skill Enhancement Course

Name of the Course	<b>Geology-SEC 3 Geochemistry (Credits: Theory-04) Theory: 30 Lectures</b>
Code	<b>GEOL-502 TH</b>
Semester Term End Examination	<b>50 marks (3 Hrs)</b>
CCA/ Skill Exam/ Project file/dissertation	<b>50 marks</b>

### 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 ), section C(Unit II),section D(Unit III) and section E(Unit VI). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and unit IV respectively. 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 marks of types: 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 seven sub-questions from section A.(Compulsory question number 1). The duration of the examination will be 3 hours.*

## Geochemistry (4 Credits)

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 Recommended:

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

### Semester – VI

### **Skill Enhancement Course**

<b>Name of the Course</b>	<b>Geology-SEC 4 Photo Geology and Remote Sensing (Credits: Theory-04) Theory: 30 Lectures</b>
Code	<b>GEOL-602 TH</b>
Semester Term End Examination	<b>50 marks (3 Hrs)</b>
CCA/ Skill Exam/ Project file/dissertation	<b>50 marks</b>



**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), section C (Unit II), section D (Unit III) and section E (Unit VI). Examiner will set nine questions in all, question number 1 (One) will be compulsory and selecting two questions each from Units I, II, III and unit IV respectively. 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 types: Multiple Choice Questions (MCQ)/fill in the blanks and/or short answer type questions.

## Photo Geology and Remote Sensing (4 Credits)

Unit-I: Elementary idea about photogeology: 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 geoscience 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.